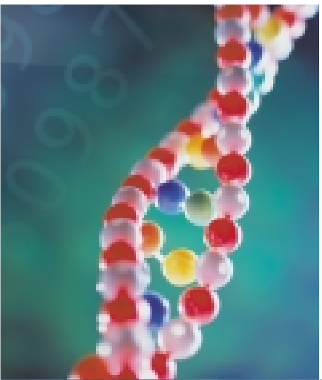
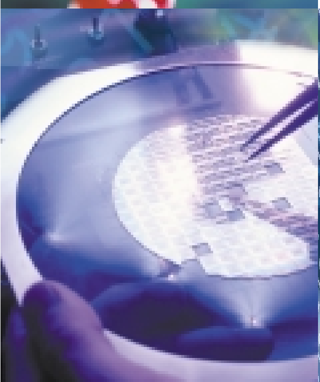
Bundesministerium
für Bildung
und Forschung

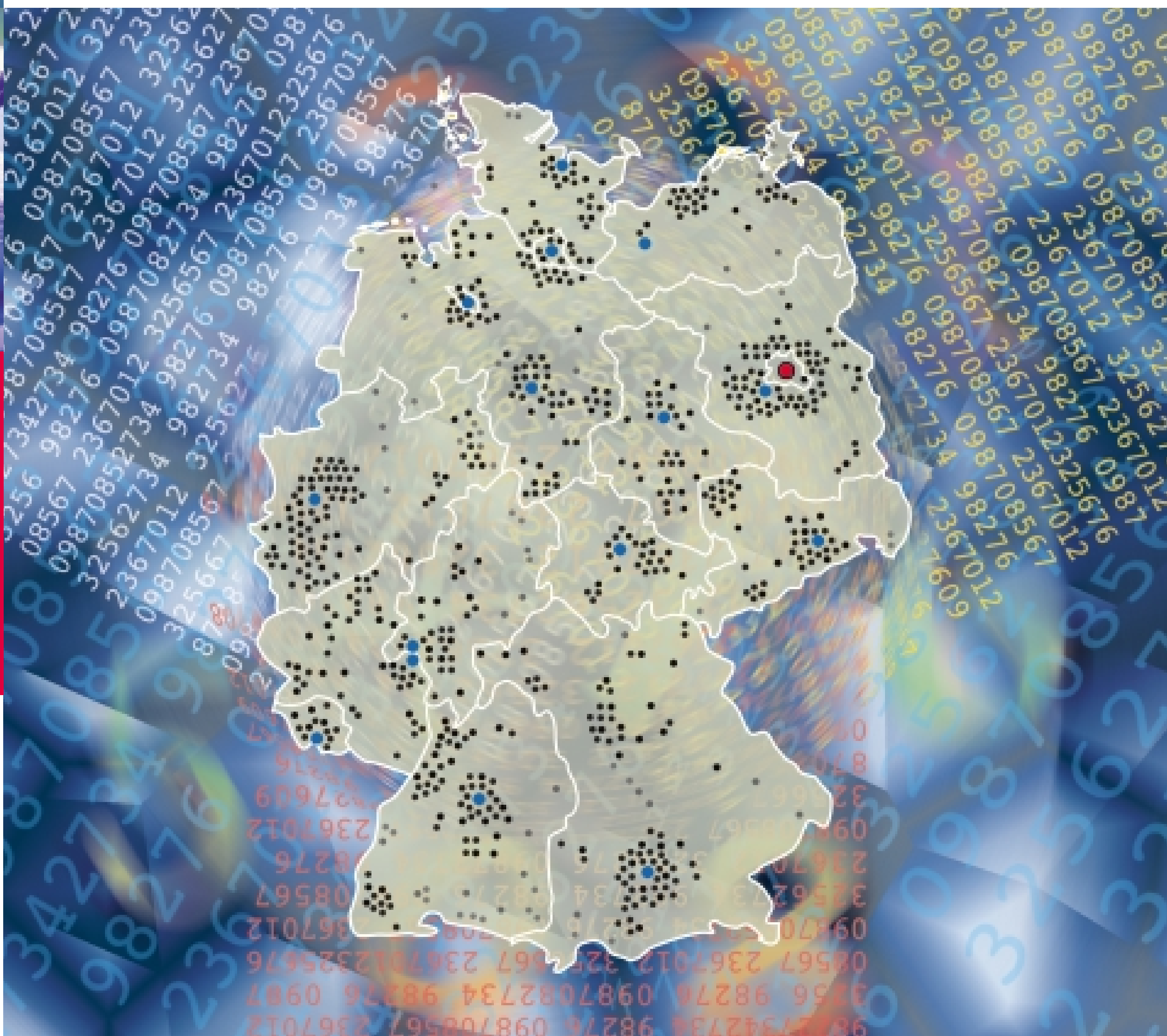
bmb+f

Report of the Federal Government on Research 2000





BMBF PUBLIK



BMBF PUBLIK

Published by
Bundesministerium
für Bildung und Forschung (BMBF)
Referat Öffentlichkeitsarbeit
53170 Bonn
E-Mail: information@bmbf.bund.de
Internet: http://www.bmbf.de

Orders
by mail to the publisher
or by calling
+49-1805-BMBF02 or +49-1805-262302
Fax +49-1805-BMBF03 or +49-1805-262303
E-mail: books@bmbf.bund.de
Internet: http://www.bmbf.de

Edited by
Ulrich Schöpke

Layout
BSMG Worldwide Deutschland, München

Content as of October 2000 (including editorial corrections of the Bundestag printed paper on which this publication is based)

Printed on recycled paper

This abridged version includes a CD-ROM with the following files:
– Full version of the Report of the Federal Government on Research 2000
– PowerPoint-File with the main topics of the Report of the Federal Government on Research 2000
– German Research Portal 2nd edition (beta-version)

Whenever the abridged version confers to parts, tables or charts of the full version the full version on the CD-ROM inside should be used.

Cover
The map of Germany on the front cover shows the regional distribution of all German research centres. The red and blue dots (*Länder* capitals) and the black dots mark locations with several research centres, while grey dots mark locations with one research centre each.

Photo credits
BSMG worldwide Deutschland, München (cover), PhotoDisc (p. 3)

Contents

Part III
Funding priorities of the Federal Government in research and technology

Part V
International co-operation in research and technology

Part VI
Funding organisations, research organisations and research institutions in Germany

Part VII
Statistics

Research for Shaping the Future

Doing research in future-oriented fields, developing the products of tomorrow, protecting humanity and the natural resources that humanity's survival depends on – these are the challenges – but also the opportunities – that research and development are confronted with. What we need in order to master these challenges and take advantage of the opportunities is state-of-the-art research policy – a policy that provides the setting for innovations and for the creation of new jobs, because only state-of-the-art research policy that promotes sustainable growth, accelerates structural change and places research at the service of humanity will pave the way for economic growth, societal development as well as cultural diversity. This is the objective that the new Federal Government is committed to.

In the 1990s, too little was invested in Germany's future. Structural reforms of the publicly funded research and development system were neglected. Long overdue reforms of the legal framework were either initiated too late or not at all. The natural interdependence between research and education was overlooked. What was neglected in particular was the need to promote and motivate junior scientists, not least by means of more equal opportunities and more attractive working conditions. The international competitiveness of German research was jeopardised; Germany is no longer part of the world's leading industrialised nations in terms of the share of GDP spent on research – a position which it used to take for granted in the 1970s and 1980s. The new German government has initiated the necessary steps and taken decisions to create better conditions for the necessary development of our country.

– We will substantially increase the budgetary appropriations earmarked for research grants in order to enable Germany to return to the international top league of countries in terms of research efforts.
– We will break up inflexible and inefficient structures and introduce more quality, competition and international benchmarks in science and research.

In the past 50 years, the German science system has gone through a dynamic development, bringing about considerable diversity; moreover, German unification has brought additional momentum to the development of the German science system. Like all industrialised nations, Germany is on its way towards becoming a knowledge society. Structural change leads to research-intensive industries, knowledge-intensive services and a dovetailing between services and products. For this reason, the Federal Government is focusing on strengthening education and research, **modernising the research landscape** and **making greater use of project funding**. There are increasingly close links between basic and applied research, and the lines between various fields of science and technology are becoming increasingly blurred. The **transfer of know-how** and **co-operation between research institutions and business enterprises** are becoming more and more important.

It is necessary to overcome the "reform jam" brought about by the previous government in the field of educational and research policies as well as in other policy fields in order to enable Germany to cope with the new societal challenges caused by **international competition**, as well. This will not be possible without a reform of the legal framework, including in particular the **reform of the law governing staff in the higher education sector**, which has already been initiated. Research will dry up without excellently trained **junior scientists**. A new important task of research policy will be **to inform** the public at an early point in time about new trends in research and development in order to ensure that there will be a broad-based dialogue about how to shape the future.

The change of course implemented by the current Federal Government has already produced the first results: there are unmistakable signs now of an awakening and a fresh impetus in research. There is growing emphasis on innovation efforts because the dynamic growth of increasingly global markets triggers more and more rapidly applicable innovations. The number of new business start-ups emanating from research institutions is growing more and more dynamically. The upward trend is beginning to stabilise. The **increase in spending on education and research**, the sense that a new era is about to dawn and the fresh impetus felt by all the parties concerned – these are the best conditions for getting back "on track". To this end, the Federal Government has defined the principles described below.

1. Guidelines for a new research policy – Research policy objectives

Germany's success in the future hinges on the innovative strength of the country's industry and scientific community. In order to master the globalisation process and the transition from the industrial society to the knowledge society, it will be necessary to improve both the conditions for education and research and the preconditions for dynamic market growth. Germany has a highly qualified workforce and an outstanding scientific and technological base for technologies of the 21st century. However, only the rapid application of the new technologies in the world markets will decide whether Germany will be able to keep pace with increasingly shorter innovation and product cycles.

The Federal Government looks at the innovation process as a whole. In areas in which Germany competes with the other technologically leading regions of the world, research and development findings obtained in Germany, as well as findings available worldwide, will have to be translated into new products, processes and services faster than in the past. More than anything else, this calls for the creation of internationally competitive conditions. With the tax reform that has just been adopted and that will be effective as of the year 2001, the Federal Government has also given a fresh impetus to the innovation dynamics of German industry because innovative companies will be able to use the liquidity leeway created by the reform to invest more money in their employees.

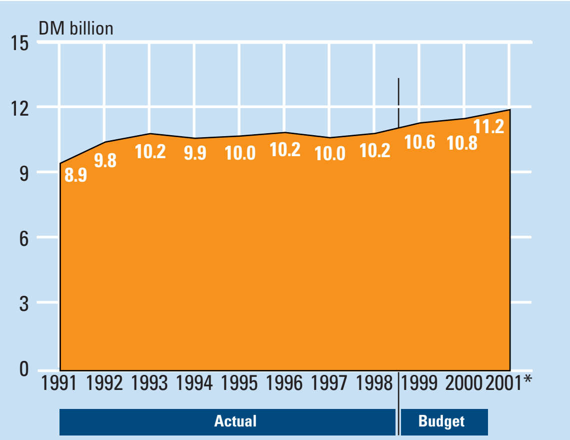
1.1 Increasing investments in education and research

In today's knowledge society, the relative importance of education and research is growing continuously. How much a country spends on education and research – and in particular on the people employed in education and research – will have a major impact on the further development of the prosperity of society. Education and research promote employment, structural change and growth. They are a means to foster equal opportunity, the maintenance of existing skills and a more equitable distribution of the prosperity generated. Investments in education and research are investments in the future.

The years of stagnation and declining expenditure on education and research are over. The Federal Government has made it its business to restore and consolidate Germany's efficiency and international competitiveness. While the previous government had reduced the spending on education and research by DM 700 million between 1993 and 1998, the new German Government already spent approximately DM one billion more on education and research in the 1999 budgetary period. Despite the necessary budget consolidation, additional funds were also made available in the year 2000. Considerable funds – in the order of magnitude of the amount spent in 1999 – will also be expended on education,

Chart 1

BMBF expenditure on research and development 1991–2001



* Draft budget
Source: Federal Ministry of Education and Research

Rounding error

BMBF, BuFo 2000

research and science in the year 2001 and in subsequent years. The Federal Government has thus adopted a course of consistently strengthening education and research – a course which it will continue to pursue in next few years.

Gross domestic expenditure on research and development increased from DM 84 billion in 1997 to DM 87 billion in 1998 and DM 92 billion in 1999. Gross domestic expenditure on R&D (GERD) as a percentage share of the gross domestic product is an important indicator for international comparisons. In 1997, this indicator amounted to 2.29 per cent. According to current estimates, it amounted to 2.31 per cent in 1998 and increased considerably in 1999 to 2.37 per cent. The stagnation or decline in R&D expenditure relative to GDP from the mid-1980s to 1997 increased the gap in terms of R&D intensity between the Federal Republic of Germany on the one hand and Japan and the United States on the other. Relative to these two leading industrialised nations, Germany has thus slipped from the position that it used to hold in the past. Since 1998, however, this trend has been reversed. This review shows that the Federal Government did the right thing when it decided to increase its spending on education and research.

1.2 Developing the research system

While the traditional differentiation of the German science system is useful in principle and has largely proven to be effective, a critical assessment reveals that it fosters isolation. The German science and research system must become more flexible. Its structures will therefore have to be further developed, which includes creating both a sharper profile and a stronger focus. Closing down low-performance research institutions is generally one of the options to be considered.

The research system in Germany is still suffering from overregulation and overly complicated decision-making processes. For this reason, both academic and non-academic research institutions will continue to be relieved of bureaucratic constraints and assume more responsibility of their own. This will require less detailed regulations and control by means of staffing schedules; instead, there will be a need for greater flexibility through budgeting and master budgets.

The measures that have already been initiated to provide greater flexibility for non-university research institutions have given research a much sharper profile, also in terms of its opportunities to co-operate with industry. The changes that were introduced by the Federal Government in the Helmholtz Centres and that are designed to control the research activities more via programmes and programme budgets will accelerate the necessary innovations, including in particular an involvement of industry in the development and assessment of the programmes.

The legal regulations governing public service employees still constitute a major obstacle to the further development of the research landscape. For this reason, the Federal Government has initiated a reform of these legal regulations. The goal of this reform is to strengthen the science and research system's efficiency and capacity for innovation, thereby safeguarding the competitiveness of Germany's higher education and research institutions in an international comparison. The duration of degree courses will have to be reduced, and higher education institutions will have to be supported in their training function. The funds spent will have to be used more effectively in order to enable more people to obtain an education in the sciences. For this reason, the goal of the Federal Government is to introduce more flexible and more performance-oriented employment and pay structures in order to create incentives to increase quality and the performance of individuals – especially those involved in teaching – and to facilitate the transfer of know-how between science and industry.

In order to prepare the reform proposals of the Federal Government, the Federal Minister of Education and Research appointed a committee of experts who submitted their recommendations in April 2000. The key points of these recommendations are described below:

– Reorganising the training of young scientists and scholars (cf. section 3.2); major elements include the introduction of a junior professorship limited to a maximum of six years, which as a rule is the prerequisite to obtaining a university professorship (involving the right to do research and teach independently, and the right to award a doctorate), and at the same time, the abolition of the post-doctoral thesis, which is currently required to obtain a full university professorship.
– Introducing a competitive and flexible pay structure without the current seniority levels; instead, there will be a fixed minimum amount and variable salary components. The purpose of this new pay system is to reward outstanding achievements in research and teaching and an above-average commitment to the university.

Furthermore, the competitiveness of Germany's higher education and research institutions is hampered by the rigid rules of collective bargaining law for public service employees. For this reason, the goal of the Federal Government is to modernise the collectively agreed employment conditions in the field of science and research by introducing a pay system that creates incentives, improves the competitiveness in the labour market, and promotes professional and geographical mobility. In its report, the expert committee also calls for the introduction of collective bargaining rules that are in keeping with requirements in the field of science – in particular performance-based pay structures –, for the conversion of seniority levels into performance-linked components, as well as for a more flexible approach towards the definition of pay groups. At the same time, the Federal Government intends to remove current barriers confronting scientific staff members of academic and non-academic institutions when they switch to jobs in industry by improving their possibilities to "take along" their supplementary benefits. This will require collective agreements between management and labour.

1.3 Increasing project funding

Project funding means more flexibility, more competition, and hence, more quality. Project funding is an important instrument for research policy because this instrument makes it possible to respond flexibly to new challenges, it is particularly well suited to initiating co-operation between the research and the business communities, and it fosters quality because of its competitive character. In the field of research grants, project funding will gain more importance again in the future. Strategic lead projects will play a particularly important role in this context. Lead projects will provide important guidance to the scientific community and industry with regard to society's expectations in terms of technological progress. Lead projects will help to identify convincing opportunities for the future and to bring together science, research, industry and policy-makers at an early point in time and on a continuous basis, thus facilitating co-operation. What is important in this context is to help the best concepts to prevail in a competitive process and to attain concrete objectives within a reasonable period of time.

1.4 Science and industry – joint efforts for innovation and jobs

In the funding of research, technology and innovations, the Federal Government is embarking upon a new course. In this context, innovation funding – especially at the interface between science and industry – will be given a clearer and more efficient competition-oriented profile. The aim is to intensify co-operation between publicly funded research centres, higher education institutions and industry. However, the strengthening of the application focus must not be misunderstood as a weakening of basic research; instead, it means that more effective use is made of basic research.

Germany's ability to attract investments and business enterprises depends on the innovativeness of its small and medium-sized enterprises. For this reason, the Federal Government is not only doing its best to improve the general setting for small and medium-sized enterprises, but is also devising a large number of funding programmes that are tailored to meet the needs of these businesses. The new Federal Government has concentrated these funding programmes within the Federal Ministry of Economics and Technology and has bundled these schemes in a new, transparent and consistent cluster of measures. To this end, the Government has developed three "funding lines", in which current funding programmes have been streamlined and combined with new initiatives to produce a clearly structured modular system. The Innovation funding line is available to support technology-based start-up companies in the development of new products, processes and services. The key programme of this funding line is called Beteiligungskapital für kleine Technologieunternehmen (BTU – Venture capital for small technology-based companiess), which in 1999, alone, mobilised a total of approximately DM 1.5 billion in equity capital for technology-based start-ups. The Research Co-operation funding line is available to provide funding for research projects conducted jointly by SMEs and research institutions. The main purpose of the Innovationskompetenz mittelständischer Unternehmen programme (PRO INNO – PROgramme INNOvation skills of small and medium-sized enterprises) is to support the networking of expertise among enterprises and between enterprises and research institutions. The Technology Consulting funding line is used to accelerate the transfer of knowledge to small and medium-sized enterprises. The funds available in this line are primarily used to support craft businesses that obtain advice on the application of new technologies in the newly established technology-based advisory centres. Relative to the amount actually spent in 1998, the funds of the Ministry of Economics and Technology budgeted for the promotion of research in small and medium-sized enterprises increased by 4.9 per cent.

Small and medium-sized enterprises receive an even greater share of the funds from programmes implemented by the Federal Ministry of Education and Research. The primary purpose of these funding programmes is to promote the integration of small and medium-sized enterprises into innovation networks, to accelerate the implementation of projects and to increase transparency and information.

The reform of the funding criteria to promote innovations is also designed to serve this purpose. In future, small and medium-sized enterprises will no longer fail because of bureaucratic red tape. As an immediate step, the BMBF has considerably streamlined and shortened the application procedure. Enterprises will now be rapidly given information about public funding opportunities. Innovations can be swiftly translated into practice. Improved commercialisation opportunities provided by all the funding projects permit an exclusive exploitation of project results. This will stimulate the exploitation of research findings and encourage innovations.

Funding has been focused in particular on research and development activities in the eastern part of Germany, especially with a view to promoting the development of innovative small and medium-sized enterprises in Germany's new *Länder* (federal states) (cf. section 5).

The establishment of technology-based firms plays an important role with a view to innovations and structural change in the German economy. Technology-based firms grow faster that other enterprises and – despite the higher technological risk involved – their chances of survival are greater than those of other newly established companies. In order to foster this process, innovative small and medium-sized enterprises will receive special support during their start-up phase and in their efforts to obtain access to venture capital. Owing to the Venture Capital for Small Technology-based Companies Programme of the Federal Ministry of Economics and Technology and the "New Market" at Germany's stock exchange, the equity capital market for innovative companies has experienced a highly dynamic development in Germany. No-one who has innovative ideas and the necessary qualifications and who is also willing to take an entrepreneurial risk should fail because of the lack of availability of external equity capital.

In order to utilise the findings of publicly funded research and development for innovations, it is critically important to protect inventions made by publicly funded research institutions and higher education institutions by obtaining industrial property rights. The conscious use of intellectual property will illustrate the value of such property and create innovation options. The patent system and the promotion of patents are strategic tasks of the Federal Government. Patents play a key role in the innovation process: they are both an instrument to protect inventions and a source of information for the planning and implementation of R&D. As a result of the patents initiative of the Federal Ministry of Education and Research (BMBF), patents have become an issue, not only in the field of publicly funded research for small and medium-sized enterprises but also in the perception of the public at large. In the framework of this initiative, the Federal Ministry of Education and Research has developed specific measures and funding options to initiate and support the acquisition of know-how in obtaining and exploiting patents. The Federal Ministry of Economics and Technology (BMWi) is anxious to achieve continuous improvements in the general conditions prevailing for patents (e.g. reducing patent costs and improving access to patents) and to increase the transparency of information about the patent system.

1.5 Increasing internationalisation

Teaching, learning and conducting research beyond national borders are increasingly being taken for granted. Nevertheless, Germany has a lot of catching up to do. The country must succeed in attracting more foreign students to Germany, and it must get more foreign researchers interested in doing research in Germany. To this end, it will be necessary to offer new and more attractive conditions.

In the past few years, there has been a growing controversy in Germany about the need to internationalise the system of education and research. The first few changes have already been initiated. Now it is necessary, however, to step up the current efforts with determination and with long-term prospects in mind.

Germany will be able to defend and safeguard its standing in the world only if it develops its own initiatives in the field of international co-operation in science and research and if it participates actively, especially in the development of a European higher education and research area. This requires the preparation and promotion of experience abroad. By means of systematic marketing, Germany will have to draw the world's attention to its capabilities in the field of science, and it will have to get foreign students and academics interested in obtaining an academic education and doing academic work in Germany. This will prepare the ground for opening up new markets and contribute towards international understanding (cf. section 8).

1.6 Science Dialogue: Evaluating and communicating opportunities

The discussion about the future that is currently being conducted in Germany must gain momentum once again, and it must be put on a broader basis.

More efforts will have to be made than in the past to communicate research findings to the public at large. Only if a large part of the population recognises and understands the benefit and the value of science, and only if they can voice their expectations and their reservations, will the necessary support for a sustainable development be obtained. This is the prerequisite to being able to guide the population's educational readiness into promising areas.

The Federal Government has launched the Science Dialogue initiative, jointly with Germany's premier science organisations. All scientists are called upon to be open-minded for the interests of the public and to present their research findings in a comprehensible manner. Every year, one scientific discipline will be highlighted, i.e. public events focusing on this discipline will be organised across Germany. This year – the first year – is the "Year of Physics". Next year will be the "Year of Life Sciences".

The Federal Ministry of Education and Research (BMBF) has doubled its funding for the interdisciplinary analysis of innovation and technology. This will considerably improve the preconditions for a thorough assessment of the opportunities arising from new knowledge. This assessment process should include technological, scientific, ethical, social, legal, economic and political aspects. It is expected that this process will help to identify currently non-utilised opportunities and to develop innovative solutions in dealing with potential risks. In future, innovation and technology analysis should play a greater role in the responsible discussion of fundamental ethical and moral questions that arise from the use of new technological options. Germany should be able to assume a leading role in Europe in this context.

2. Research funding priorities

Against this background, the following programme priorities have been defined:

With its renowned universities and excellent research institutions, Germany has a first-rate research and development platform. This platform must now be strengthened and modernised. **Basic research** continuously generates new knowledge – and thus a permanent flow of new options for the future. Higher education institutions, which are the key sites where knowledge is preserved, generated and discussed from cultural, economic and technological perspectives, should play a more important role in this context. The same applies to the transfer of knowledge. For this reason, more funding will be made available for the construction of higher education institutions and for the acquisition of large-scale equipment needed for basic research; in addition, we will continue to increase the grants provided to the Deutsche Forschungsgemeinschaft and the Max Planck Society. The funding area *Funding organisations; restructuring of research in the new Länder, university construction and mainly university-related special programmes* accounted for the largest portion of the Federal Government's expenditure in 1998 (19.3 per cent). According to the budget for the year 2000, this funding area will account for 19.8 per cent of the German Government's expenditure. Most of these resources (6.5 per cent) were earmarked for *Basic DFG funding* in 1998; this share had increased to 6.9 per cent in the year 2000. Due to the increase in grants-in-aid provided to the Fraunhofer Society and the increase in funds made available for research at Fachhochschulen (Universities of Applied Sciences), more importance is also being attached to **application-oriented research**, especially with a view to meeting the requirements of small and medium-sized enterprises.

State-of-the-art **information and communications technologies** increasingly pervade all walks of life in society – professional life, teaching and learning processes in initial and continuing education, the participation in public legal and economic life, as well as every-day life and leisure time. These technologies substantially change economic structures and open up considerable growth and employment opportunities worldwide. In Germany, information and communication enterprises now also enjoy the highest growth rates in terms of employment and sales. With average rates of approximately 10 per cent, the growth achieved by the German information industry in the past few years has been much more rapid than that of the overall economy. Nevertheless, this dynamic growth is not sufficient to keep pace in the international competition for the siting of industry. Despite its good information technology infrastructure, which is also recognised internationally, Germany has some catching up to do when it comes to the penetration and the utilisation of the Internet in society. This applies in particular to the educational sector, small and medium-sized businesses, public administration, Internet-related research and the provision of an adequate number of qualified IT professionals. For this reason, the Federal Government has decided to increase R&D spending on *Information technology (including multimedia and production engineering)* to 14.1 per cent, which is far above average.

On 22 September 1999, the Federal Government adopted an action programme entitled Innovation and Jobs in the Information Society of the 21st Century, and hand in hand with Initiative D21 – an association of companies – the Government has initiated an unprecedented collaboration between industry and government to cope with this challenge. The Federal Government has thus presented a political framework concept designed to pave the way toward the information, knowledge and education society – a concept that encompasses all policy areas, integrates industry, trade unions and other partners, defines concrete and thus verifiable objectives, bundles the necessary actions, and is open for new measures, initiatives and other arrangements, especially within the scope of the Alliance for Work, Training and Employment.

This framework concept is designed to prepare the ground for Germany to move to the top group of the leading industrialised nations in terms of the use of state-of-the-art information and communications technologies in the next three to five years. To this end, the Federal Government has set a new course in its action programme, especially with regard to its educational, research and technology policies.

One of the priorities of the programme is the further development of the legal framework – in particular on the basis of European legislation.

The Federal Ministry of Economics and Technology (BMWi) promotes the use of new information and communications technologies in a variety of ways, including competitions. Initiators of new business start-ups, for instance, are encouraged to establish more enterprises in the multimedia sector, and municipalities are given incentives to establish virtual city halls and marketplaces for their citizens. Every year, the BMWi awards the German Internet Prize to small and medium-sized enterprises that have set successful examples of innovative Internet developments.

In addition, the teaching of media skills and the development of new media for all educational institutions have now become crucially important. In spring of 2000, the Federal Ministry of Education and Research (BMBF) launched a programme – funded with DM 400 million – for the development of didactically high-quality educational software. Furthermore, the Ministry initiated computer exchanges together with industry and prompted companies to act as IT sponsors for schools. And finally, the Ministry made efforts together with Germany's *Länder* (state) governments to improve and intensify the initial and further training of teachers in information technology. Another major priority are measures initiated jointly with industry and the *Länder* governments to remedy the shortage of IT professionals. These measures included increasing the number of training places available in IT occupations, the Green Card campaign, an immediate-action programme funded with DM 100 million to upgrade the quality of computer science courses at higher education institutions, and the development of a regulatory framework and new curricula and teaching instruments for continuing education in information technology. A new course has also been set for research and technology policies. Priority areas are the expansion of IT infrastructures for science, industry and the public at large (German Research Network, digital libraries, e-commerce competence networks), the creation of the technological prerequisites to establishing even more efficient network generations (terabit networks, mobile communications), the development of innovative telematics applications in the fields of health, transport and the environment, as well as the development of new Internet applications (teleworking, teleco-operation, virtual reality) and of intelligent Internet technologies (software development, search engines, protocols, ad-hoc networks). And still another priority is the digital modernisation of public administration (Virtual Town Hall, electronic contract awarding procedures, tax return, voting via the Internet).

The E-Commerce Directive, which entered into force in July 2000 and which will be implemented as soon as possible, was drawn up in the Federal Ministry of Economics and Technology. This directive has created the legal basis that ensures that information providers and users will have confidence in the security of the technical systems and that will prevent abuse. The country-of-origin principle laid down in the directive will also require amendments in German competition law in order to prevent companies in Germany from being discriminated against.

The Federal Government's action programme for Innovation and Jobs in the Information Society of the 21st Century is open to respond to new developments; it is an offer made to all groups of society in Germany to participate in shaping the information society. The additional initiatives that have been launched since the publication of the programme to eliminate the shortage of IT professionals and to connect schools to the Internet demonstrate that this is the right approach. The action programme has sparked off a development. The next step to be taken now is to put this development on a broader basis and to increase its momentum.

The purpose of funding **biotechnology** is to ensure that the high international standard of performance in the life sciences will be maintained in the years to come, with the intention of promoting innovation processes that are aimed at preserving and improving human health, making careful use of the environment, as well as safeguarding existing jobs and creating new ones. Conducting efficient basic research, developing sufficient expertise, using innovative technologies to improve production processes and services, as well as modifying industrial production processes by means of biotechnological processes – all of these activities are expected to create the necessary preconditions for sustainable development. Educational and research policies can make an important contribution to this end through supplementary courses in the fields of initial and further education, promotion of junior scientists and research, innovative framework conditions and dialogues with citizens. BioChance and BioProfile are two funding programmes that are part of an integrated set of measures designed to step up the commercialisation of German biotechnology. The funds of these programmes are used to promote industrial research and pre-competition development projects in the field of biotechnology that can make a major contribution to the future establishment of new companies in the market. The number of biotech start-ups has already increased considerably. In Europe, Germany is now the number-one country.

The German Human Genome Project (DHGP) – which was launched in 1996 as a joint initiative of the BMBF, the DFG and industry – has now entered into its second phase (1999 – 2002). The Federal Government's funding in this field is now focused on functional genomics, which is designed to accelerate the systematic utilisation of findings. To this end, the funds available have been increased by 70 per cent. The genome research strategy paper published in July 2000 bundles the activities in the fields of human genome research, plant and microbial genome research, as well as proteome research and the associated bioinformatics, and is the strategy designed to strengthen German genome research.

In addition, the BMBF has provided more funds for safety research and for monitoring in the area of green genetic engineering. Potential changes in the environment can usually be detected only by means of long-term monitoring. The purpose of funding research in this area in the future will therefore be to clear up open questions related to the application of new technologies. More funds have also been made available for research in the field of biological monitoring.

Relative to the funds spent in 1998, the R&D expenditure on biotechnology budgeted for 2000 shows an above-average increase by 9.8 per cent. With this increase in funds set aside for genome research, Germany is now number two following the United States in terms of public funding of genome research. What needs to be done now is to use these funds efficiently, focusing on the key innovative areas of genome research.

Being able to live a healthier, longer and more active life is an elementary human need. For the Federal Government, it is therefore an important objective to provide efficient and cost-effective medical care for all groups of the population. The new **Health Research** programme makes a major contribution towards attaining this objective:

– More effective disease control and development of disease prevention methods:
  In many cases, the causes of a large number of severe diseases which are characterised by high incidence, early death, a chronic course or prolonged suffering are not yet understood. Funding of research in molecular biology and biomedicine, in particular the results of human genome research, will produce new findings about life processes as well as the causes and the pathogenesis of diseases. This will help to develop new prevention strategies and fundamentally new therapeutic procedures.
– Health services:
– Based on population-related public health promotion, research will be sponsored in the field of health services to improve patient care, focusing on the elderly, the chronically ill and multimorbidity patients.
– Health research conducted jointly by industry and science:
– In order to improve medical care, it is necessary to strengthen the collaboration between science and industry. Only in this way will it be possible to accelerate the translation of the enormous innovation opportunities arising from the explosion of knowledge into products and processes, and thus to achieve visible improvements in medical care for the population.
– Strengthening research by optimising and innovating the science system:

– The German health care system still suffers from considerable structural shortcomings; this applies in particular to the field of clinical research. For this reason, one of the priority goals has to be to strengthen patient-centred clinical research. In addition, the purpose of structural activities and programmes is to create, preserve, improve and interconnect research capabilities that are also competitive at international level.

Relative to the funds spent in 1998, the 2000 budget for R&D expenditure on *Research and development for the health sector* shows an above-average increase of 8.5 per cent.

Based on the German Government's Research for the Environment Programme, **research for environmentally sound, sustainable development** places new emphasis on regional sustainability, integrated research on the earth system, biodiversity and the socio-economic aspects of global change, in particular research for a policy of keeping peace. The purpose of promoting integrated environmental protection is to stimulate innovations for sustainable economic activities. It is not just a matter of fostering technological innovations in specific industries; attention must also increasingly be focused on the general setting, new strategies for product use and consumer behaviour issues. The overall objective is to achieve greater integration of ecological, social, economic and institutional issues in the various funding areas. This is being supported by combining environmental research with the promotion of social and economic sciences as well as science research, e.g. by means of a socio-ecological research funding line.

Three strategies are being pursued in the fields of research, technology and educational policies to achieve sustainable development:

– Criteria of sustainable development are explicitly and in increasingly concrete terms taken into consideration in efforts to promote key technologies such as new materials and chemistry, production engineering, information technology and biotechnology.
– The players that are important for a sustainable use of resources and that are outside the actual production sector – e.g. services, public supply and disposal institutions, local governments, environmental action groups and consumers – are increasingly being included in research efforts.
– New funding activities such as in the field of socio-ecological research systematically help to develop fundamental reference knowledge about societal needs, material flows and the possibilities and prospects for a transition from the industrial to the knowledge society. This will improve the scientific basis for a reflective policy that will also consider immediate consequences and long-term repercussions.

Since the end of the Cold War, the political and societal environment for peace and conflict research has changed dramatically. Today, there is an unprecedented concatenation of cultural, religious and ecological conflicts that jeopardise peace. Hence, peace and conflict research is facing new challenges and issues. To this end, the Federal Government will establish a **Peace and Conflict Research Foundation**.

The Federal Government conducts departmental research in order to obtain reliable information as a basis for its decision-making in the fields of agriculture, forestry and the timber industry so as to reach an international consensus on how to achieve an environmentally sound, sustainable development in these areas. The international spread of green genetic engineering, the change in the global climate, but also the change in economic conditions in Europe and worldwide (WTO), suggest that there is a need for research in the fields of traditional agriculture, partly in order to monitor and supervise the development in the interest of the consumer, and partly in order to support the necessary adjustment process in agriculture. The Federal Government's interest in improving the general conditions for organic farming will be borne out by establishing an institute for this purpose and by providing the required funding for projects.

Relative to the funds spent in 1998, the budget earmarked for R&D expenditure on *Sustainable development* in 2000 shows an above-average increase by 9.2 per cent.

Research and development in the fields of physics, chemistry and material sciences has a pacesetter function that is comparable to that of biotechnology. Combined with intelligent production processes, this research provides the platform for new technological developments of tomorrow. For this reason, the Federal Government funds the search for functions and materials for tomorrow's technologies:

– The efficiency, cost-effectiveness and acceptance of products and systems largely depend on the materials used. Improved traditional materials, as well as completely new ones, are the basis for system innovations. They play a key role and are pacesetters for technological and economic progress. For this reason, the funding available for materials research has been substantially increased.
– Because of their great innovation potential, nanotechnology and laser research are two funding priorities in the fields of physical and chemical technologies. Optical technologies are funded with a view to expectations that in future greater use will be made of light as an enabling technology for a wide field of applications.
– Microsystems will change every-day life. The Federal Government's funding in this area is focused on small and medium-sized enterprises because these are confronted with a special technological challenge and because they are a major source of new jobs.

Due to the technological progress achieved in the past few years, it is now possible in principle to produce minute functional systems from a few atoms or molecules and to apply them in innovative products. In the next few years, **nanotechnology** will evolve into one of the most important key technologies. The Federal Government's goal is to turn Germany into a premier venue for nanotechnology. Nanotechnology will contribute towards a sustainable use of resources, help to supply new drugs, foster next-generation information and communications technologies, and not least, help to preserve existing jobs or create new ones in Germany. The Federal Ministry of Education and Research provides a total of DM 65 million annually to support nanotechnology in the framework of a cross-programme initiative. By establishing networks and bundling expertise, the BMBF plans to make Germany's existing strengths (technology leadership) more visible internationally and to achieve greater efficiency, an innovation lead and higher value added by means of synergies. To this end, the Ministry will sponsor six centres of excellence in nanotechnology. The role of these centres will be to bundle interdisciplinary knowledge in their respective fields, to co-ordinate research, to create an economically attractive environment for nanotechnology, and to communicate the benefit of nanotechnology for society to a broad public. In addition to establishing networks in the framework of the centres of excellence, the Ministry will also provide grants for application-oriented research projects that are aimed at industrial-scale application.

In nanotechnology, the boundaries between the traditional sciences are becoming blurred. This is illustrated by the increasingly important interdisciplinary communication and co-operation between physics, chemistry, biology and the engineering sciences. Last but not least, the interdisciplinary nature of nanotechnology also poses a challenge in terms of the training of young scientists.

In order to facilitate rapid utilisation of these fundamental innovations, especially in small and medium-sized enterprises, the Federal Government has increased its funding of research for the production of tomorrow. To this end, the Government will sponsor joint projects of industry and science, with the objective of continuing Germany's success in the world market, with highly efficient machines and systems, with electrical engineering and electronics, with vehicles and many other new high-quality products – some of which are not even known yet today.

Funding **energy research**, which is a key responsibility of government as part of its duty to provide for the future, contributes to attaining the Federal Government's overriding energy policy objective, which is to enter into an era of non-subsidised sustainable energy supply without nuclear energy.

Efforts in the field of energy research are aimed at:

– reducing emissions of harmful greenhouse gases,
– making headway in the development of high technology in Germany, and
– improving the export opportunities of German companies in the market for energy technologies that is growing worldwide.

Against the background of these objectives, funding of non-nuclear energy research is focused on the development of technologies that will make it possible:

– to continue to reduce primary energy demand (e.g. by increasing the energy conversion efficiency, improving power station technology, and developing new secondary energy sources, e.g. through fuel cells),
– to make efficient use of energy (e.g. by improving the heat supply of buildings and heat storage technologies and by using heat generated by solar energy), and
– to use renewable energy sources cost-effectively.

Efforts in this field will be focused on continuing to increase the efficiency of existing power stations and developing new energy generation technologies. In conjunction with the extensive funding available for the use of renewable energy sources, this will ensure that these technologies will be competitive in the long term and that eventually they will account for the largest portion of energy supply. This will be necessary in order to comply with the global warming management targets set by the Federal Government. In Germany, carbon dioxide emissions will have to be reduced by 25 per cent by the year 2005, relative to 1990. In addition, the international Kyoto Protocol of 1997 makes it mandatory to reduce the emissions of six greenhouse gases by 21 per cent by the period 2008-2012, relative to 1990. In order to reach these targets, the Federal Government submitted an interim report on its global warming management programme in July 2000. This programme, which is expected to be adopted after the summer recess this year, contains additional measures that will ensure the attainment of the global warming management targets.

It is necessary to pursue future-oriented **transport and mobility research** in order to make city life tolerable for people despite growing road traffic volumes, without putting into question the mobility needs of people and goods. The new Mobility and Transport research programme, for which the BMBF was primarily responsible and which was adopted by the German Federal Cabinet in May 2000, has created the research policy framework for measures designed to improve ground transport. The purpose of such measures is to help safeguard sustainable mobility, increase the capacity, efficiency, safety and user-friendliness of the transport system, and finally to improve the international competitiveness of the transport industry. In order to cope with these challenges, it is no longer sufficient to achieve technological progress and to improve specific modes of transport. Instead, the aim must be to link the various modes of transport with each other in order to create an integrated transport system. In addition, it is necessary for all the parties involved – i.e. politicians, the business sector and the scientific community – to cooperate on the basis of division of labour, while giving due account to user interests at an early point in time. The research programme relies not only on an extensive and intelligent use of new information, communication and guidance technologies as a key research priority but it also focuses on technological, system-based, behavioural and organisational contributions to solutions in order to promote a shift of freight traffic to rail and waterway transport and a shift of passenger traffic to bus and railway transport. At the same time, the programme is aimed at achieving a more responsible attitude towards health, the environment and resources. Although considerable success has been achieved in the past few years, increasing traffic safety continues to be a major challenge. Interdisciplinary research activities in the field of mobility and transport are designed to obtain findings that will help to understand user behaviour in order to be able to avoid potential barriers from the outset.

The development of the new TRANSRAPID transport system was completed in spring 2000 in the framework of the research and type approval programme funded by the BMBF. However, the Federal Ministry of Transport, Building and Housing (BMVBW) will establish a follow-up application-oriented development priority – also in the interest of preserving Germany's ability to attract investments – in order to adapt and optimise as well as further develop the magnetic levitation technology, involving the use of the Transrapid Versuchsanlage Emsland (TVE – Transrapid experimental facility in Emsland). In this context, one of the objectives will also be to continue to develop the magnetic levitation technology in order to establish the high-speed magnetic levitation train as a new environmentally sound means of public transport, both in terms of its use as a fast and efficient regional transport system in greater metropolitan areas and as a long-distance transport component establishing links between conurbations.

In the age of globalisation, mobility is inconceivable without **air transport**. Air traffic will continue to grow; current forecasts suggest that it will do so at annual rates of 4 or 5 per cent. However, the increase in air traffic volumes must not lead to a growing burden for human beings and nature. For this reason, strategic goals of the funded technology projects in the field of aircraft construction include not only the economic aspects of decoupling air traffic growth from environmental pollution but also lowering noise levels in the vicinity of airports. To this end, the aviation research programme of the Federal Ministry of Economics is aimed at reducing carbon dioxide emissions by 25 per cent, nitrogen oxide emissions by 85 per cent and aircraft noise by 6 dB. It is necessary to increase the safety, environmental soundness and fuel economy of aircraft even further. Mega mergers in the aviation industry worldwide and new products will continue to increase competitive pressure in the next few years. Again, aviation research will have to make a contribution to help preserve and strengthen future-oriented aviation sites and highly qualified jobs in Germany and Europe. The objectives for the next few years include innovations and new technological developments such as the planned megaliner as well as the integration of aviation into European structures. The Federal Government will continue to pursue its civil aviation research and technology programme until the year 2002, with the following systematic key concepts in mind:
– the megaliner (wide-body aircraft for over 400 passengers),
– a next-generation aircraft (50 – 200 passengers),
– the all-weather rescue helicopter, and
– efficient, low-emission and low-noise drive systems.

In addition, the Federal Ministry of Economics also supports a quick integration of the European aviation industry in order to enable it to survive in the competition with the United States. The funds set aside for European aviation research in the EU's 5th RTD Framework Programme are more than twice as high as the amounts available in the previous programme. This will make it possible to provide substantial funding for strategic projects with a high European added value.

The overriding objective of **spaceflight** funding is to perceive and use space travel as an instrument of a global policy of sustainable development. For this reason, spaceflight research must be focused not only on deep space but also – and primarily – on the planet earth. Observation from space is a technology that provides unique opportunities to obtain knowledge about the earth system and to improve our understanding of the interaction of various forces and factors. Applications of spaceflight, in particular in the fields of earth and weather observation and telecommunications, have become indispensable in many areas of every-day life.

In this framework, future spaceflight projects will have to be characterised to a greater extent by the quest for scientific excellence or substantial economic benefits. This will have to go hand in hand with the principle of a greater involvement of industry and the users of space technologies and services in designing and financing the projects. Public/Private Partnerships (PPPs) at national and European level are an important instrument for application-oriented projects such as the planned European satellite navigation system Galileo. Particular attention will be paid to the transfer of technologies from space travel and the participation of SMEs in space projects, in particular against the background of the current consolidation processes in the European aerospace industry.

Preparations are currently being made to develop a new integrated spaceflight programme that will be geared towards the core competencies of German space science and the German aerospace industry.

For the Federal Government, space travel is primarily a European challenge. Key elements of Germany's participation in European programmes include the ARIANE launcher, which safeguards Europe's own access to space, and the Galileo satellite navigation system. The ideas put forward by the last ESA conference at ministerial level in May 1999 for the future development of European space travel activities must now be promoted and implemented.

Greater importance will be attached again to **social research**, both as a basis of political decision-making and to obtain knowledge that can provide guidance about major trends in society.

As in the European Framework Programme on Research, efforts in social research will be focused on improving our knowledge about social trends and interdependencies as a basis for pursuing democratically founded policies. It is only on the basis of reliable data that social sciences (sociology, economics and law) can produce well-founded analyses and define options for action that can be used in politics, industry and society to develop successful measures. The high informative quality of statistics will thus become a key prerequisite for social and economic research that will also be competitive on an international scale. Data as well as their quality and availability play a crucial role for research. The increasing opening of countries across national borders makes it also necessary to consider European and – more generally – international dimensions.

As a first step towards continuously "improving the informational infrastructure", the BMBF has set up a commission by the same name. Its mandate is generally to improve co-operation between the fields of statistics, administrative data and science, including all kinds of data sources, making use primarily of international experience, and examining best practice examples to see if they can be applied in Germany. The recommendations of the commission will be available at the end of the year 2000.

The Federal Government has also changed its emphasis on specific research topics. By creating new initiatives and mobilising numerous funded institutions for research on interdisciplinary issues and in cross-disciplinary alliances, the potential of economic and social sciences is utilised for sustainable development in order to do justice to the ecological, economic and social aspects of sustainable development.

In order to back up their policies, the various departments of the Federal Government rely on contributions from economics and social science, in particular in the following areas:
– New findings are needed primarily with regard to the current priority research areas, i.e. family, senior citizens, women, as well as children and adolescents, and their interrelationships.

– Research and development aimed at improving working conditions primarily deal with innovative work concepts and the future of work, questions of occupational health and safety in the framework of new forms of work and new organisational concepts, the impact of demographic change on work, as well as questions and problems relating to the emerging service society, and new types of services.
– Research in the field of education can play the role of a trendsetter in the modernisation of the German education system, taking into consideration findings from other fields of science, in particular labour market and occupational research. Currently available research findings as well as experience from pilot projects provide the basis, inter alia, of the activities of the Forum Bildung (Forum for Education).
– Conceptual inputs for policy making are necessary to be able to define the social policy framework and its interactions with other policy areas such as economic, structural and financial policies; the effectiveness of social policy instruments has to be analysed and assessed.
– The purpose of legal facts research is to study social, political and other factual conditions for the development and effectiveness of legal standards. Criminological research is aimed at studying crime manifestations, causes and trends, as well as ways for the public authorities in charge of criminal prosecution, enforcement of sentences and imprisonment to cope with crime.
– Financial and economic research is designed to study longer-term economic trends, and scientifically analyses the relevance of such trends for financial and economic policies. Financial and economic research addresses current problems and reform discussions and provides scientifically-based support by conducting efficiency and feasibility studies and by furnishing conceptual inputs for policy making.
– The Federal Government's tax reform policy is being scientifically assessed by analyses of the reform's economic effects and administrative feasibility. Another research priority is the area of analyses and forecasts of macroeconomic trends, both for the world economy and for the German economy. This includes monitoring and analysing the adjustment process in Germany's new *Länder*. Furthermore, questions and problems related to money, capital and financial markets are relevant in an international context.
– In the framework of the discussion on Germany's competitiveness, research in the field of social sciences should analyse not only the traditional technological and economic parameters but also "social performance" as a necessary yardstick of the long-term stability of social democracy.
– Empirical economic research is focused on monitoring and studying economic processes in Germany and abroad. In the context of globalisation, international economic relations are gaining in importance.

In addition, the Federal Government relies on Germany's higher education institutions to make sufficient funds available for the entire spectrum of social sciences. The Federal Government also supports such efforts together with the *Länder* governments by continuously increasing the funds made available to the Deutsche Forschungsgemeinschaft (DFG).

3. Research needs education

There is an inseparable link between education and research. Excellent research is impossible without excellently qualified junior scientists. However, research also needs well trained technical staff. Hence, the training of junior non-academic staff is as important as the training of young academic staff. Germany's entire education system must be designed in such a way that it will also help to preserve Germany's research and innovation capacity.

Germany has a differentiated education system which provides excellent training opportunities. Nevertheless, there is still urgent need for action in certain areas.

3.1 Promotion of junior scientists

Germany's education and training system must, wherever possible, make full use of the country's untapped educational potential; and Germany must become attractive again for particularly talented young scientists from abroad. For talent to develop, it needs supportive environmental conditions – both material and ideal – that can compete with the conditions prevailing in other leading nations.

In the near future, a disproportionately high number of scientists in Germany will terminate their employment for age reasons. Extrapolations suggest that approximately 50 per cent will leave their jobs in the next decade; in some disciplines, the rate is even higher. Germany is thus considerably above the standard international replacement rate of 4 per cent annually. During this phase of science development, the promotion of junior scientists by universities will play a particularly important role. Universities are the only institutions that combine all the conditions indispensable for training junior scientists at a single location:

- Academic research covers the entire spectrum of issues and scientific disciplines, which provides an opportunity for interdisciplinary co-operation between various academic departments;
- Universities are the only institutions that provide a combination of research, teaching and training in the education of junior scientists;
- More than any other institution, universities stand for a continuous dialogue with younger generations who are eager to learn and often approach new issues in unconventional ways;
- In many areas – in particular in the humanities – universities are the most important research institutions; in fact, in some areas they are the only ones.

There are also many non-university research institutions that play an increasingly important role in the training of junior scientists. Their co-operation with universities should be intensified, and they should offer a wider variety of training courses.

In future, the Federal Government will step up its efforts to support universities and non-university research institutions in fulfilling these functions in the framework of its responsibilities and within the scope of the resources available. The Federal Government expects the *Länder* governments also to increase their efforts to provide special support for junior scientists even at times when budgets are tight.

In addition to universities, applied research and development pursued at Germany's Fachhochschulen (Universities of Applied Sciences) also provide training opportunities for young people who are interested in long-term careers in the fields of research and science. Particularly talented graduates of Fachhochschulen should be given the possibility to obtain a doctorate at a university without having to go via the time-consuming route of first obtaining a university diploma. Opening the universities for particularly talented doctoral students from Fachhochschulen is indispensable if junior scientists are to be promoted effectively. Almost all of the *Länder* have adopted legislation that enables such Fachhochschule graduates to obtain their doctorates at universities. This legislation must now be swiftly translated into practice by the various departments of universities.

In view of the quantitative and qualitative problems that exist nowadays the Federal Government has also adopted new approaches to the promotion of junior scientists. Today, nearly 28,000 young scientists obtain their doctorates in Germany every year, and 1,800 successfully pass the exam that entitles them to hold a full professorship at a university. Nevertheless, there is a lack of junior scientists in major fields of science. While young researchers are generally well trained and hold a wide range of qualifications, there are still the following shortcomings with regard to the promotion of junior scientists:

- They are not given adequate opportunities in younger years to do independent research that requires a high degree of scientific creativity.
- The overall duration of training is still too long, and as a result, junior scientists are too old at the end of their training, relative to other countries.
- International networking is still not sufficiently developed.

Major steps have been initiated or accelerated to eliminate such shortcomings: the reliable continuation of the postgraduate research group programme, which was successfully initiated ten years ago; the promotion of junior scientists through non-university basic research institutions that are largely funded by the Federal Government; and the Emmy Noether programme which was launched in 1999 to support postdoctoral junior university teachers. Both the postgraduate research group programme and the Emmy Noether programme are pilot programmes with new structures designed to promote excellence. The aim of the reorganisation of training courses for junior scientists in the framework of the reform of civil service staff regulations – in particular the introduction of junior professorships – is to enable junior scientists to start working independently at an earlier point in time. Earlier independence and shorter as well as better structured training courses during all phases will considerably help to increase the attractiveness of German higher education institutions for qualified junior scientists from Germany and abroad, and to improve opportunities for women in science and research. Another novelty is the establishment of the first YOUNG ACADEMY in Germany, which combines structural innovation with a new concept of promoting young scientists.

3.2 Seizing opportunities: Women in science and research

Women are a minority in the scientific community. Approximately 109,000 or 23.7 per cent of the 460,400 persons employed in R&D in 1997 (all data given in full-time equivalents) were women. Compared with 1995, the share of women in R&D thus decreased slightly, both in absolute and in relative terms. There are substantial differences between the various sectors; these differences are even somewhat amplified by the statistical computation methods used. While women account for about 35 per cent of the total R&D staff employed at universities and non-university research institutions of the OECD member states, the share of women in the R&D staff employed in the private sector of these countries is only half as high. Since the private sector accounts for the largest proportion of R&D staff, the average share of women in the total R&D workforce is relatively low.

Nearly ten per cent of all professors at higher education institutions in Germany are women. Germany thus lags far behind other countries; in the European Union, Germany is even last but one. In the new *Länder* in the eastern part of Germany, women account for a larger share of researchers than in Germany's west; this is true both generally and for each individual discipline. Their share of scientific R&D staff at higher education institutions is 24.0 per cent overall, and ranges from 11.8 per cent in the engineering sciences to 36.5 per cent in medicine.

Educational and research policies must be consistently guided by the principle of equal opportunities for women (gender mainstreaming) – a principle that should be an integral part of all programmes and measures. This equal opportunity principle will thus be established as a performance and competition factor, and a shift in paradigm will be initiated in the policies for the promotion of women. The objective is to benefit from different perspectives and approaches of men and women in the interest of education, research, industry and society.

In view of the inadequate participation of women – in particular in leading positions in science and research – the Federal Government will launch a programme entitled Equal Opportunities for Women in Research and Teaching, which will be implemented jointly with the *Länder* governments as of 2001. A total of DM 60 million annually has been earmarked for this programme, which is 50 per cent higher than the amount that had previously been available for personalised measures designed to promote women in the field of science under the Third Special Funding Programme for Higher Education and Research. The promotion of women is no longer considered to be a special priority but an ongoing task – until such time when conditions will have changed drastically. Germany has a great deal of catching up to do in this area.

The BMBF has convinced the supervisory bodies of the Hermann von Helmholtz Association of German Research Centres to adopt the necessary policy decision to enforce equal opportunities, to work out personnel development plans designed to achieve equal opportunity over the next five years, and to appoint equal opportunity commissioners who will report to the Association's executive board.

In 1999, the Centres of the Hermann von Helmholtz Association (HGF) were authorised through an initiative of the Federal Minister of Education and Research to use 100 permanent employment slots systematically for women scientists, in particular to prepare them for leading positions. The purpose of this initiative is to increase the share of women in R&D staff, especially in top positions. For the year 2000, another 100 employment slots have been earmarked to be allocated primarily to centres that are actively involved in the implementation of equal opportunity.

The Anstoss zum Aufstieg (Impetus for career development) programme is designed to achieve a substantial increase in the share of women in leading scientific positions in the next five years. This programme systematically supports female scientists in their careers through continuing education, coaching and mentoring. The objective is to take advantage of the change in generations so that women will fill 20 per cent of all professorships by the year 2005. In future, the scope of the programme will be extended to include other research institutions and junior female scientists.

In addition to creating jobs and training opportunities for women, it is indispensable to improve the general conditions for making scientific work compatible with family life. A major breakthrough was achieved in this respect in the 1999 federal budget. In 1999, the research institutions MPG, HGF, DFG and FhG, which receive institutional funding from departmental budget 30, were authorised for the first time to spend funds allocated to them – without any adverse impact on their budgets – in order to develop and maintain childcare facilities for their employees.

3.3 FORUM BILDUNG – A joint reform initiative

The reform of the education system in Germany is a challenge of national significance. This challenge cannot be mastered single-handedly by the Federal Government, or the *Länder* governments, or any of the groups in society. Based on an initiative of the Federal Minister of Education and Research, the Federal and *Länder* governments have therefore jointly established the FORUM BILDUNG (Forum for Education) in order to improve the quality and sustainability of Germany's education system. The ministers of education and science of the Federal and *Länder* governments, as well as representatives of employers and trade unions, the scientific community, the churches, apprentices and students co-operate within the FORUM BILDUNG, which is chaired jointly by the Federal Minister of Education and Research and the Bavarian State Minister of Science, Research and Art.

By the end of 2001, the FORUM BILDUNG will have prepared recommendations with regard to educational objectives, curricula and educational methods. These recommendations will be designed to go beyond specific educational sectors such as school education, vocational training, higher education or continuing education. In its work, the FORUM BILDUNG will incorporate the recommendations already made in the course of the current national debate on education. International comparisons provide an opportunity to learn from the experience and the success of others. National and international examples of positive developments will play an important role in developing problem-solving approaches. What is really new about the FORUM BILDUNG is that all the parties concerned are brought together in a single body, and that a constructive debate about concrete measures is conducted across all educational sectors – a debate that is open to all interested parties. The FORUM BILDUNG is a national alliance for education.

The activities of the FORUM BILDUNG are focused on five priorities reaching across the educational sectors:
- Educational and training objectives for tomorrow: learning in an international context;
- Promotion of equal opportunity: equality and differences in the educational sector;
- Quality assurance in an international competition: personal responsibility and government intervention;
- Life-long learning: implementing a generally recognised principle;
- New learning and teaching cultures: putting traditional methods of imparting knowledge to the test.

The recommendations of the FORUM BILDUNG will permit an educational campaign in the course of which every FORUM member will help to implement the jointly drafted recommendations in their own field of responsibility. The substantive objective of these recommendations is better to prepare adolescents and adults for future challenges and to enable them to assume responsibility in their personal and social life, in their working and professional life, and in society and cultural life.

All organisations and individuals who are reflecting on necessary developments and changes of the education system are invited to participate in the broad dialogue on the joint development of possibilities for the future (http://www.forumbildung.de/).

4. Safeguarding the quality of research in Germany

The yardsticks for the future development of the research system are quality and efficiency in international competition. There is a need to sharpen Germany's profile in fields of outstanding performance. First and foremost, innovation means bringing together knowledge from various fields to develop new approaches and solutions. There is no clear dividing line between basic research and application-oriented research, nor is such a distinction very useful in terms of the results to be achieved. Instead, quality and openmindedness vis-à-vis innovative developments are also key criteria for the work to be performed by publicly funded research institutions.

The German research scene is characterised by diversity and a high degree of plurality. Against the backdrop of broad-based university research, where the funding provided by the DFG continuously safeguards scientific quality and competition, science organisations like the MPG and FhG meet the specific requirements of basic research and research that satisfies the needs of industry. On the other hand, the work performed by the national research centres that are members of the Helmholtz Association is characterised partly by large special-purpose equipment and partly by research into the future needs of government and society, which in the field of key technologies overlaps with the requirements of industry. The centres that are members of the Gottfried Wilhelm Leibniz Science Association (WGL) are devoted to specific research topics. Departmental research institutions of the Federal Government conduct research in areas that are particularly relevant for the performance of the state's sovereign functions. Each of these organisations or institutions has its own financing mechanisms, some of which can only be explained by the respective institutions' historical development.

This plurality, which is based primarily on Article 91b of the German Constitution, has revealed strengths and weaknesses since its introduction in the framework agreement concluded between the Federal and *Länder* governments in 1975; after a quarter of a century, it is time to review the rules adopted in this agreement. During that same period, however, there have been changes not only in the functions of the players – e.g. the original tasks of a number of Helmholtz Centres – , but also in the international context in which the players and the entire system have to position themselves.

4.1 Evaluation

With their decision of November 1996 to "safeguard the quality of research", the heads of the Federal and *Länder* governments initiated an evaluation of all research institutions that are funded jointly by the Federal and *Länder* governments. The system evaluation reports for the Fraunhofer Society (FhG), as well as the Max Planck Society (MPG) and the Deutsche Forschungsgemeinschaft (DFG) are now available. The Science Council intends to conclude the evaluation of the Blue List institutions (WGL) by the end of the year 2000. The same applies to the system evaluation of the Helmholtz Association (HGF), which is also the responsibility of the Science Council.

The findings of the evaluation got something moving in the German research landscape. This is illustrated by the institutional reorientation that is envisaged with the merger of the Forschungszentrum Informationstechnik (GMD – National Research Centre for Information Technology) with the Fraunhofer Society, which is expected to produce Europe's largest integrated research network in the field of IT research. However, measures designed to create greater flexibility – such as easing the MPG's strict staffing schedule rules for salary groups below the C4 grade (full professorship) – will also help to provide more latitude.

In addition, an independent expert committee has been commissioned by the BMWi to evaluate the funding of industry-integrating research activities as of autumn 2000 in order to adapt the BMWi's funding system to meet the future requirements of small and medium-sized enterprises, while at the same time making the system more consistent. This evaluation is based on the results of the working groups looking into the issue of Improving the Implementation of Research Findings, which were composed of representatives of the Arbeitsgemeinschaft industrieller Forschungsvereinigungen (AiF – German Federation of Industrial Co-operative Research Associations), the Bundesanstalt für Meterialforschung und -prüfung (BAM – Federal Institute for Materials Research and Testing (BAM), the Physikalisch-Technische Bundesanstalt (PTB – Federal Institute of Physics and Metrology), the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute of Geosciences and Natural Resources) and external industrial research institutions.

After receiving the various evaluation reports as well as the opinions to be presented by the research institutions involved, the Federal and *Länder* governments will jointly draw the necessary conclusions from the evaluation and then take appropriate action.

4.2 The future development of the structures of the German research system and its funding mechanisms

The quality of research in Germany depends on the presence of research institutions with quality assurance structures that strive for excellence on the basis of their specific research assignment, in competition with each other and in the awareness of international competition.

The system evaluation reports available to date confirm that the research profile of the institutes of the Fraunhofer Society is tailormade to suit the needs of industry and that, in particular, it meets the requirements of small and medium-sized enterprises that are characteristic of many sectors. While a number of specific suggestions are made in the reports on the DFG and the MPG, these two institutions are praised for their outstanding achievements at international level that are fundamental for the German research system.

However, the evaluation reports also warn about weaknesses of the German system: the system's lack of permeability across organisational boundaries; insufficient co-operation between universities and non-university research institutions; limited flexibility in complicated processes of co-ordination between grant donors, and persisting weaknesses in the co-operation between publicly funded research and industry.

Taking into consideration the evaluation reports that are still outstanding, there is a need to discuss the conclusions to be drawn from the reports for the future structure and work of the organisations. This discussion, which in fact is already underway, is based on the Federal Government's conviction that organisational diversity can enhance the future viability and competitiveness of the research sector if it supports the institutions in adapting their expertise and resources to changing requirements. Preparing the research system for the needs of tomorrow means first and foremost organising flexibility. More specifically, the research landscape will have to be prepared for the following challenges of the future:

Safeguarding programmatic flexibility

– The yardstick for the institutions' competency and use of resources is their ability to stand up against international competition. This means that it will be necessary to continue to sharpen their profiles in areas in which they are achieve outstanding performance. Innovation requires bringing together knowledge from various fields. Hence, a yardstick for the sustainability of research institutions is also their ability to establish cross-links with other disciplines, to question current schools of thought, and to acquire new expertise in co-operation with others.
– In future, the conventional assignment of research institutions to basic research or application-oriented research cannot be the only thing that matters; there are two key criteria for public research institutions to apply when choosing between various potential orientations: the prospect of their further development as an institution and the co-ordination of programmatic objectives across institutional boundaries.

Creating organisational/administrative flexibility

– To be both focused and adaptable, research requires greater flexibility. Implementing a decision of the heads of the Federal and *Länder* governments, the MPG introduced new rules to that effect as early as in 1999; these new rules will soon also be introduced in other jointly funded institutions.
– The reorganisation of the control instruments for universities and non-university research institutions by introducing demand management based on target agreements and budgeting requires greater flexibility in terms of pay scales. This implies that the employment and remuneration conditions must be designed in such a way that they will support the implementation of programme objectives, that achievements of employees will be adequately rewarded, and that it will be possible to recruit qualified personnel. In other respects, it will also be necessary to maintain, and where possible improve, flexibility of staff regulations against the background of the particularities of the research sector.

Facilitating mobility between the organisations

– In order to be able to link programme objectives and to break up the traditional boundaries between basic research and application-oriented research and between the various disciplines, the institutions must be willing and able to network. Networking is required both within the major science organisations but also among them, in particular between universities and non-university research institutions. Concepts of a "virtual institute" or a "temporary institute" sponsored by several organisations should be thoroughly examined in this context. The system of programme-driven funding, which was designed for the Helmholtz Centres, and the rules on co-operation among a large number of parties – including industry – within the framework of the Human Genome Project and the competence networks can serve as reference points for other developments.
– The financing ratio between the Federal and *Länder* governments must not be a major obstacle for this cross-linkage for specific assignments or if institutions whose research priorities have changed are to be incorporated into another research organisation. One of the major challenges for the reorganisation of the research scene will be to increase the flexibility of the current financing system.

Guaranteeing permeability between publicly funded research and industry

– Research in technological areas derives its relevance from its potential industrial application. Increasingly, basic research is also a source of innovations. Hence, one of the major objectives in reorganising the research landscape continues to be making current boundaries between publicly funded research and industry more permeable. As research that is relevant for industry approaches marketable results, a smooth transition of such research from the public to the private sector must be possible.
– This will make it necessary to optimise the instruments available in order to ensure that the utilisation of research results can be passed on as early as possible to the responsibility of industry by means of innovative business start-ups, without at the same time compromising the motivation of the institution to continue to show the necessary professional commitment. Individuals who start up new businesses, as well as investors and research institutions need rules that will permit a dovetailing of research and product development and that will ensure that the contributions made by research and product development to the success of an innovation will be given their due.
– However, it will also be necessary to modify the overall system of pay and employment conditions as well as old-age pensions in such a way that employees are encouraged, not hindered, to switch between publicly funded institutions and industry. The innovations of tomorrow will need the experience of industry in applying knowledge as much as the know-how of researchers so that promising new products and services can be developed. It is particularly important that the mobility between science and industry must no longer be hampered by the loss of pension entitlements. The amendment to the legislation on company pensions adopted by the Federal Government will make an important contribution to this effect.

It is necessary to find a new – internationally competitive – balance between longer-term research and flexibility for innovations.

5. Germany's new *Länder*

Approximately DM 2.5 billion or 17.2 per cent of the R&D funding provided by the Federal Government in Germany in 1998 was spent in the new *Länder* including East Berlin. Following a decline of this share to 16.8 per cent in 1997, it returned to a level above 17 per cent in 1998. In the year 2000, a sum of over DM 3 billion was made available. This sum does not include project funding transferred to the new *Länder* via grant recipients in Germany's old *Länder* including West Berlin.

A comparison between Germany's old and new *Länder* in terms of R&D personnel per 1,000 inhabitants shows that there was still a considerable difference in 1997. In the western part of the country, there were 6.0 R&D employees per 1,000 inhabitants in 1997, while the corresponding figure in the east was 3.8. As far as universities and publicly funded research institutions are concerned, the alignment process between the old and the new *Länder* has already been completed: In 1997, there were 2.1 R&D employees in these institutions in both the western and the eastern *Länder*. Of the total of over 100,600 persons who were engaged in research and development activities at universities in 1997, approximately 18,900 were employed in the new *Länder*. Hence, the old *Länder* account for 81.2 per cent and the new *Länder* for 18.8 per cent, which almost exactly reflects the respective shares of the population in 1997. However, there are still major differences in the private sector, where the number of R&D employees per 1,000 inhabitants in the western part of Germany (3.9) is more than twice that in the new *Länder* (1.6).

The development of the scientific and technical infrastructure in the field of publicly funded research has largely been completed and has reached a top level in many areas.

InnoRegio is a special funding programme which was launched by the BMBF for the new *Länder* in 1999 in order to support joint activities of the various innovation partners within a region: the universities, research institutions, innovative enterprises and the regional and local public authorities. The strong response to this programme from eastern German regions (as demonstrated by 440 applications) has shown that there is a potential that needs to be supported and promoted. InnoRegio has provided a new impetus and has led to the development of concepts for innovations and private-sector networks. This has enabled previously underprivileged regions to use and to develop their innovation potential more efficiently.

However, what industry in the eastern part of Germany is still lacking is a sound mix of large-scale, medium-sized and small enterprises that will establish a closely-knit network of innovation activities together with universities and research institutions. Only innovation processes and networking will make it possible to achieve more progress in consolidating and restructuring the eastern German research landscape, which will continue to be a particular challenge in the future. Considerable success has been achieved in stabilising the research and development potentials in eastern Germany, not least due to the BMWi's *Special R&D programme for the new Länder*.

Particularly intensive support is given to research and development activities in eastern Germany with a view to building up innovative small and medium-sized businesses in the new *Länder*. Through its special programme on *Funding and promoting research, development and innovation in small and medium-sized enterprises (SMEs) and in extramural industrial research institutions*, the BMWi continues to fund eastern German research projects and eastern German research staff. With FUTOUR 2000, the BMWi continues to provide funding for technology-based business start-ups in the new *Länder*, and it paves the way through intensive funding for a large number of additional high-tech start-ups in Germany's new *Länder*.

However, the Federal Government is convinced that it is necessary to continue to make considerable efforts in order to give the new *Länder* the same development opportunities that the old *Länder* expect and implement. Nevertheless, it should not be forgotten that nationally and internationally competitive research institutions have emerged in the publicly funded research sector since German unification, while there is still considerable need for action in the private sector in order to continue to reduce current structural weaknesses.

6. Research and development in industry

Industry accounts for about two-thirds of both the implementation of R&D projects and their financing; most of these funds are spent on the development of new products and processes. In 1999, the sum expended by industry to finance R&D amounted to DM 58.4 billion, i.e. 63.5 per cent of total R&D spending. The importance of industry becomes even clearer if one looks at its role in the performance of R&D: Industry accounts for 68.8 per cent – or DM 63.3 billion – of the estimated total of DM 92.0 billion spent in Germany in 1999 for the implementation of research and development. The business enterprise sector spent most of this amount for development activities, which makes it relatively difficult to compare this sum directly with the public funds made available of research purposes.

With a share of approximately 65 per cent, industry accounts by far for the largest proportion of the total amount spent on R&D staff.

In 1998, the internal R&D expenditure of industry amounted to DM 59.3 billion, following DM 56.5 billion in the previous year. The turnaround achieved with this increase by 4.9 per cent between 1997 and 1998 should have been accelerated in 1999, with another increase by 6.7 per cent to DM 63.3 billion (based on the provisional statistics currently available). The R&D expenditure of the business enterprise sector has therefore grown, thus considerably contributing to the increase in total R&D spending in Germany. This dynamic growth was supported by business enterprises and by institutions for cooperative research and experimental development (IfG), which are also considered to be part of the private sector.

However, the R&D expenditure in industry is still focused on large-scale companies: Companies with over 10,000 employees accounted for nearly half of the intramural R&D expenditure of all enterprises in 1997, while small and medium-sized enterprises with fewer than 500 employees accounted for only 15 per cent. Relative to 1995, however, this reflected a shift in favour of smaller enterprises: SMEs accounted for 14.4 per cent in 1995 versus 12.4 per cent in 1991. The share of companies in the top size category decreased from 54.8 per cent in 1991 to 49.2 per cent in 1997.

The contribution of industry to the resources available to universities for research and development nearly doubled in the 1990s, from DM 846 million in 1991 to DM 1,490 million in 1998.

In 1999, the share of industry in the BMBF's direct project funding (i.e. projects that are individually assessed and approved) in the field of research and technology amounted to DM 1.062 billion. This sum increased by 15 per cent between 1997 and 1999; it accounts for approximately 35 per cent of the BMBF's total direct project funding.

One of the Federal Government's priority research funding areas in the private sector is SME funding. In 1999, the amount earmarked for SMEs reached a level of DM 1.1 billion. This means that small and medium-sized enterprises receive approximately 55 per cent of the funds spent jointly by the Federal Ministry of Education and Research and the Federal Ministry of Economics and Technology to support research and development in industry. This is in contrast to the business enterprise sector's own R&D spending, where – as already mentioned – enterprises with fewer than 500 employees and institutions for co-operative research receive only approximately 15 per cent of the total. Relative to industry's own efforts, the Federal Government's support of small and medium-sized enterprises is thus far above average. In this way, the Federal Government acknowledges the importance of SMEs for growth and employment and the role they play in the innovation process.

The Federal Government expressly welcomes the substantial contributions which German industry is making towards funding research in Germany and which have recently been increasing again. Industry thus plays a major role in safeguarding the competitiveness of the German research sector in the world, thereby safeguarding its own competitiveness and potential for development.

7. German research funding in an international comparison

In the last decade, investments in research and development varied widely in the G7 countries. Gross domestic expenditure on R&D (GERD) grew most rapidly in North America. Between 1994 and 1997 alone, R&D expenditure in the United States increased by 25.2 per cent. In the same period, Japan invested 20.1 per cent more in research and development, while Germany increased its spending by only 12.3 per cent.

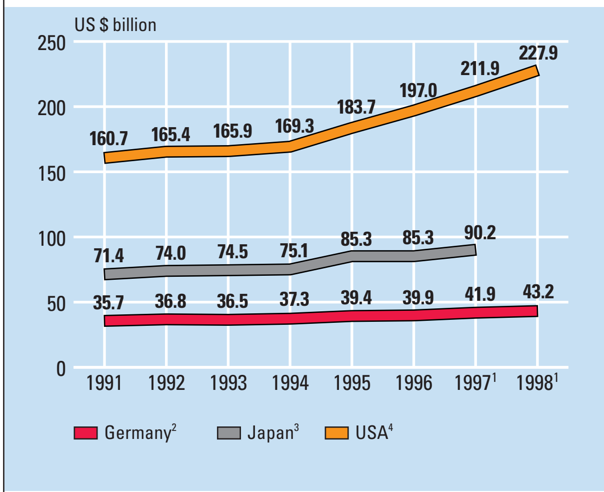
In terms of R&D intensity (i.e. gross domestic expenditure on R&D as a percentage of GDP), Japan has held the leading position for a decade now, with a share of 2.91 per cent in 1997. The gap between Japan and the United States has narrowed because of the rapid growth of R&D expenditure in the United States (2.70 per cent in 1997). Germany only ranks third, at 2.31 per cent[1].

In addition, the longer-term trend of R&D intensity and gross domestic expenditure on R&D illustrates that the gap between Germany and Japan as well as the United States has clearly widened, at the latest since 1994. While R&D expenditure increased in the United States and Japan (both in absolute terms and relative to GDP), R&D intensity stagnated in Germany. 1999 was the first year in which R&D expenditure as a percentage of GDP showed a considerable increase again. This increase continued in the year 2000, and based on the budget adopted by the Federal Government, it will persist in the year 2001.

The Federal Government feels that this negative development with regard to Germany's position in international competition is a key reason for the need to continue its already initiated policy of consolidating and strengthening education and research. In addition to making additional funding available, it is indispensable to pursue the structural and organisational renewal of education and research outlined above.

Chart 2

Comparison of R&D expenditure in the USA, Japan and Germany 1991–1998*



Rounding error

* Nominal expenditure, in US $ purchasing power parities.
1 Provisional OECD data, partly based on national estimated.
2 1992 break in series, even years estimated.
3 R&D expenditure overestimated up to and including 1995. 1996 break in series.
4 Excludes most or all capital expenditure; 1991 break in series.

Source: OECD (1999/2) *BMBF, BuFo 2000*

[1] Differences relative to national data (e.g. in Table I/3) are due to the fact that the data for the international comparison of national accounts have not yet been converted to the European System of Integrated Economic Accounts 1995 (ESA).

8. The international character of German research

In our globalised economy, Europe also competes with Japan and the United States in the field of research. The countries within Europe have increasingly learnt that in today's world they can only survive when they network their resources. This applies in particular to the Federal Republic of Germany.

Not only past experience but also the analysis of the economic present demonstrate that Germany's economic future and the prosperity of Germany's citizens can only be safeguarded if the country is firmly embedded in Europe. German industry exports over 60 per cent of its products and services to the European Union. In the past few years, this share has grown steadily. An assessment of the success of Europe from a German perspective must not be limited exclusively to the figures of the EU budget and its financing. The momentum of European integration will continue to increase in the next few years. The single currency area is already accelerating European integration and will lead to considerable changes in the attitudes of Europe's citizens in the long term. The enlargement of the EU, which has already been initiated, will continue to increase the economic capabilities of the Community, especially in the business enterprise sector.

The EU plays an important role in the fields of education, research and development. After the introduction of the single European market, Europe will increasingly see the development of a European research area in which it will be necessary to think about how responsibilities can be effectively redistributed.

One of the priority objectives of the Federal Government is therefore to transform the German science and research system into an internationally competitive research system and to continue to foster the strengthening of the international links of science and research. The strategic goal pursued by making science and research more international is to take advantage of the knowledge resources that are available worldwide and to co-operate with the best partners. More importantly, co-operation in science and research contributes considerably towards politically shaping international relations. Germany is perceived and sought-after by many countries as a competent partner. Increasingly, Germany will have to live up to this responsibility.

Internationalisation has rightly become a key concept whenever it is necessary to respond to the globalisation process and whenever knowledge generation, gains in expertise and innovation momentum are at stake. For this reason, European and international co-operation is at the centre of any future-oriented science and research policy. The internationalisation policy pursued by the Federal Government in this context is primarily aimed at the following objectives and purposes:

International co-operative ventures for science and research

International co-operative research is designed to strengthen the scientific community as a whole, to obtain more excellent research findings through co-operation and thus to foster the development of human society across national borders. Co-operative measures have a dual purpose: On the one hand, they are expected to help transfer scientific and technological know-how between the research institutions of the co-operation partners; international mobility and the recruitment of scientific talent for research institutions in Germany play an important role in this context. On the other hand, co-operation is expected to provide access to internationally leading research regions and centres of excellence, thereby opening up research opportunities that would not be available to Germany alone. The further development of scientific and technological co-operation is a top priority for the Federal Government, which will focus its co-operation schemes on selected countries and priority regions and establish closer links between co-operative R&D ventures and programmes in the field of initial and continuing education and training.

Research on global problems

Transboundary problems – ranging from environmental hazards to migration and transport issues – require international research efforts and solutions. Given its scientific and technological capabilities, Germany is called upon to contribute towards finding solutions to such problems. For this reason, the Federal Government will not only increase its commitment with regard to international developments such as the Rio and the Kyoto process; but also step up its involvement in regional co-operation projects. The successful co-operation among the littoral states of the river Oder aimed at preventing future flood disasters is a good case in point.

Developing a European research area

European integration also plays a key role for science and research. What is important for the Federal Government in this context is that Germany's participation in the Fifth Framework Programme should be stepped up and that Germany should give its input to designing the future Sixth Framework Programme – including the question of more efficient implementation structures – in a dialogue with science and industry. In future, Europe will have to bundle its resources in order to persevere in global competition. Networks of research institutions in the Member States improve R&D capabilities and give the European research landscape a sharper profile. The same applies to the establishment of European centres of excellence, the promotion of the mobility of scientists, and greater co-ordination of national and European R&D policies, e.g. with a view to the more effective use and further development of the European research infrastructure. Germany's attractiveness as a research site will continue to increase if it is located in the centre of a European research landscape that overcomes national borders and opens up new horizons for research.

Finally, a European research area requires transparent and consistent rules for the protection of the intellectual property inherent in research findings. For this reason, the Federal Government will continue to strongly support the creation of a system of industrial property rights at European level that will help to promote innovation and research. The most important goal here is the rapid introduction of a low-cost and enforceable Community patent that will apply consistently across the entire single market.

Using a common R&D infrastructure

Since financial resources are limited, it does not make sense for each country to operate its own large-scale facilities for basic research. International co-operation in building up and operating expensive equipment provides an opportunity to share costs, to increase capacity utilisation and to accelerate the research process by means of division of labour. The Federal Government advocates making the current international research institutions even more efficient and co-ordinating their activities more effectively with national activities. Future decisions on large-scale equipment and investments should be discussed within the framework of the EU and implemented, wherever possible, by means of international division of labour. However, there must be guarantees for fair financial burden sharing as well as a fair return in terms of contracts awarded and an adequate representation of German scientists and managers in international institutions.

Developing a European higher education area

Against the background of global competition, German and European higher education and science institutions will only be able to survive and prosper if they can develop an international profile, and be perceived as competitive international players, in the emerging global market for education. This is not yet sufficiently true for the European higher education systems, which still vary too widely.

In June 1999, the ministers of education of 29 European countries therefore signed a declaration in Bologna in which they agreed to create within one decade a European higher education area with clearly identifiable common basic structures, and to continue to promote European co-operation in the higher education sector, as well as the mobility of students and teachers. Germany will make constructive contributions to attaining this European objective; by amending the Framework Act for Higher Education, for instance, the Federal Government has already made it possible to award international university degrees in Germany. In 2000, the BMBF will spend a total of DM 12 million on introducing these degrees.

Promoting experience abroad

The Federal Government will stick to its objective of increasing its funding to encourage cross-border mobility, in particular for junior scientists. Experience abroad has become an important prerequisite for starting a professional career and for being promoted. What science and industry need are employees who are not only well versed in their profession but who are also familiar with other countries, speak other languages and are able to co-operate internationally. The objective of the Federal Government is to increase the share of German students who want to study one or several semesters abroad from currently 10 per cent to 20 per cent. Due the reform of the Federal Education and Training Assistance Act, students will be able to obtain grants after having studied two semesters in Germany if they decide to spend the rest of their studies elsewhere within Europe. In addition to the EU's successful ERASMUS and SOKRATES programmes, new programmes developed by the DAAD will promote the mobility of German students abroad. To this end, the BMBF will provide a total of DM 100 million in the year 2000 alone. Studying abroad often provides the basis for lasting personal contacts that promote and facilitate scientific and economic co-operation.

Enhancing Germany's attractiveness as an education and research venue through systematic marketing

Germany must become more attractive for foreign students and scientists. The example of the United States demonstrates the innovation momentum that universities and research institutions can develop if they see themselves as international science venues and try to attract the best talent worldwide. If Germany wants to stay abreast, the research and working conditions in Germany will have to meet international standards. In addition to improving locational conditions, the improvement of the institutional conditions of the research system (developing a sharper profile, promoting the mobility of research staff, creating regional and functional networks) will be of crucial importance for Germany's international attractiveness as a location for performing research and science activities. The Federal Government will use aggressive marketing schemes to promote Germany as an education and research venue.

Opening up new markets

Scientific co-operation is also expected to help companies obtain access to new markets. Companies often need local partners to help them overcome market entry barriers and minimise the risks of a commitment abroad. In addition, R&D co-operation can be used systematically to adapt products and services to demand in other countries. For this reason, the involvement of business enterprises, especially SMEs, in scientific and technological co-operation is one of the priority requirements which the Federal Government imposes on future international co-operation. Opening up specialised programmes to more co-operation can provide additional impetus. In addition, the technology co-operation network promoted under the BMWi's PRO INNO programme, with its 19 contact points in 17 countries (mainly in Eastern Europe), offers a variety of support measures for companies that want to co-operate with foreign partners.

This year, the BMBF has launched an Internet platform (kompetenznetze.de) to be used as an international marketing instrument for presenting the most competent research, business and education networks in Germany; this platform can be used for inquiries and communication purposes by people from Germany and abroad who are seeking information and co-operation.

It is also important that more German small and medium-sized enterprises join European co-operation networks. For this reason, the BMWi will expand the existing advisory network for European funding sources and will try to convince the European Commission that it is necessary to simplify the approval procedures for European funding.

Setting standards and norms

Those who hold leading positions in research and development protect their head start in terms of quality and their market success by setting technical standards and norms. International joint ventures and strategic alliances between representatives of politics, science and industry prepare the ground for this purpose. Lead projects conducted in the framework of the EU and EUREKA are aimed at developing internationally leading standards and norms. From the perspective of the Federal Government, it is desirable that more German institutions and enterprises should take the lead in such project consortiums.

Improving R&D monitoring

Thorough knowledge about the state of the art in science and research in other countries is a prerequisite to a successful internationalisation strategy. For this reason, the BMBF plans to transform current pilot projects (e.g. the International Technology Reporting Network) into a flexible and interactive information service. Through this process, the MInistry hopes to achieve greater transparency and closer co-operation with science and mediating organisations.

Today, the Federal Republic of Germany not only maintains close relations within the European Union, but also co-operates with over 50 countries worldwide in the field of science and technology. In many cases, this co-operation is based on intergovernmental agreements that are filled with life by universities, non-university research institutions and business enterprises that conduct research. Over the years, this has led to a closely-knit network of bilateral and multilateral relations, which will be further expanded to provide a sound basis for the Federal Government to attain the objectives it has set itself and to master challenges successfully.

Part I

The German Research Landscape – Structure, Financing and Strategy

Introduction

Germany feels committed by its long-standing tradition in the field of research. The beginnings of research in Germany go back to the time when the first German universities were established. German research produced eminent scientists and inventors like Johannes Gutenberg (1400–1468), Gottfried Wilhelm Leibniz (1646–1716), the Alexander brothers (1769-1859), and Wilhelm von Humboldt (1767–1835), as well as Karl Friedrich Gauss (1777–1855).

German research flourished during the period of economic prosperity, which began in the mid-19th century and lasted until the 1920s. This period is inseparably linked with outstanding representatives of German science, research and technology, including such renowned personalities as Robert Wilhelm Bunsen (1811–1899), Carl Zeiss (1816–1888), Werner von Siemens (1816–1892), Hermann Helmholtz (1821–1894), Nikolaus August Otto (1832–1891), Robert Koch (1843–1910), Carl Benz (1844–1929), Wilhelm Conrad Röntgen (1845–1923), Max Planck (1858–1947), Albert Einstein (1879–1955), and Otto Heinrich Warburg (1883–1970).

In order to continue to deepen their basic findings systematically, these pioneers and founding fathers established the first scientific institutions, and they also used their findings in the interest of German industry. German research became both the trigger and the driving force of completely new emerging sectors such as the electrical engineering industry, the chemical and pharmaceutical industries, and the automotive industry. At the beginning of the 20th century, Germany was considered to be the epitome of science and research in the world. The products of its industry ("Made in Germany") were recognized worldwide.

However, German research has not only experienced these highlights; it has also witnessed dark periods. The dictatorship of national socialism led to the expulsion of leading scientists from Germany, and German research was isolated from international developments. After World War II, the reorganisation of the German State and its research within the framework of the newly established Federal Republic of Germany was guided by liberal objectives and the federal model, primarily in the form of corporations under private law, while centralist science structures were introduced in the former German Democratic Republic. In 1990, when Germany was reunited, all German science and research capabilities were merged, brought together into a single structure and integrated into a German research system to form part of the international research landscape.

At the beginning of the 21st century, German research differs from research in neighbouring European countries and overseas due to the broad range and wide diversity of its research structures, which have their roots in German history.

1. Structure of the German research landscape

The following section provides a description of the structure of the German research landscape and its financing.

German industry accounts for about two-thirds of German research, in terms of both the performance and the financing of research; consequently, industry is the most important sector for research. Government accounts for roughly one-third of the funding of research and development (R&D) and also one-third of the research projects implemented, if one includes the universities. Most of the publicly funded R&D is carried out by universities and non-university[1] research institutions.

The following figure illustrates the complexity and the variety of the structure of the German research landscape. Public institutions, for instance, are partially financed from third-party funds provided by German industry, while private research institutions, on the other hand, also receive public funding.

1999 Gross domestic expenditure on R&D (GERD) by research-performing sector

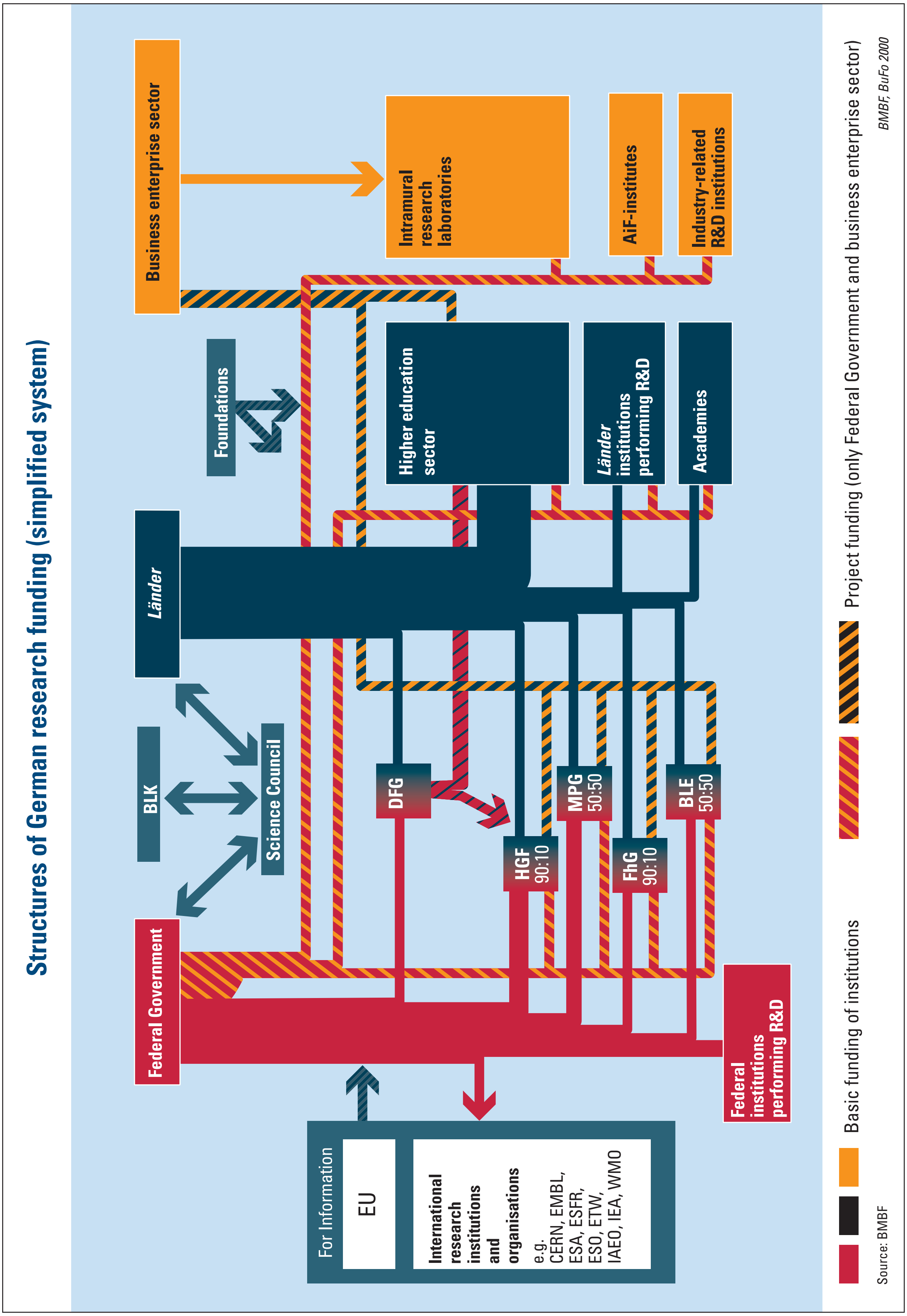
Business enterprise sector	68.8 %
Higher education sector	16.8 %
Government sector and private non-profit institutions	14.4 %

1999 R&D expenditure by funding sector

Business enterprise sector	65.5 %
Government sector and private non-profit institutions	34.4 %

[1] The term "non-university" is used to describe institutions other than universities or any other higher education institutions because R&D in the higher education sector is not only conducted at conventional universities but also at Universities of Applied Sciences (Fachhochschulen); see below.

Chart 3


Structures of German research funding (simplified system)
Business enterprise sector
Intramural research laboratories
AiF-institutes
Industry-related R&D institutions
Foundations
Higher education sector
Länder institutions performing R&D
Academies
Länder
BLK
Science Council
Federal Government
DFG
HGF 90:10
MPG 50:50
FhG 90:10
BLE 50:50
Federal institutions performing R&D
For Information
EU
International research institutions and organisations
e.g. CERN, EMBL, ESA, ESFR, ESO, ETW, IAEO, IEA, WMO
Basic funding of institutions
Project funding (only Federal Government and business enterprise sector)
Source: BMBF
BMBF, BuFo 2000

2. Organisations and institutions performing R&D

2.1 Higher education institutions

Germany's universities have traditionally been the backbone of the country's research system. When measured in terms of their share of R&D expenditure, Germany's universities are the second largest sector following industry. The universities' 1999 expenditure on teaching and research is estimated at DM 35.7 billion.

This eminent position, which is facilitated by the broad range of subjects and methods covered by university research, is safeguarded by the promotion of junior scientists. Since universities constitute the largest – and at the same time the most comprehensive – potential pool of publicly funded research in Germany, they play a key role as both the platform and the most important hubs of the German research system. Because of the institutional links between research, research-oriented training of junior scientists and teaching, the efficiency of Germany's universities is an important determining factor for the success of the entire German research system since the non-university research institutions are also largely dependent on the presence of efficient universities – as a breeding ground and recruitment field for junior scientists, as a broad platform for a wide variety of disciplines and forms of research, and also as a co-operation partner in selected fields of research.

Universities cover a broad spectrum of research activities, including basic research, application-oriented research and development activities. A number of co-operative ventures – in particular collaborative projects, collaborative research centres and transfer centres – have developed within universities, among universities, and between universities and non-university institutions.

When *Fachhochschulen* (Universities of Applied Sciences) were established in Germany at the beginning of the 1970s, they followed the tradition of their predecessor institutions and initially did not conduct any research – at least for the most part –; instead, they limited themselves to teaching. And in some *Länder*, they were only allowed to conduct research if this research was directly related to their teaching assignment. Nowadays, however, these *Fachhochschulen* are playing an increasingly important role in application-oriented research and development; because of their practical orientation and their integration into a specific region, they provide important links between the science and the business communities, and they are the "natural" partners for businesses in their region, in particular for small and medium-sized enterprises that do not have any research and development departments of their own. Even if training junior scientists is not one of the official functions of the *Fachhochschulen*, the implementation of application-oriented research and development projects is becoming increasingly important, also with a view to the training functions of the *Fachhochschulen*.

2.2 Associated institutes

Associated institutes are legally independent institutions at universities that are closely linked with these universities in organisational terms as well as physically and in terms of personnel, without, however, being an integral part of the university concerned. As a link between higher education and industry, these institutes conduct research in industry-related areas – in the dichotomy, as it were, between applied research and market-oriented product development.

INFO-BOX

DEFINITIONS OF BASIC RESEARCH, APPLIED RESEARCH, AND EXPERIMENTAL DEVELOPMENT

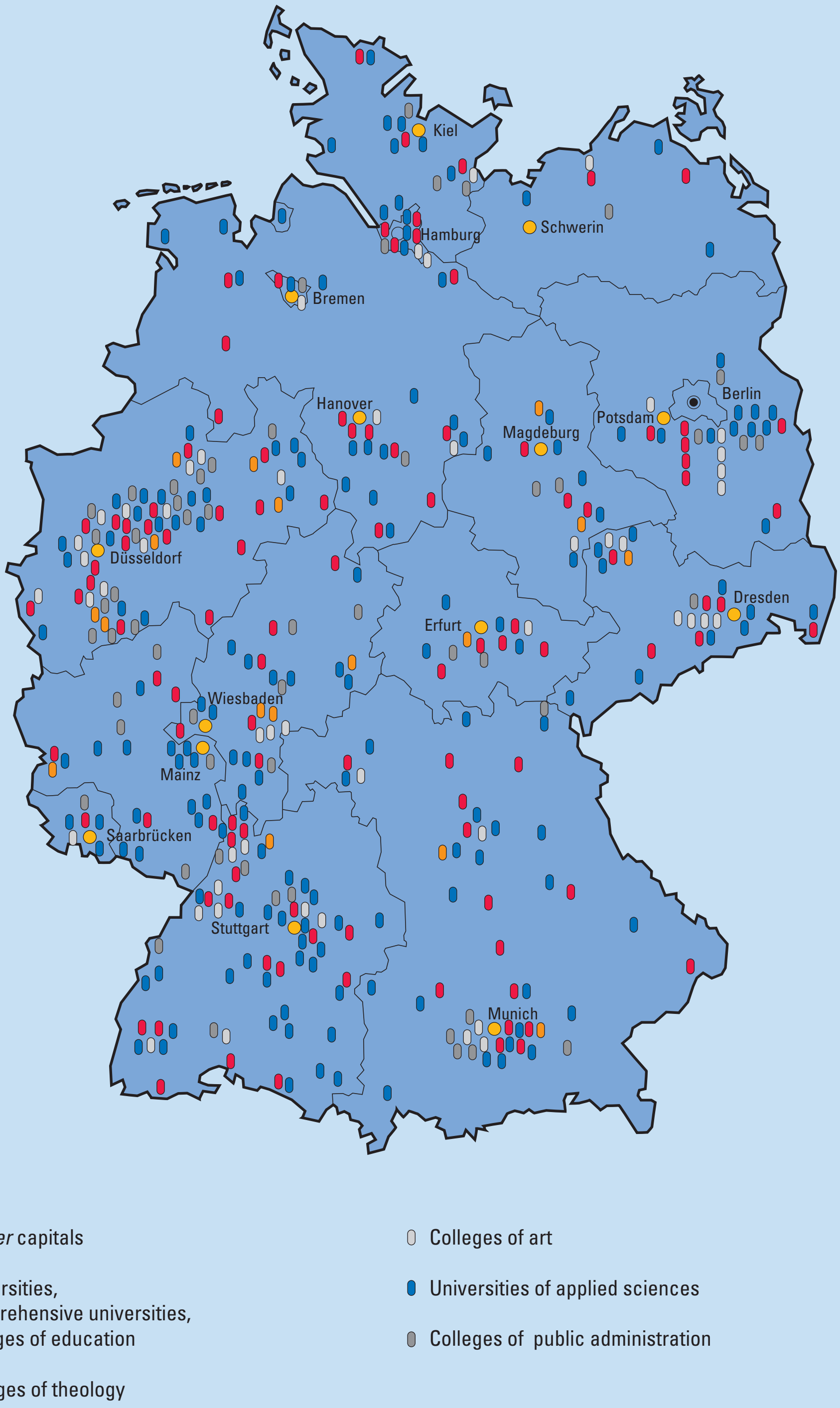
Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view (cf. Frascati Manual 1993, para. 224).

Applied research is also original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective (cf. Frascati Manual 1993, para. 229).

Experimental development is systematic work, drawing on existing knowledge gained from research and practical experience, that is directed to produce new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed (cf. Frascati Manual 1993, para. 233).

Chart 4

Higher education institutions



Source: BMBF

BMBF, BuFo 2000

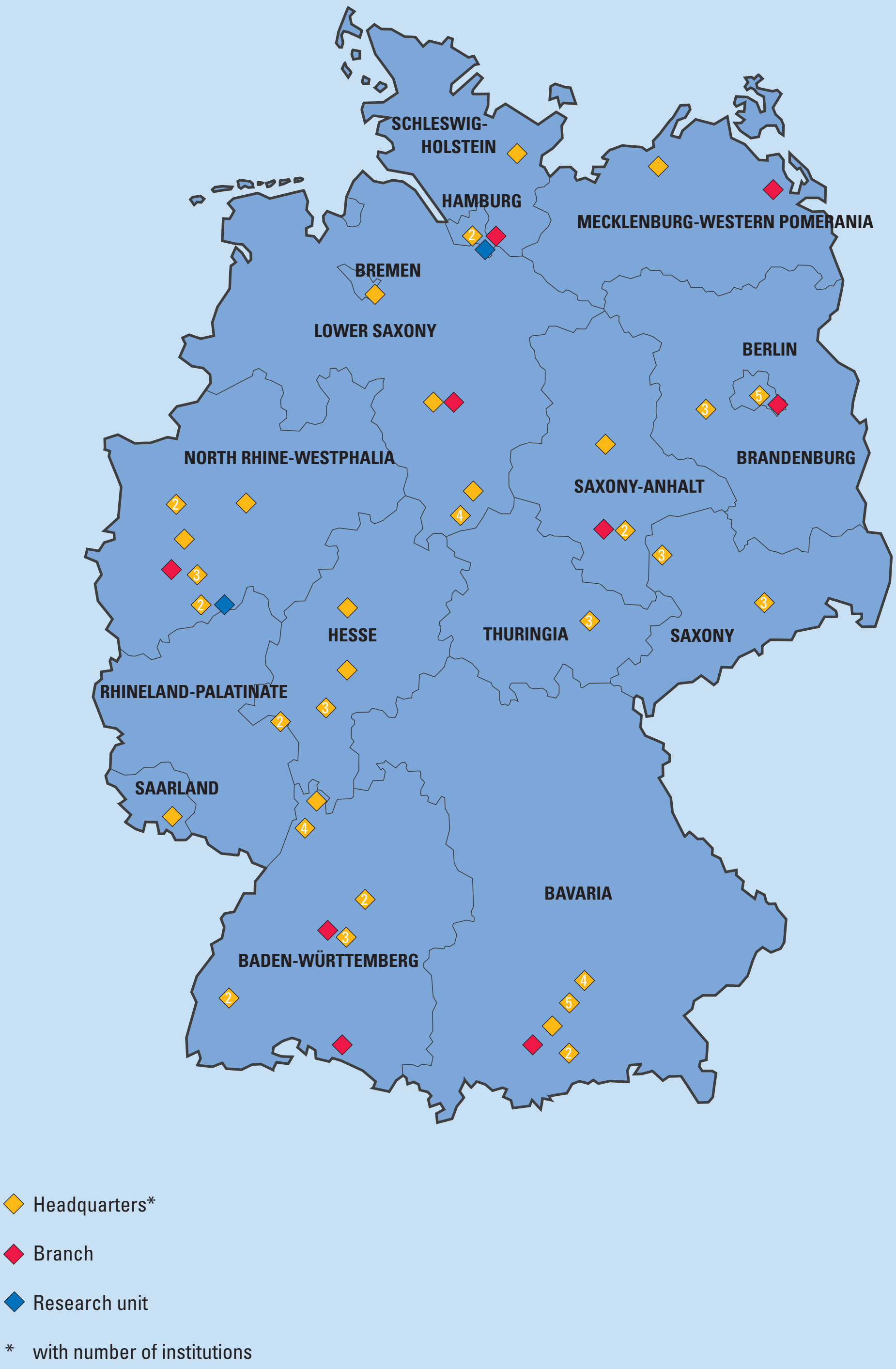
2.3 Max Planck Society (MPG)

The Max Planck Society (MPG) is the most important science organisation for basic research. In the year 2000, a total of DM 1.7 billion has been budgeted for the 79 research institutions of the MPG (funding is provided in a 50:50 ratio by the Federal and *Länder* governments).

The MPG's prominent position within the German research system and in the international context is based first of all on the internationally recognised research achievements of its scientific members. This is illustrated not least by the large number of coveted awards, including in particular 15 Nobel prizes since 1954, of which ten have been awarded since 1984. Another success factor is that no strings are attached to the basic funding which the MPG receives as an institution. The MPG has used the autonomy associated with this funding very successfully in order to identify previously neglected areas in promising fields of research, to find the best scientists worldwide to do research in these areas, and to assume a leading role in a number of fields of research. The MPG has created centres of excellence that are first-rate on a global scale. As a matter of principle, the activities of the MPG and its co-operative ventures are interdisciplinary in nature. By means of a well co-ordinated system of internal and external evaluation, the MPG ensures that its performance meets high quality standards. It will discontinue fields of work that cease to achieve top quality or are no longer promising will be discontinued. Due to its co-operation with a wide variety of institutions at national level and in international competition, the MPG has become a central hub in the network of Germany's research system.

Chart 5

Institutions of the Max Planck Society



Source: BMBF

BMBF, BuFo 2000

2.4 Fraunhofer Society (FhG)

The Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (FhG – Fraunhofer Society for the Advancement of Applied Research) is the leading organisation that supports institutions of applied research in Germany. The FhG is currently operating 48 research institutions with a total expenditure volume of over DM 1.37 billion; over DM 600 million is provided by the Federal Government (BMBF) and the *Länder* governments for jointly funded research, while the FhG must cover DM 695 million from income of its own and special funding projects.

The FhG conducts contract research for manufacturing companies, businesses in the service sector and public authorities, and it provides information and services. The activities of the FhG are consistently guided by the objective of translating research findings into new and innovative products, processes and services. The contract research institutes of the FhG generate nearly two-thirds of their income themselves.

The core funding provided by the Federal Government and by the *Länder* governments to the FhG enables the organisation to build up and safeguard its scientific potential in independently selected fields of research, to develop innovative technologies and to monitor them continuously.

Through offices maintained by some Fraunhofer institutes in the United States and Asia, the FhG organisation stays in touch with the world's most important current and future economic regions.

The FhG relies on close co-operation with higher education institutions to be able to recruit the support of junior scientists on a regular basis because the FhG does not have any significant resources at its disposal for basic research. This co-operation is characterised by joint appointments of scientists to chairs or honorary professorships at universities and the position of director of a Fraunhofer institute.

Chart 6

Institutions of the Fraunhofer Society

Source: BMBF

BMBF, BuFo 2000

2.5 Helmholtz Association of German Research Centres (HGF)

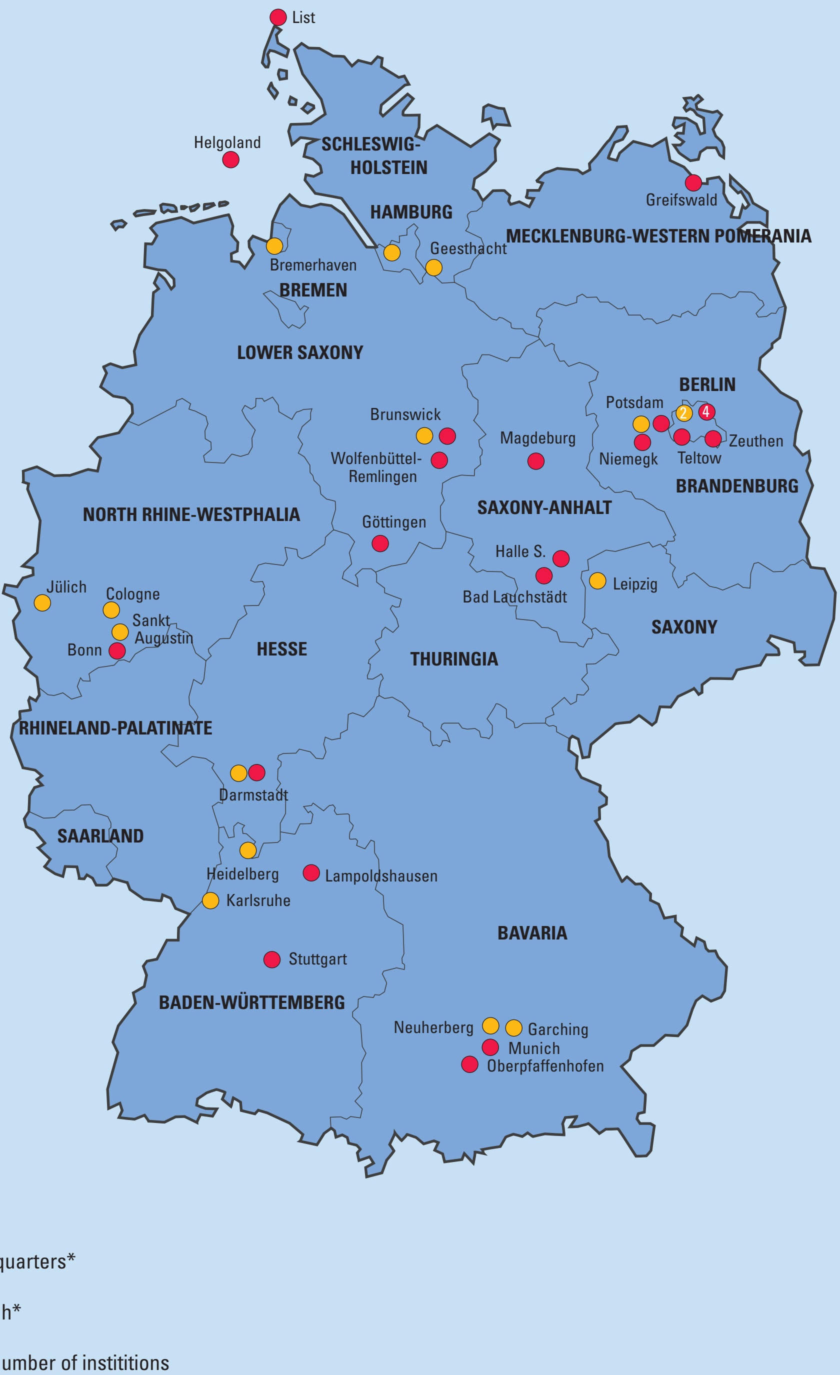
In the year 2000, the 16 national research centres that are currently members of the Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF – Helmholtz Association of German Research Centres) had a total budget of DM 4.4 billion (obtained in a ratio of 90:10 from the Federal Government and *Länder* governments, as well as from external funds and other income); the funding provided by the Federal Government and the *Länder* governments accounted for over DM 3.3 billion of this sum.

The Helmholtz Centres make large-scale equipment and the associated infrastructure available to national and international groups of researchers; in addition, the Centres conduct research in areas where government and society have an interest to obtain research results to provide for the future and that are designed to meet the long-term requirements of industries in key technologies.

Against the background of the increasing dovetailing of knowledge-oriented basic research, application and industrial application, the functions and research priorities of the Helmholtz Centres are currently being restructured. In future, the funding provided to the Centres will be guided by their programmes and programme budgets. More co-operation and more competition are additional strategic objectives that will have equal priority in optimisation efforts.

Chart 7

Helmholtz centres



Source: BMBF

BMBF, BuFo 2000

2.6 Gottfried Wilhelm Leibniz Science Association (WGL)

A total of 84 research institutions and institutions providing services that are included in the so-called "Blue List" (BLE) are currently members of the Wissensgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association). The funding made available by the Federal Government and the *Länder* governments in the year 2000 amounted to nearly DM 1.3 billion (the ratio of federal to *Länder* funds is generally 50:50, with some exceptions).

Since their establishment, the "Blue List" institutions have focused their attention on future-oriented issues of supraregional significance and national scientific interest. They also provide important services for the German research community. The Federal Government and the *Länder* governments use the "Blue List" institutions as a flexible instrument to promote research into questions and subjects that are of common interest.

In order to protect their common interests and to intensify their co-operation, almost all the "Blue List" institutions have joined the Gottfried Wilhelm Leibniz Science Association (WGL). The 33 institutions in the new *Länder* have a considerable impact on the cities in which they are located, and they play a key role in the economic development of the new *Länder*. By co-operating with a wide variety of institutions, in particular universities and MPG as well as FhG institutes, the "Blue List" institutions help shape the science landscape of the research mission in Germany to which they give a fresh, innovative impetus.

Chart 8

Blue List institutions

Source: BMBF

BMBF, BuFo 2000

2.7 Federal and *Länder* institutions performing R&D

The R&D expenditure of the 52 federal institutions that perform research functions amounts to some DM 1.3 billion (fully funded by the Federal Government). These institutions perform their R&D functions in the framework of their governmental duties. The various activities are assigned to the federal ministries into whose portfolios they fall. The objective of their research activities is therefore first and foremost to obtain scientific findings that will help to perform departmental duties ("departmental or mission-oriented research"); however, they also help to acquire general knowledge.

In addition, there are 84 *Länder* and municipal research institutions (that are not part of the Blue List), which are fully financed from *Länder* funds.

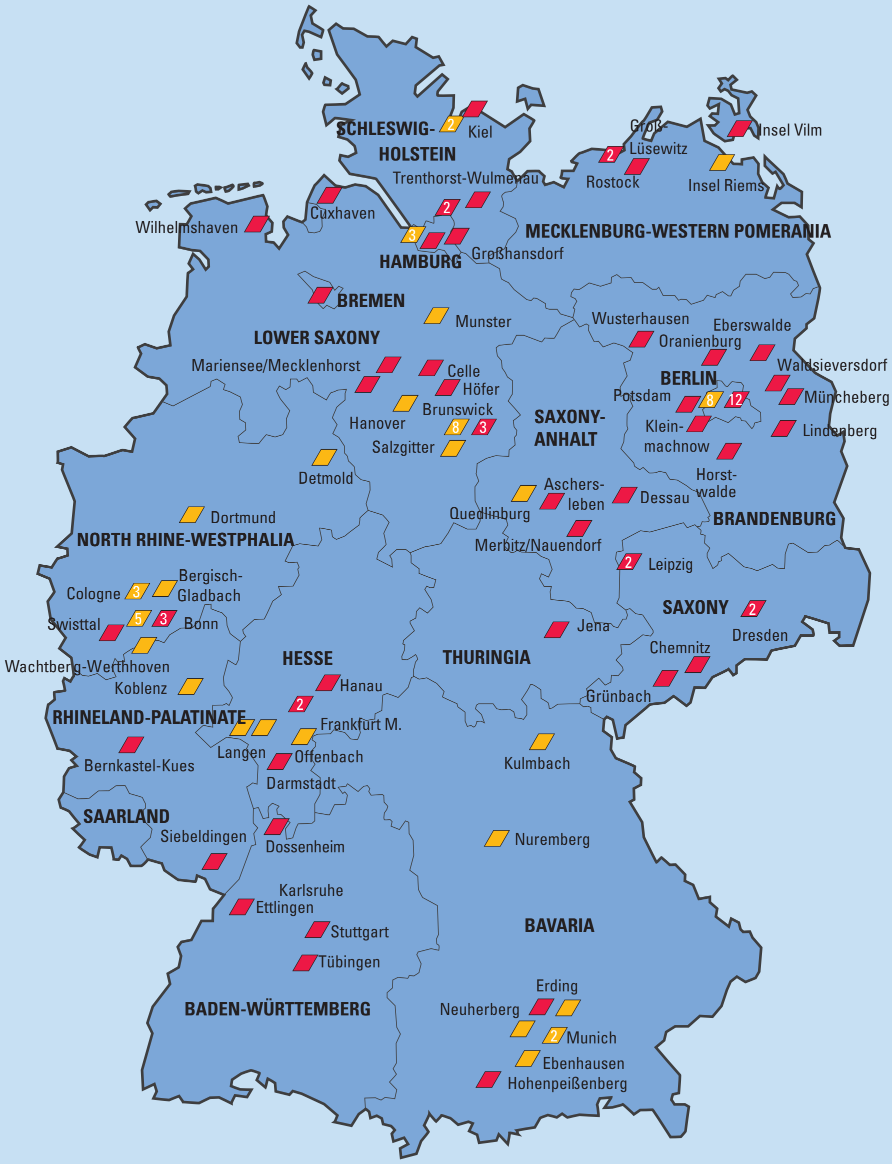
Info-Box

Departmental research

Departmental research (or mission-oriented research) is research (or research and development) that is aimed at obtaining scientific findings that are directly related to the activities of a given government department or ministry. These findings are used as a basis for decisions to be taken in due compliance with departmental duties. If the general level of knowledge is not sufficient for this purpose, the necessary research will be performed primarily by federal institutions (or *Länder* institutions when *Länder* ministries are involved) (cf. Part VI, section 6).

Chart 9

Federal institutions performing R&D



Headquarters*

Branch*

* with number of institutions

Source: BMBF

BMBF, BuFo 2000

2.8 Academies

Germany's seven academies of sciences – which are located in Berlin, Düsseldorf, Göttingen, Heidelberg, Leipzig, Mainz and Munich and which have over 1,400 ordinary and corresponding members from a wide variety of disciplines – are members of the Union of Germany Academies of Sciences. These academies, whose basic budgets are financed exclusively by the *Länder* governments, are scientific forums designed to foster science, in particular interdisciplinary reflection and the cross-disciplinary generation of knowledge; they also act as mediators in scientific and societal conflicts related to the assessment of science, and serve as points of contact for international scientific co-operation. An important function of the academies is the implementation of the Academies Programme with a total volume of DM 74 million in the year 2000, half of which is funded by the Federal Government, while the other half is financed by the *Länder* governments.

The Deutsche Akademie der Naturforscher Leopoldina (German Academy of Natural Science) in Halle, which is a supranational society of scholars in the fields of science and medicine, is funded by the Federal Government (BMBF) and the *Land* Government of Sachsen-Anhalt in a ratio of 80:20.

Chart 10

Academies

Source: BMBF

BMBF, BuFo 2000

2.9 Business enterprises

In the performance of R&D, industry accounts for over two-thirds of the German research budget. After a weak period in the first half of the 1990s, the R&D expenditure of industry grew very rapidly in the second half of the decade and helped considerably to increase total R&D expenditure in Germany.

However, it is very difficult to compare the research efforts made by public research institutions and the higher education sector on the one hand and by industry on the other. The research efforts of industry are primarily focused on market-oriented development. According to informal estimates, industry invests only approximately 5 per cent of its research expenditure in basic research.

In Germany's manufacturing sector, every third company pursues its own research and development activities (38 per cent in 1998). Over half of these companies perform R&D continuously, while the remainder tend to do so occasionally. Some industries are particularly active in R&D: the chemical industry, the mechanical engineering industry, and the medical engineering, as well as the measuring and control engineering industries. In these industries, more than 50 per cent of the companies are involved in research.

In the service sector, on the other hand, research is by far not as important as it is in the manufacturing industry. Only one in every ten companies states that it performs research and development activities. R&D is particularly widespread among engineering service providers (30 per cent). IT and telecommunications companies are also relatively active in R&D (17 per cent), while only one in every 20 distributive service providers (trade and transport) participates in the research process.

Not surprisingly, the R&D commitment increases with a company's size. In the manufacturing industry, 80 per cent of the large-scale companies conduct research. And in the services sector, research is performed by 38 per cent of the large-scale companies, which is over four times the rate of small and medium-sized enterprises.

2.10 Extramural industrial research institutions in the new *Länder*

Extramural industrial research institutions provide market-oriented and customer-focused research and development services and findings. On behalf of manufacturing companies or other research institutions, they either provide R&D services or they directly implement R&D projects for clients, which is generally only possible if they have done their own pre-competitive research in scientific and technological fields and if they possess R&D know-how, which they usually obtain from participating in publicly funded R&D projects. In addition, they have to be in close contact with customers and the market. Some of the extramural industrial research institutions are the result of a transformation of research departments of companies in the former GDR. They have not been integrated into the R&D institutions that receive basic funding; instead, they operate as independent legal entities under private law.

The fact that considerable progress has already been made in the development of an industrial R&D infrastructure in Eastern Germany is largely due to the roughly 300 external industrial research institutions and R&D service providers in the new *Länder*. They were able to expand economically and achieve high growth rates in terms of production, turnover and patent yield.

2.11 Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e.V.) (AiF – German Federation of Industrial Co-operative Research Associations) and institutions for co-operative industrial research and experimental development

Small and medium-sized enterprises need research concepts that continuously broaden their industry-specific knowledge, increase the efficiency of their processes and furnish ideas to specific companies for the development of new products or services. However, many SMEs cannot afford to pursue their own research activities. For this reason, approximately 50,000 businesses – most of them small and medium-sized enterprises – have established a total of 107 industry-related or technology-focused research associations, which in turn established an umbrella organisation in 1954, the Arbeitsgemeinschaft industrieller Forschungsvereinigungen (AiF – German Federation of Industrial Co-operative Research Associations).

The primary function of the AiF is to co-ordinate co-operative industrial research which is financed from funds of the Federal Ministry of Economics and Technology (BMWi) and which supports the industry's own efforts in the field of research and technology, thus helping industry to help itself.

The co-operative industrial research organised by the AiF provides strategic services to deal with SME research issues that cover the entire spectrum of a given industry or field of technology. In the AiF research associations, representatives of the member enterprises define pre-competitive research projects in direct contact with research institutions; these include over 800 primarily industry-run research institutes, institutes associated with universities or other non-university research institutions, as well as a large number of university institutes. During the entire project implementation period, the researchers can discuss questions with "project-supporting committees", whose members are practitioners. This participation of the representatives of small and medium-sized enterprises ensures that SME interests will be safeguarded, and it guarantees that the findings will be rapidly translated into practice. The research findings are published, and they are available to all interested enterprises. This mode of operation has led to the development of an efficient and sophisticated collaborative network.

In addition to co-ordinating co-operative industrial research, the AiF is also the project managing agency for programmes designed to promote innovation. In this capacity, the AiF has also been in charge of the BMBF's programme for the promotion of application-oriented research and development at Universities of Applied Sciences. This programme was introduced in 1996.

3. Players funding and promoting R&D in Germany

3.1 The Federal Government and the *Länder* governments

The federative system of the Federal Republic of Germany enables both the Federal Government and the *Länder* governments to fund and promote German research in their respective fields of responsibility. Under Art. 91 b of the Basic Law, both may co-operate in the promotion of scientific research institutions and projects of supraregional importance. This is in line with the Federal Government's and the *Länder* governments' joint responsibility for research, which in many cases calls for co-ordinated action in the interest of the nation as a whole.

The Federal Government and the *Länder* governments have developed the instruments required for this purpose. The Federal/*Länder* Commission for Educational Planning and Research Promotion (BLK) provides a permanent forum for discussing and co-ordinating all research promotion issues that affect the Federal Government and the *Länder* governments. The substance and the forms of co-operation between the Federal Government and the *Länder* governments in the field of research promotion were laid down in detail in the 1975 "Skeleton Agreement between the Federal and *Länder* Governments on the Joint Promotion of Research Pursuant to Article 91 b of the Basic Law".

Many of the key players in Germany's research landscape – such as the Deutsche Forschungsgemeinschaft (DFG), the Centres of the Hermann von Helmholtz Association (HGF), the Max Planck Society (MPG), the Fraunhofer Society (FhG), and the "Blue List" institutions that have joined the Gottfried Wilhelm Leibniz Science Association (WGL) – are jointly funded by the Federal Government and the *Länder* governments. Despite varying regional interests, Germany has created a research system that is efficient – also from an overall national perspective – owing to the co-operation between the Federal Government and the *Länder* governments. This explicitly also applies to the *Länder* in the eastern part of Germany.

In 1999, the Federal and the *Länder* governments spent a total of DM 31.6 billion on R&D.

3.2 The business enterprise sector

The business enterprise sector is the most important source of funding for German research. In 1999, German business enterprises spent a total of DM 60.7 billion on R&D, which was nearly two-thirds of the total R&D expenditure in that year. Most of the funds spent by industry were invested in development projects.

In the past ten years, industry has increasingly conducted R&D together with partners in science and industry and has reduced the share of intramural R&D activities. Today, one out of every ten deutschmarks spent on R&D is paid to extramural partners, either in the framework of co-operative ventures or contract research. More and more large-scale companies, in particular, award R&D contracts to third parties. In addition, there are other developments such as the partial spinning-out of R&D departments or the establishment of joint ventures with competitors, customers or suppliers to implement R&D. All of these trends lead to an increase in extramural R&D expenditure.

Two-thirds of the money paid by business enterprises for R&D to third parties remains within German industry, while one-sixth is paid to scientific institutions. In addition, R&D contracts awarded to, and co-operative ventures concluded with, partners abroad have increased considerably: Today, one out of every five deutschmarks spent on extramural R&D is paid to partners abroad, which means that this share of R&D spending has doubled since the mid-1980s. This trend is a reflection of the growing internationalisation of research and development. Subsidiaries of foreign companies today account for roughly one-sixth of the total R&D expenditure of industry. Hence, it is hard to imagine the German research landscape without foreign companies as a source of funding for research in Germany.

3.3 The European Union

The framework research programmes managed by the European Commission are playing an increasingly important role within the system of R&D-funding players. The EU's Fifth RTD Framework Programme, which extends from 1999 to 2003, has a total volume of 14.96 billion, of which approximately DM 1.3 billion annually flows into the German research system. This means that, overall, European funding accounts for only about 4 per cent of public research funding in Germany. However, if one compares the EU's priority funding areas with national project funding volumes in the areas concerned, then European funding accounts for much greater shares of the total funding volumes (e.g. some 10 per cent in biotechnology and up to 20 per cent in information technology). Above and beyond these purely financial aspects, the European research programmes have played a key role in the development of science and research networks in Europe; they have thus made a major contribution to developing a globally visible profile for the European research landscape.

In addition, COST (Coopération européenne dans le domaine de la recherche scientifique et technique – European Co-operation in the Field of Scientific and Technical Research) and EUREKA (Initiative for stronger technological co-operation in Europe) are two collaborative mechanisms that provide a framework for co-operative ventures between research institutions and business enterprises in Europe without any direct project funding. These systems of co-operation, which are exclusively driven by the interests of science and industry, are perfect add-ons that augment the European Framework Programmes in variable geometry.

SOCRATES (schools/universities) and LEONARDO (vocational education), the EU's educational programmes, which have a total volume of 3 billion and extend from 2000 to 2006, include not only extensive exchange activities but also – and more importantly – transnational projects designed to improve the quality of the educational systems. This also includes funding for transnational networks in the fields of higher education and vocational education research. For the first time, the programmes include explicit provisions permitting joint implementation of projects with the EU's Framework Programme on Research.

3.4 The Deutsche Forschungsgemeinschaft (DFG)

The Deutsche Forschungsgemeinschaft (DFG) is the most important funding organisation for university research. In the year 2000, the DFG's resources from public funds amounted to a total of over DM 2.28 billion (for the individual grants programme, the ratio of federal to *Länder* funds is 50:50).

The DFG makes it possible to carry out research projects that could not be implemented with the basic funding of the universities alone. In a difficult environment, the DFG provides a variety of incentives to develop and selectively preserve research-oriented structures in higher education institutions. Many of the DFG's activities are considered to be exemplary in an international comparison. They play an eminently important role not only for the efficiency of knowledge-oriented basic research that is not focused on specific applications but for all forms and fields of research in Germany because the DFG is responsible for all disciplines and fields of knowledge.

The funding decisions taken by the DFG enjoy a high level of acceptance within the German science system. They have become an irreplaceable instrument in a quality-oriented, achievement-stimulating competition for external funds, especially in the higher education sector. The only condition that research projects must fulfil in order to qualify for funding from the DFG is their scientific quality, which must be proven beyond any doubt in an appraisal process independently developed by the DFG itself. Today, more than ever before, positive funding decisions by the DFG are therefore regarded as a seal of quality that makes these decisions important irrespective of the amount of funding granted.

3.5 Foundations

The major science-promoting foundations are making a valuable contribution towards safeguarding the quality of research in Germany.

The foundations complement public research funding and are an expression of private financial commitment. The donors are thus setting an example of responsible action in a democratic state because the state cannot on its own assume all functions, meet all requirements and cope with all challenges.

The purpose of the recent amendment to Germany's tax law provisions for foundations has been to provide stronger tax incentives for potential donors and to improve the instruments that are designed to preserve – on a long-term basis – the foundations' ability to fund activities. With this amendment, the Federal Government wanted to support and strengthen foundations, facilitate the establishment of new foundations and create a positive environment for foundations.

The Donors' Association for the Promotion of Sciences and Humanities (Stifterverband für die Deutsche Wissenschaft e.V.) is an example of a concerted action of industry to promote German science and research. At the end of 1999, the Association managed a total of 279 foundations and endowment funds under its umbrella. However, there are also other large German foundations – such as the Volkswagen Foundation, the Thyssen Foundation, the Robert Bosch Foundation, the German Foundation for the Environment and the Bertelsmann Foundation – which sponsor projects or institutions from a wide variety of different fields of science.

The eleven organisations for the promotion of young talent, which are financed exclusively from federal funds, play a particularly important role in the German system of foundations because of the grants and scholarships that they provide to undergraduate students and PhD candidates. The diversity of their funding organisations reflects the pluralism of German society. What all the organisations for the promotion of young talent have in common is their sense of responsibility both vis-à-vis talented individuals and vis-à-vis Germany's liberal democratic society as a whole, which would not be viable without functional elites.

The purpose of the Alexander von Humboldt Foundation (AvH), which is also primarily financed from federal funds, is to enable highly qualified postdoctoral foreign scientists to conduct long-term research projects in Germany, and conversely, to enable German scientists to conduct research abroad at institutes of foreign scientists who are former participants of the Humboldt programme in Germany.

3.6 Deutscher Akademischer Austauschdienst (DAAD – German Academic Exchange Service)

The DAAD is an institution jointly run by the German universities, which is primarily financed by the Federal Government. The task of the DAAD is to promote relations with higher education institutions abroad, primarily by exchanging students and scientists. The DAAD's exchange programme for scientists is a reciprocal programme that is based on cultural agreements concluded by the Federal Government or on separate bilateral agreements concluded by the DAAD with partner organisations abroad. One of the DAAD's key funding principles is "individuals take precedence over projects". The purpose of the mobility cost allowances paid by the DAAD is to enable young scientists to gather experience abroad and to internationalise ongoing research projects, because the above principle does not rule out that the grants provided to individuals are integrated into overriding project-related objectives such as the bilateral exchange of scientists.

4. Governmental funding instruments

The Federal Government has a number of different instruments at its disposal to fund research and development. The German research system is financed both through target-oriented short or medium-term funding (project funding) and through medium or long-term basic or core funding of institutions.

4.1 Project funding

Project funding is invariably provided – especially when funds of the BMBF or the BMWi are involved – in the framework of general or specialised funding programmes, and always on the basis of applications for fixed-term projects. Direct project funding is always provided for a given concrete field of research. The purpose of this funding is to achieve an internationally high level of performance in selected areas of research and development.

The purpose of indirect project funding is to support not only qualified research institutions and individual scientists but also – and more importantly – small and medium-sized enterprises in their efforts to become active in research and development. The funding is not focused on a specific research topic; instead, it is designed to strengthen and develop the personnel platform and, where necessary, the required research infrastructure; it also aims to support co-operation among research institutions, among business enterprises, or between industry and science, and the exchange of personnel.

Most research and development projects that receive project funding are scientifically, technically and administratively supported by so-called project managing agencies, in particular when it comes to giving advice to applicants, preparing decisions on funding, handling projects and ensuring efficiency control. The Federal Government has granted loans to various project managing agencies. These agencies are authorised not only to prepare funding decisions but also to take such decisions themselves within the framework of certain specified technical requirements.

Generally speaking, it is possible to finance both individual projects and collaborative projects that are conducted jointly with several equal partners who work together closely in the framework of a co-operation agreement.

One particular form of project funding is the support of competence networks. A competitive process is used in this context to identify and promote innovation clusters whose players co-operate with each other across various industries, technologies and parts of the value chain in order to find a common solution to a given problem. The BioRegio competition was followed by competitions for centres of excellence in nanotechnology, competence networks for medicine and centres of excellence for medical technology, and the InnoRegio competition among regions not related to any specific topic. In this context, mention should also be made of the BMWi's Promotion of Innovative Networks (InnoNet) Programme, which is used to support the development of research networks between small and medium-sized enterprises on the one hand and research institutions on the other.

Another strategically important instrument of the BMBF is the funding of so-called lead projects as a new type of collaborative project. The BMBF publicly announces such funding schemes by way of calls for tenders. Within the framework of predetermined topics, the participants choose their own concrete assignments. Juries of independent experts then apply a two-tier process to select the best ideas and the most promising approaches from this competition of ideas.

INFO-BOX
LEAD PROJECTS

Lead projects are a new instrument of governmental research promotion that is used to translate pioneering ideas in strategically important fields more rapidly into marketable products, processes and services.

The success of such projects results from the principle of selecting only those projects where business enterprises and universities, research institutions and users co-operate very closely in cross-sectoral and interdisciplinary networks to develop problem solutions. Both industry and users are directly involved in the research process and the translation of its findings into practice. Lead projects deal with topics that are particularly relevant for society:

- The development of innovative products and associated production processes on the basis of new technologies;
- The use of globally available knowledge for initial and continuing education and training, and for innovation processes;
- Using the resources of molecular medicine for diagnosis and treatment;
- Mobility in conurbations: energy generation and energy storage for decentralised and mobile use;
- Man/technology interactions in the knowledge society;
- Nutrition: modern food production methods.

4.2 Basic funding of institutions

The basic (or statutory) funding provided to institutions is not earmarked for specific research projects; instead, these funds are granted by the Federal Government (or jointly with *Länder* governments) over a longer period of time to support research institutions as a whole. The purpose of this funding is to safeguard the expertise and the strategic orientation of the German research system. Major examples are grants-in-aid provided by the Federal and *Länder* governments in the framework of their joint promotion of research under Article 91 b of the Basic Law.

The institutions funded jointly by the Federal and *Länder* governments pursuant to Article 91 b of the Basic Law must be flexible enough to adapt to changing priorities in terms of the scope of their resources and the focus on specific topics. This flexibility must not be hampered by co-ordination processes of public grant donors.

The provision of basic funding to institutions is associated with stringent requirements and strict accountability. In the absence of concrete requirements with regard to the utilisation of research findings, the general requirements to be met by the funded institutions in their activity reports on the past fiscal year make it possible to monitor the utilisation of findings.

5. Quality assurance

Research requires internal and external quality assurance. Governmental funding activities – in particular those of the BMBF and the BMWi – are subject to various quality assurance measures. This applies not only to funding provided to support research, development and innovation projects but also to the basic funding of research institutions as a whole.

Quality assurance measures that have proven to be effective include in particular the assessment of the chances of success of a project prior to the funding decision, as well as continuous monitoring during the funding period by means of interim assessments, status seminars, etc., and finally, the assessment of the results after the completion of the project. A new requirement which was recently introduced is the obligation to prepare and update a so-called utilisation plan to ensure that the know-how obtained with tax money is actually put to use.

As of the year 2000, a special controlling system will be developed for the programmes of the BMBF in order to determine the programme implementation status on a regular basis, to evaluate the results already achieved and to use them as a basis for future decisions (programme monitoring). The reviews that the BMBF has already been carrying out for a long time in its various funding and innovation areas will be complemented by funding audits. These audits will then lead to a systematic evaluation of all funding programmes and priorities of the BMBF. The purpose of these quality assurance measures is to make the orientation towards quality standards and the competition for the best way to reach a goal an everyday work assignment in the German science and research system.

In addition, the research landscape and its forms of organisation are assessed in the framework of external system evaluation exercises. While the evaluation reports on the FhG as well as the DFG and the MPG were already submitted in 1999, the reports on all "Blue List" institutes and on the HGF will be completed in the year 2000.

Furthermore, a committee of independent experts working on behalf of the BMWi will evaluate the industry's integrated research-promoting activities as of autumn 2000 in order to adapt the BMWi's funding system to the future requirements of small and medium-sized enterprises, and at the same time, to make this funding system more consistent. The evaluation will be based on the findings obtained by working groups that were set up to look into the improved application of research findings. These working groups also involved the participation of the AiF, the Bundesanstalt für Materialforschung und –prüfung (BAM – Federal Institute of Materials Research and Testing), the Physikalisch-Technische Bundesanstalt (PTB – Federal Institute of Physics and Metrology), the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources) and extramural industrial research institutions.

6. Achievements

6.1 Innovation

A major yardstick to measure the success of German research is industry's capacity for innovation, because new research findings will only add economic value if they can be translated into successful innovations in the market.

Relative to their international competitors, German business enterprises perform quite well in terms of innovative capacity. With 4.5 per cent of turnover spent on innovations in the manufacturing sector (and 2.0 per cent in the services sector), German companies are in the very top group.

In addition, a relatively large number of companies are involved in innovations in Germany: 66 per cent of the companies in the manufacturing sector and 58 per cent of the service businesses can be described as innovative. Small and medium-sized enterprises are also involved in innovations on a large scale.

However, not all innovative enterprises also conduct research and development activities of their own. In many cases, production processes are made more efficient simply by purchasing components from third parties, or new products are introduced in the market by imitating or slightly modifying products of competitors. The introduction or optimisation of information technology is a particularly important vehicle for innovations, especially in the services sector. In the manufacturing sector, nearly two out of three innovative companies also pursue their own research and development activities, while this is true of not even one in five companies in the services sector.

6.2 Patents and licences

Along with the scientific value and the knowledge acquired, the primary objective of German research is to make the most effective and efficient commercial use of research and development results that have often been obtained with considerable expense in terms of financial and human resources.

To this end, it is necessary – both in non-university research and in the higher education sector – to develop and maintain efficient units that obtain patents for inventions made to the extent that this makes economic sense, thereby enabling the institution concerned to permit companies to use these research findings commercially, e.g. by granting licences. In addition to the macroeconomic benefit achieved by this transfer process, the royalties earned by institutions that successfully market their inventions help to provide a personal incentive for the inventors and to finance additional research efforts.

The examples of the Helmholtz Association and the Fraunhofer Society illustrate the scale of these activities. With a total of 477 domestic patent applications in 1998, all the HGF Centres taken together would rank sixth on the list of the top 50 patent applicants, which is published annually by the Deutsches Patent- und Markenamt (German Patent and Trade Mark Office). The HGF Centres are followed by the FhG, which ranks seventh with 417 patent applications. There is no comparable collection of statistical data on inventions in the higher education sector. However, in many segments of university research, there is still considerable untapped potential for patents, and this potential needs to be activated.

Info-Box
The BMBF's patent initiative

Patenting and promoting patents are strategic challenges for the BMBF. Patents play a key role in the innovation process, not only as an instrument to protect inventions but also as a source of information for the planning and implementation of R&D. Owing to the BMBF's patent initiative, which was launched in 1996, patents have become a subject of discussion – in particular in the field of publicly financed research, in small and medium-sized enterprises, and in the public at large. By means of systematic measures and funding schemes, the BMBF stimulates and supports the development of patent and patent exploitation expertise.

In the field of public research and research promotion, the recipients of public funding are expected and encouraged to assume responsibility for their own patent and exploitation management. Wherever possible, research findings have to be commercially utilised; in order to give an incentive to the grant recipients, they are allowed to keep all proceeds from the exploitation of patents. At the time when they file their applications, they already have to submit a plan for the utilisation of their patents – initially in the form of an outline, which subsequently will become more and more detailed.

In the framework of its SME patent initiative, the BMBF supports the first patent application of an SME or a start-up business. By filing their first patent application, patent novices acquire experience in dealing with the patents system and learn about its benefits. Nearly 2,000 applicants have already taken advantage of this service; every month, over 40 new applicants make effective use of patents for the first time.

INSTI – the innovation network built up by the BMBF – operates over 30 contact points across Germany which provide patent and innovation advice and services.

The Patent Agency for German Research, which is attached to the Fraunhofer Society in Munich, helps inventors with a special set of supporting services (assistance in the filing of patent applications and the exploitation of inventions with promising market prospects by providing loans and practical help for exploitation).

The Innovation Market is a new web-based instrument for the exploitation of top inventions which is being developed and implemented by the BMBF in co-operation with the Deutsche Börse (German Stock Exchange) and the Kreditanstalt für Wiederaufbau (KfW – Reconstruction Loan Corporation) (www.venture-management-services.de/innovation). The BMBF supports the participation of enterprises in the Innovation Market by providing grants for evaluation contracts in the framework of its INSTI exploitation initiative.

Patent novices and other interested parties can retrieve introductory information from the BMBF's patent server in the Internet (www.patente.bmbf.de).

6.3 Business spin-offs and start-ups

Very often, new technologies are launched by start-up businesses. In addition, innovative business start-ups enjoy above-average growth rates and are particularly effective in creating new jobs.

The vast majority of the roughly 14,000 annual business start-ups in technology-oriented and knowledge-based industries can be more or less attributed to the higher education sector. With a total of approximately 180 business start-ups annually, however, non-university research institutions also make a major contribution towards creating high-quality jobs.

In their first year of operation, the five regional networks that are funded by the BMBF in the framework of its EXIST – Business Start-ups from Universities Programme have supported or initiated over 150 business start-ups; most of them are knowledge-based or technology-oriented businesses.

As early as the 1980s, a very closely-knit network of various types of transfer agencies was built up at German universities and *Fachhochschulen* (Universities of Applied Sciences). These agencies provide a wide range of services, including systematic public relations activities, marketing of research findings, and coaching for business start-ups. Technology transfer agencies are an integral part of the EXIST networks; some of them play the role of the "spider in the web".

6.4 Science and research prizes

The quality of German research can also be measured in terms of the prestigious prizes that members of the research community have won in the past few years.

The German Future Prize which is awarded by the Federal President is one of the most important science awards. The most important German award for the best junior scientists is the Heinz Maier Leibniz Prize, which was introduced in 1977 and is awarded annually by the Federal Minister of Education and Research and the president of the Deutsche Forschungsgemeinschaft (DFG) to six post-doctoral junior scientists, each of whom receives prize money amounting to DM 30,000. Another prize that is also awarded once a year by a selection committee appointed by the German University Rectors' Conference (HRK) is the Prize for Outstanding Achievements in International University Co-operation. A prize of DM 20,000 is awarded to university teachers or student associations that have rendered outstanding services by promoting the international relations of higher education institutions, improving opportunities to attend university courses and furthering the integration of foreign students. Since 1990, the Alexander von Humboldt Foundation and the Max Planck Society have jointly awarded the Max Planck Research Prizes for International Co-operation. These prizes, which have been donated by the BMBF, are awarded to a total of twelve scientists from any discipline or nation for particularly outstanding, internationally recognised scientific achievements. The maximum prize money per year and per prize winner amounts to DM 250,000.

7. Strategic planning

7.1 Responsibility of research institutions in the German research landscape

In the field of basic funding of institutions, it is important to pursue a strategy that will enable the institutions and science organisations funded by the Federal and *Länder* governments to optimise their efficiency through interaction. The efficiency is measured in terms of the objectives attained relative to a given specific research assignment and to the international state of the art.

The German research institutions have a high degree of responsibility for their future-oriented research strategy: The standards for basic research at universities and for the research activities of the MPG and comparable "Blue List" institutions are set by the international scientific community. Criteria for the assessment of research include the quality and quantity of junior scientists trained, scientific publications, invitations to attend scientific events and award ceremonies, (Nobel) prizes, or the conferment of chairmanships and memberships of scientific boards. For the FhG, institutes of industry and Universities of Applied Sciences, the proof of their efficiency is the exploitability of, and the demand for, their research findings in industry, the awarding of research contracts and the willingness of industry to provide funding (third-party funds). The yardstick for the scientific success of Centres of the Helmholtz Association and "Blue List" institutions, which deal with similar research topics, is defined by government and society in the framework of their responsibility to make provisions for the future, by industry in key technologies, and by science in the field of basic research requiring large-scale equipment.

Furthermore, the contributions that all research institutions make to Germany's economic development and to the creation of jobs are playing an increasingly important role in the assessment of their activities.

The structures of the research scene – as well as the decision-making processes which determine the research priorities of the various research institutions – have to be compatible with these challenges.

7.2 The Science Council

As early as 1957, the Federal and *Länder* governments established the Science Council as a political forum to discuss questions relating to science and research. With its recommendations and statements, the Science Council – which is financed by the Federal Government and the *Länder* governments on a 50:50 basis – makes major contributions towards Federal and *Länder* government decisions on fundamental educational and research policy issues. As a body created for policy deliberations, the Science Council expresses its views on substantive and structural developments of the higher education sector, science and research, as well as on the construction of universities. At the request of the Federal Government and *Länder* governments, the Science Council also draws up expert reports on specific institutions, developments and planning processes. This applies both to universities and non-university institutions. At present, the Science Council is preparing a report on the German science and research system.

7.3 FUTUR: A dialogue about the future

Publicly funded research requires strategic planning. Visions of the future of politics, industry and research play an important role within the framework of strategic planning. These visions deal with ways of protecting the country's future competitiveness, safeguarding and creating jobs, and generally speaking, with matters relating to research, education and training.

Delphi '98 – a study conducted to identify global trends in science and technology – was presented to the public in February 1998. Over 2,000 experts from companies, service businesses and public authorities, universities and non-university research institutions expressed their views about 1,070 specific trends expected for the next 30 years in twelve subject areas. Based on this experience and the findings of this survey, the BMBF has developed a new strategic approach that is broader than the original Delphi process.

With FUTUR – Jointly Shaping the Future, the BMBF wants to initiate a strategic dialogue about the future, primarily in order to obtain more reliable information as a decision-making basis for the promotion of innovation, new application-oriented programmes in education and research, and new projects.

To this effect, the BMBF established an Internet platform in mid-1999 in order to stimulate an exchange of ideas, views and knowledge about the future. FUTUR is addressed to experts and the public at large and aims at bringing together their knowledge and their expertise. The key objective is something that has been postulated for a long time: a dialogue involving the science and the business communities as well as all citizens who want to participate in shaping our future. Through this dialogue, these three groups should come to an understanding amongst themselves with regard to common visions and ways to implement these visions.

7.4 Development of indicators

Indicators are developed at both national and international level in order to be able to monitor developments in the research landscape and to make the effects of general policy decisions visible. Indicators make it possible to make comparisons over time and across national borders. In order to ensure that national data are comparable at international level, it is very important that the OECD and the EU co-operate closely, for instance, when it comes to agreeing on common definitions or comparable methods of data collection. These efforts manifest themselves in a variety of handbooks on research and development, innovation, human capital in science and technology and other topics. This year, the participants of the

Lisbon summit suggested that indicators should be developed that are suitable for the presentation of a single European research area.

For purposes of assessing German research in an international comparison, there are already accepted indicators – such as R&D expenditure and R&D personnel – which, when broken down into the three sectors of business enterprises, higher education and non-university research institutions (government), also provide more detailed information about the research landscape. However, it is necessary to develop indicators for the output side, which currently is not sufficiently well portrayed by the number of patents or scientific publications. More information is also needed with regard to indicators on the relationship between input and output in the German research exercise. In Germany, efforts are being made to improve the collection of data on R&D activities in the service sector, which is not yet satisfactory. One issue of great concern at international level, for instance, is the impact of globalisation on R&D.

In addition to the core area – which is measuring R&D indicators – information is also collected about the innovation activities of business enterprises. The collection of national data is incorporated into the EU-wide innovation survey. Another national activity in this context is the annual publication of a study on technological performance, which contains not only data and indicators describing Germany's status and prospects in terms of technological performance but also an analysis of the strengths and weaknesses of the German innovation system, also relative to other countries.

7.5 International co-operation and alliances

In the age of globalisation, international co-operation of German research institutions is not only one of the most important but also one of the most dynamic areas of science, research and technology policies.

Today, "internationalisation" is something that concerns all players in the German research system and that helps to integrate German universities, research institutions and companies that perform research into a global network of efficient partners.

Given that today over 80 per cent of the new technological know-how generated globally is produced outside Germany, German research should pro-actively participate in the global innovation process by becoming involved in foreign centres of excellence (e.g. through collaborative R&D projects or through physical presence on site). There are three closely interconnected "levels of action" that encompass the vast number of players, fields of action and instruments of international co-operation:

- Bilateral relations with European and non-European countries: German research institutions currently practise various types of scientific and technical co-operation with over 40 countries.
- European co-operation, in particular among EU countries but also going beyond the EU: The EU's Fifth RTD Framework Programme does not replace national research efforts; it rather reinforces them by adding the European networking component. In the course of the first three years of the Fourth Framework Programme alone, the EU activities led to approximately 112,000 co-operative links between a wide variety of players primarily in Europe, but also with non-European partners. In addition, EUREKA and COST provide a framework for co-operation, also for non-EU countries. The same applies, for instance, to ESA or CERN, the European Science Foundation (ESF) or INTAS, the International Association for the Promotion of Co-operation with Scientists from the Independent States of the Former Soviet Union.
- Co-operation within the framework of international and multilateral organisations: One important case in point is the OECD with its Committee for Scientific and Technological Policy (CSTP).

There is considerable overlapping and also a variety of cross-links between these "levels". German research is integrated into a closely knit international network that safeguards its efficiency. Increasing the density of this network while continuing the internationalisation of German research is a top-priority political objective.

8. Marketing

8.1 The BMBF's public relations activities

The Federal Ministry of Education and Research pursues a wide range of objectives with its public relations activities.

The ministry wants to make its objectives and priority work areas transparent and understandable for the public at large. Citizens can request a large number of publications (currently well over 100) from the BMBF, either in printed or in electronic form. In addition, the BMBF provides easily comprehensible information on topical issues in the fields of research and education. And the Report of the Federal Government on Research which is published every four years in compliance with a 1976 mandate from the German Bundestag, is itself an important element of the Ministry's public relations work.

Of course, the ministry also answers inquiries made by telephone, letter or e-mail. Citizens are given qualified information, and where necessary, they are referred to other institutions for further information.

More specialised technical information is provided to an expert audience. The ministry's research funding programmes are presented in brochures and in the Internet in a user-friendly manner and are edited in such a way that they make it easier for interested business enterprises and institutions to obtain access to funds and assistance.

The BMBF is also present with its own information booths at many major national and international trade fairs and exhibitions (CeBIT, Hanover Industrial Fair, International Radio Show, Interschul, didacta, medica, ACHEMA, etc.) in order to be directly available on site for the trade visitors who attend these events.

In addition, other federal ministries and research and scientific institutions also publish information on their own research and work priorities in the framework of their own public relations activities.

INFO-BOX

THE BMBF'S WEBSITE : WWW.BMBF.DE

The BMBF attaches great importance to the electronic media, in particular the Internet. This is also reflected by the BMBF's website. The ministry has gone to great lengths to improve and optimise its website. In 2000, the website was completely revamped to make it more appealing and more user-friendly. Some of the highlights are listed below:

- All funding programmes currently available in the fields of research and education are listed in a clearly structured form, they are easy to search, and the website contains references to additional information – including electronic application forms for funding.
- The website is an important instrument for interested parties from the science and research communities, from business enterprises and institutions who are looking for innovation funding.
- The BMBF's vision is to use the Internet not only as an information and communication medium but to achieve genuine interactivity, e.g. by means of virtual worlds.

In addition, the range of available information is supplemented by a large number of other websites that are grouped around the BMBF's homepage, e.g. websites of project managing agencies of the BMBF and websites that have emerged from funded projects.

INFO-BOX

RESEARCH REPORTING

The Report of the Federal Government on Research is a comprehensive account of research activities in Germany which the Federal Government submits to the German Bundestag every four years. The report describes the research and technology policies pursued by the Federal Government, and it provides information about the promotion of research and technology, research resources in an international comparison, international co-operation in the field of research and technology, and the diversity of the German research landscape's institutional structure. In a separate part of the Report, the *Länder* present their own research and technology policies.

Two years after its publication, the Report is followed by Facts and Figures, an update of the Federal Government's Report on Research.

The last two reports that have been published are:

- the 1996 Report of the Federal Government on Research,
- Facts and Figures 1998.

Abridged versions of the reports are published in English.

8.2 International marketing of Germany as an R&D location

The particular strengths of the German science system are the excellence of scientific research, the broad spectrum of the research landscape, and the variety of functions performed by Germany's science organisations and research institutions. However, the international marketing of Germany as an attractive location for science and the German industrial settlement policy tend to be rather weak.

For this reason the BMBF commissioned a study in late 1999 that was designed to take stock of the activities pursued by German agencies to market Germany as a site for R&D and to present successful examples of such activities in other countries.

The BMBF has developed an Internet platform called kompetenznetze.de (see Infobox), which has made an important contribution to these marketing efforts because efficient competence networks safeguard Germany's competitiveness at the international level. So it is all the more important to make these clusters internationally visible. "kompetenznetze.de" is a platform that presents Germany's most attractive networks to the world at large – a platform that serves parties interested in co-operation as a guide to innovation, investment, and education activities.

For the *Länder*, an active research policy also helps to attract businesses to settle in their regions. The creation of an attractive research infrastructure and the presentation of the *Länder*'s own efficiency and their particular areas of expertise play a very important role in their regional marketing efforts. A wide variety of actions are conceivable. The *Länder* can choose from a broad range of instruments to promote research and technology, including the establishment of venture capital companies that are geared to meet regional needs, and the implementation of PR activities that lead to the establishment of offices representing a given region abroad.

Info-Box
The BMBF's on-line platform: kompetenznetze.de

kompetenznetze.de is
- an instrument for marketing Germany internationally as a site for science and research by presenting Germany's most competent networks,
- an attractive source of information and a communication platform for seekers of information and co-operation from Germany and abroad.

kompetenznetze.de was developed for
- investors and start-up businesses looking for a suitable location,
- scientists and students,
- key persons from the areas of corporate planning, politics and administration who are looking for co-operation partners, and the media.

Competence networks
- are focused on a specific topic,
- are collaborative associations of several capable partners that are concentrated in a given region but whose activities go beyond the boundaries of their region,
- are characterised by close interaction and intensive communication among the players involved,
- are embedded in a general setting that stimulates innovation,
- cover several parts of the value chain (vertical networking, including initial and further training), different sectors of industry and various disciplines (horizontal networking),
- are capable of generating innovations that are in the vanguard of progress worldwide and that can add substantial value.

For more information, please visit www.kompetenznetze.de.

8.3 Germany's attractiveness as a location for higher education

In order to strengthen Germany's competitiveness as a site for university studies, a wide range of activities and measures have been developed in the past few years to make Germany more attractive again for foreign students and scholars. Lectures held in foreign languages and internationally oriented courses of study as well as co-operation with a growing number of universities in other countries have given a fresh impetus to the internationalisation of research, teaching and studies in Germany. New ways of organising courses of study – e.g. due to the introduction of international university degrees such as bachelor's and master's degrees– and a new credit system to rate the individual's performance facilitate mobility and the mutual recognition of study periods spent in other countries. Owing to the DAAD's programmes, it was possible to attract qualified foreign university lecturers and assistant professors to spend some time at German universities. Amendments made to German aliens laws have improved the general conditions for foreign students and scholars in Germany.

In order to improve the marketing for Germany as a place for university studies and scientific research, the Federal and *Länder* governments and the universities have launched other web-based initiatives. Studien- und Berufswahl online (Study Opportunities and Career Choice On-line) is a website managed by the BLK and the BfA, providing up-to-date information in English about study opportunities in Germany. The German educational server of the Federal and *Länder* governments will make co-ordinated web-based information on Germany as a provider of education and training available to a broad national and international public.

The DAAD and the HRK are also responsible for increasing the range of information available in the Internet on study and research opportunities and funding options in Germany. The HRK's Hochschulkompass (higher education compass) provides data and information about Germany's higher education institutions, describes undergraduate and postgraduate courses, and supplies details about the over 12,000 international co-operation agreements concluded by German universities. On behalf of the BMBF, the DAAD has strengthened its presence at educational fairs and exhibitions; in 1999, it was represented at a total of 40 fairs. Furthermore, advertising activities in foreign countries will be improved, also by using the services of university lecturers and long-term assistant professors of the DAAD and by building up a network of alumni.

8.4 The science dialogue

The science and research communities will have to intensify their dialogue with society and industry in order to live up to their important responsibility of strengthening the capacity for innovation, creating jobs and preserving the cultural identity of Germany. It is not only the politicians who bear responsibility in this area, but it is first and foremost researchers and research institutions that will have to become more active at all levels in advocating and promoting the understanding of science and technology. An important step in this direction was taken in May 1999, when the research organisations and the Stifterverband für die deutsche Wissenschaft (Donors' Association for the Promotion of Sciences and Humanities in Germany) signed the memorandum on Public Understanding of Science and the Humanities (PUSH) – a science dialogue.

Based on this initiative of May 1999, the BMBF has launched its nationwide Science Dialogue initiative which was developed in collaboration with the large research organisations in order to intensify the dialogue between the science community and society. In 2000, this initiative which will extend over several years started out with the Year of Physics. In addition to five major events, various other activities and experiments connected with the Year of Physics are being carried out very successfully at universities, research institutions and schools across Germany. In 2001, the initiative will highlight the life sciences and in 2002 the geosciences.

9. The general setting

9.1 The legal framework

Safeguarding German research is a challenge for government and society alike. In this context, the legal framework has a major impact on the various players' scope for action. The purpose of legal control in the field of research is not only to prevent unacceptable hazards and risks for the public at large and to foster efficient structures, but also to avoid over-regulation. At the same time, technological progress calls for the creation of a positive legal environment to allow new opportunities to develop and be seized, and to facilitate, stimulate and promote innovation by means of legislation. Against this background, the role of government is not so much that of a regulator imposing obligations and prohibitions but that of a moderator and facilitator of society's development. It is important – particularly for the German research system – to encourage self-regulation and to adjust the legal structures of the research system continuously so that they fit the objectives that have been defined and stimulate innovation.

One of the general conditions concerns the personnel working in German research: The competitiveness of universities and non-university research institutions depends on their opportunities to recruit and hire qualified personnel (if necessary, worldwide). Working conditions also have a major impact on the motivation and performance of R&D personnel. This includes internal career prospects, personnel development and continuing education opportunities as well as the structure of the remuneration system and fringe benefits. Important elements in the higher education sector include the changes initiated by the Federal Government with regard to the qualification requirements for university teachers (e.g. by introducing independent junior professorships not requiring a post-doctoral thesis [*Habilitation*]), and a more performance-driven pay structure, in particular in order to improve the quality of teaching (e.g. by means of variable salary components). The purpose of these changes is to achieve greater performance orientation in the public sector by means of a suitable system of remuneration, to improve the competitiveness of university staff in the labour market and to promote their professional and geographical mobility.

9.2 Funding rules including the utilisation of findings

The new project funding rules (e.g. NKBF 98 and BNBest-BMBF 98) which were introduced in 1999 in the funding areas covered by the portfolio of the BMBF and in some funding areas of the BMWi are aimed at making greater use of the findings of research and development. Grant recipients are explicitly obliged to utilise their research findings to generate innovations. One key prerequisite to such utilisation is the preparation of a utilisation plan that is subject to efficiency control and must be submitted by grant recipients in the form of a forecast together with their funding applications. It also has to be updated at regular intervals. Whenever such an update is submitted, the grant recipient must also provide information on the locations where the findings have been used and on the benefits they offer for various user groups in Germany. In return, the grant recipient generally has the right to the exclusive utilisation of the research findings, unless there is an overriding public interest. The Federal Government waives its right to claim a share of the revenues from the utilisation of the findings.

In the event that grant recipients fail to comply with their performance or utilisation obligations, they will be subject to sanctions (e.g. the loss of the right to exclusive utilisation). In accordance with a decision taken by the Interdepartmental Committee on Science and Research on 18 June 1999, all government departments will adopt the rules introduced by the BMBF with regard to the utilisation of findings from R&D projects.

Info-Box

Important Internet addresses concerning the German research landscape

- Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke" e.V. (AiF – German Federation of Industrial Co-operative Research Associations): http://www.aif.de
- Deutsche Forschungsgemeinschaft: http://www.dfg.de
- Deutscher Akademischer Austauschdienst e.V. (DAAD – German Academic Exchange Service): http://www.daad.de
- EU RTD Framework Programme: www.cordis.lu
- EXIST: http://www.exist.de
- Research Map Germany: http://www.forschung.bmbf.de
- Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V. (FhG – Fraunhofer Society for the Advancement of Applied Research): http://www.fhg.de
- Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF – Hermann von Helmholtz Association of German Research Centres): http://www.helmholtz.de
- Hochschulrektorenkonferenz (HRK – German University Rectors' Conference): http://www.hrk.de
- InnoRegio: www.innoregio.de
- Promotion of innovation: Innovationsförderung – Hilfen für Forschung und Entwicklung (Promotion of Innovation – Assistance for Research and Development): http://www.bmbf.de/veroe01/digipubl.htm/veroef01/digipubl.htm
- Kompetenznetze (Competence Networks): ww.kompetenznetze.de
- Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. (MPG – Max Planck Society for the Promotion of Science): http://www.mpg.de
- Patents: BMBF patent server (www.patente.bmbf.de): INSTI (www.insti.de)
- Foundations: Index of German Foundations published by the Bundesverband Deutscher Stiftungen (Federal Association of German Foundations): http://www.stiftungsindex.de/
- Technological performance: Germany's Technological Performance, Summary Report: http://www.bmbf.de/veroe01/digipubl.htm/veroef01/digipubl.htm
- Union der deutschen Akademien der Wissenschaften (Union of the German Academies of Science): http://www.akademienunion.de
- Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association): http://www.wgl.de
- Wissenschaftsrat (WR – Science Council): http://www.wissenschaftsrat.de

Part II

Resources for science, research and development in Germany and in an international comparison

Definitions

The following definitions of the most important terms used in Part II are based on international conventions or, if indicated, on the Frascati Manual adopted by the Organisation for Economic Co-operation and Development (OECD); the Frascati Manual sets out the terminological and methodological basis for the collection of statistical data on research and development. Further definitions will be found in the text.

Science expenditure
Science expenditure covers expenditure on research and development (R&D) as well as expenditure on academic teaching and education and other related scientific and technological activities. The latter include, for example, scientific and technical information services, data collections for general purposes, studies on the feasibility of technical projects (feasibility studies for research projects, however, form part of R&D), and development of a basis for decision-making in politics and industry.

R&D expenditure
Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (cf. Frascati Manual 1993, para. 57). Expenditure incurred in the context of this work is expenditure on research and development.

Net expenditure
Expenditure adjusted for payments made at the same level of the public sector minus payments made by other public institutions. It reflects the expenditure to be financed from the institution's or group's of institutions own sources of funds (burden principle).

Direct expenditure
Labour costs, current operating expenditure, expenditure on fixed assets as well as regular and capital-forming payments to other sectors, excluding payments to the government sector.

Deviations from net expenditure basically correspond to the balance of payment transactions within the government sector.

Basic funds
Net expenditure minus direct revenues, i.e. revenues generated in the functional area concerned. It indicates the level of funds from the general budget provided by a body for this area.

Gross domestic expenditure on research and development
Total intramural expenditure on R&D performed on the national territory, whatever the source of finance; this also includes R&D performed within the country and funded from abroad and by international organisations. However, it does not cover the expenditure on R&D performed by international organisations on the national territory as well as payment made for R&D performed abroad (cf. Frascati Manual 1993, para. 385).

Intramural R&D expenditure
All expenditure on R&D performed within a country or within a certain sector of the economy or another reporting unit, whatever the source of funds. This does not include funds for R&D performed abroad or by international organisations (cf. Frascati Manual 1993, para. 335).

Extramural R&D expenditure
Expenditure on research and development performed abroad, within international organisations or outside a certain sector or other unit (reporting unit) of the economy (cf. Frascati Manual 1993, para. 333).

Total R&D expenditure
Total expenditure comprises the intramural and extramural R&D expenditure of a country, a sector or other unit (reporting unit) of the economy.

Government expenditure on R&D
All resources allocated to R&D by Federal and *Länder* (state) governments, regardless of the sector in which R&D is performed.

R&D expenditure by the business enterprise sector
Expenditure by business enterprises and institutions for co-operative industrial research and experimental development.

Self-financed expenditure by the business enterprise sector
Intramural R&D expenditure financed from the business enterprise sector's own resources.

Sectoring
- Business enterprise sector: private and public enterprises, institutions for co-operative industrial research and experimental development, and private non-profit institutions mainly financed by, or serving, business enterprises (cf. Frascati Manual 1993, paras. 145–167).
- Higher education sector: all universities, colleges of technology, Fachhochschulen (Universities of Applied Sciences) and other institutions of post-secondary education, whatever their source of finance or legal status, including their research institutes, experimental stations and clinics (cf. Frascati Manual 1993, paras. 190–214).
- Government sector (without higher education):
  National reporting is based on a narrow definition of the government sector, i.e. on the financing side only the budget resources of Federal, *Länder* and local governments are covered, and on the performing side it is also only the institutions of the Federal, *Länder* and local governments that are covered.
  For the purposes of *international* reporting, the government sector also comprises private non-profit organisations mainly financed by government (e.g. Helmholtz Centres, Max Planck Society and Fraunhofer Society). On the financing side revenues

by these organisations are also included (Frascati Manual 1993, paras. 168–177).

– Private non-profit institutions (PNP sector):
  In *national* reports coverage of this sector includes non-profit organisations mainly financed by government (e.g. Helmholtz Centres, Max Planck Society and Fraunhofer Society) and private non-profit organisations financed neither mainly by government nor mainly by the business enterprise sector and not primarily serving business enterprises.
  For *international* reporting, however, this sector includes only private non-profit organisations financed neither mainly by government nor mainly by the business enterprise sector (cf. Frascati Manual 1993, paras. 178–189).
– Abroad:
  On the financing side, this sector includes funds from abroad, the European Union and international organisations earmarked for research and development performed within the frontiers of the Federal Republic of Germany, while the performing side includes flows of R&D funds to other countries, to the EU and international organisations, even if the latter are based in Germany (cf. Frascati Manual 1993, paras. 215–219).

Personnel devoted to research and development (R&D personnel)
All persons employed directly on R&D, regardless of the level at which they are employed, including researchers, technicians and equivalent staff and other supporting staff (cf. Frascati Manual 1993, paras. 279 ff).

Researchers
Scientists or engineers engaged in the conception or creation of new knowledge, products, processes, methods and systems – as a rule, holders of university level degrees (cf. Frascati Manual 1993, para. 311).

Technicians and equivalent staff
Persons with technical training or equivalent non-technical training employed directly on R&D, usually under the supervision of researchers – generally persons who have completed trade or technical school (Fachschule) (cf. Frascati Manual 1993, para. 316).

Other supporting staff
Persons directly associated with R&D activities, i.e. secretarial, clerical and administrative staff, skilled craftsmen, unskilled and semi-skilled auxiliary staff (cf. Frascati Manual 1993, para. 319).

Full-time equivalent (FTE)
Unit to measure the full-time activity of a person over a certain period. This unit serves to express the working time of a person doing part-time R&D work (including part-time workers) as the working time of a full-time R&D worker (cf. Frascati Manual 1993, paras. 295 ff.)

Territory

1. Results for Germany as a whole:
– Results for the Federal Republic of Germany covering the territory after 3 October 1990): ***"Germany"***

2. Results for parts of Germany:
– Results for the Federal Republic of Germany including West Berlin covering the territory up to of 3 October 1990): ***"Former West Germany"***
– Results for the new German *Länder* and East Berlin as of 3 October 1990: ***"New Länder and East Berlin"***
  (The new *Länder* are Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia).

Legend

0 = less than half of one in the last decimal place, but more than nothing
\- = not available
. = survey not yet completed or no longer possible
X = not shown for reasons of confidentiality, but included in total

1. Science expenditure

Expenditure on research and development (R&D) forms part of a larger category of expenditures which, in total, may be considered investments in the future. This category includes not only R&D expenditure but also expenditure on education and science, with occasional overlaps between these two types of expenditure.

Science expenditure includes not only expenditure on research and development (R&D), but also expenditure on academic education and training and other related scientific activities such as scientific and technical information services, general purpose data collections and feasibility studies on technical projects. Actual science expenditure data are available up to and including 1997, while the data for 1998 and 1999 are estimates. In 1997, science expenditure amounted to just under DM 109.6 billion which was 2.1 per cent up on 1996 and 13.9 per cent up on 1991. In 1998 and 1999, science expenditure continued to increase substantially: In 1998, it was DM 113.2 billion which was a rise of 3.3 per cent over the previous year; in 1999, it grew by another 5.7 per cent totalling DM 119.6 billion.

In the years after German unification there has been a shift in the balance of contributions made by the government sector and the business enterprise sector to financing science expenditure. While from 1991 to 1996 the share of public budgets had increased continuously from 50.6 per cent to 52.7 per cent, it began to drop in 1997. The contribution of the business enterprise sector, on the other hand, rose to more than half again in 1998 and 1999. Science expenditure by the business enterprise sector in 1999 was an estimated DM 61.3 billion which corresponds to 51.2 per cent.

Between the early and the late 1990s the shares of central, regional and local governments also underwent major changes. Whereas federal expenditure rose by 3.5 per cent between 1991 and 1999, the expenditure by *Länder* and local governments went up by 31.4 per cent over the same period. This was mainly attributable to the development of expenditure in the new *Länder.*

The Federal Government's science expenditure primarily benefits non-university research institutions (cf. Table VII/10,) whereas the science expenditure of the *Länder* governments mainly serves to finance universities and other higher education institutions. *Länder* data are based on the concept of basic funds, which means that direct revenues, especially income from hospital patient care, are deducted from the *Länder* governments' net science expenditure. This approach is designed to eliminate the impact of expenditure on patient care at university hospitals.

Table II/1 (cf.Table VII/1)

Science expenditure of the Federal Republic of Germany by funding source*

– Percentage –

Funding source	1989	1991	1993	1995	1996	1997	1998	1999
1. Government	47.6	50.6	51.9	52.4	52.7	51.0	49.6	48.8
1.1 Federal Government (including ERP)	20.6	20.9	20.2	19.3	19.1	18.1	17.6	17.4
1.2 *Länder* and local government [1]	25.1	27.9	30.1	31.2	31.7	30.7	29.9	29.4
of which new Länder (excluding East Berlin)	·	*3.5*	*4.3*	*5.2*	*5.3*	*5.3*	*5.3*	*5.0*
1.3 Non-profit science organisations	1.9	1.7	1.6	1.9	1.9	2.2	2.1	2.0
2. Business enterprise sector	52.4	49.4	48.1	47.6	47.3	49.0	50.4	51.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
DM million	79 812	96 206	101 765	105 340	107 315	109 583	113 187	119 665

* Including *Bundeswehr* universities.

1 Science expenditure by *Länder* is not based on net expenditure but on "basic funds", which result after deduction ofdirect receipts (especially Länder revenues from patient care in university hospitals).

Source: BMBF

Rounding error

2. Expenditure on research and development

Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. In 1997, the last year for which actual data are available for all financing sectors, German financing sources spent DM 84.1 billion on this work, which was 2.6 per cent more than in 1996. Estimates indicate that expenditure rose by 4.2 per cent to DM 87.6 billion in 1998 and by another 5.7 per cent to DM 92.6 billion in 1999.

In more recent years the business enterprise sector enjoyed the highest growth in R&D expenditure. From 1998 to 1999, expenditure rose from by 7.6 per cent to DM 60.7 billion. In the years before, R&D funding by the business enterprise sector grew by 6.2 per cent (1998) and 5.9 per cent (1997).

In 1997, R&D expenditure by the Federal and *Länder* governments taken together fell by 3.6 per cent to DM 30.7 billion. In 1998 and 1999, however, R&D funding was stepped up again by 0.9 per cent and 2.2 per cent, respectively, so that in 1999 R&D expenditure amounted to DM 31.6 billion.

The Federal Government's R&D budget was subject to greater fluctuations than the *Länder* budgets. While in 1999 expenditure

Table II/2 (cf. Table VII/2)

R&D expenditure of the Federal Republic of Germany* by financing sector and as percentage of gross national income [1]

Financing sector[2]	1989	1991	1993	1995	1996	1997	1998	1999
I. Federal Government [3] – DM million	14 185	17 002	16 897	16 547	16 740	16 062	16 171	16 770
Index 1991 = 100	(83)	100	99	97	98	94	95	99
% of total R&D expenditure	*21.9*	*22.2*	*21.5*	*20.5*	*20.4*	*19.1*	*18.5*	*18.1*
II. *Länder* [3/4] – DM million	9020	12 190	13 114	14 381	14 769	14 618	14 784	14 860
Index 1991 = 100	(74)	100	108	118	121	120	121	122
% of total R&D expenditure	*13.9*	*15.9*	*16.7*	*17.8*	*18.0*	*17.4*	*16.9*	*16.0*
Federal and *Länder* governments, total	23 205	29 192	30 011	30 928	31 509	30 680	30 955	31 630
Index 1991 = 100	(79)	100	103	106	108	105	106	108
% of total R&D expenditure	*35.9*	*38.1*	*38.2*	*38.3*	*38.5*	*36.5*	*35.3*	*34.1*
III. Business enterprise sector [4] – DM million	41 197	46 949	48 323	49 542	50 166	53 108	56 401	60 706
Index 1991 = 100	(88)	100	103	106	107	113	120	129
% of total R&D expenditure	*63.6*	*61.4*	*61.5*	*61.4*	*61.2*	*63.2*	*64.4*	*65.5*
IV. Private non-profit sector								
DM million	325	382	239	203	246	276	280	298
Index 1991 = 100	(85)	100	63	53	64	72	73	78
% of total R&D expenditure	*0.5*	*0.5*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
Total R&D expenditure – DM million	64 727	76 523	78 573	80 673	81 921	84 065	87 636	92 634
Index 1991 = 100	(85)	100	103	105	107	110	115	121
% of gross national income [1]	*2.88*	*2.59*	*2.42*	*2.31*	*2.29*	*2.30*	*2.33*	*2.42*

* Data from surveys conducted in domestic financing sectors. 1989 former West Germany, from 1991 onwards Germany.

1 Since 1991 gross national income in accordance with the European System of Accounts (ESA) 1995, 1989 gross national product.

2 Estimated in some cases, actual figures for Federal Government up to and including 1998, for other sectors up to and including 1997. Federal Government and Länder revised.

3 Federal and Länder institutions included with their R&D shares only.

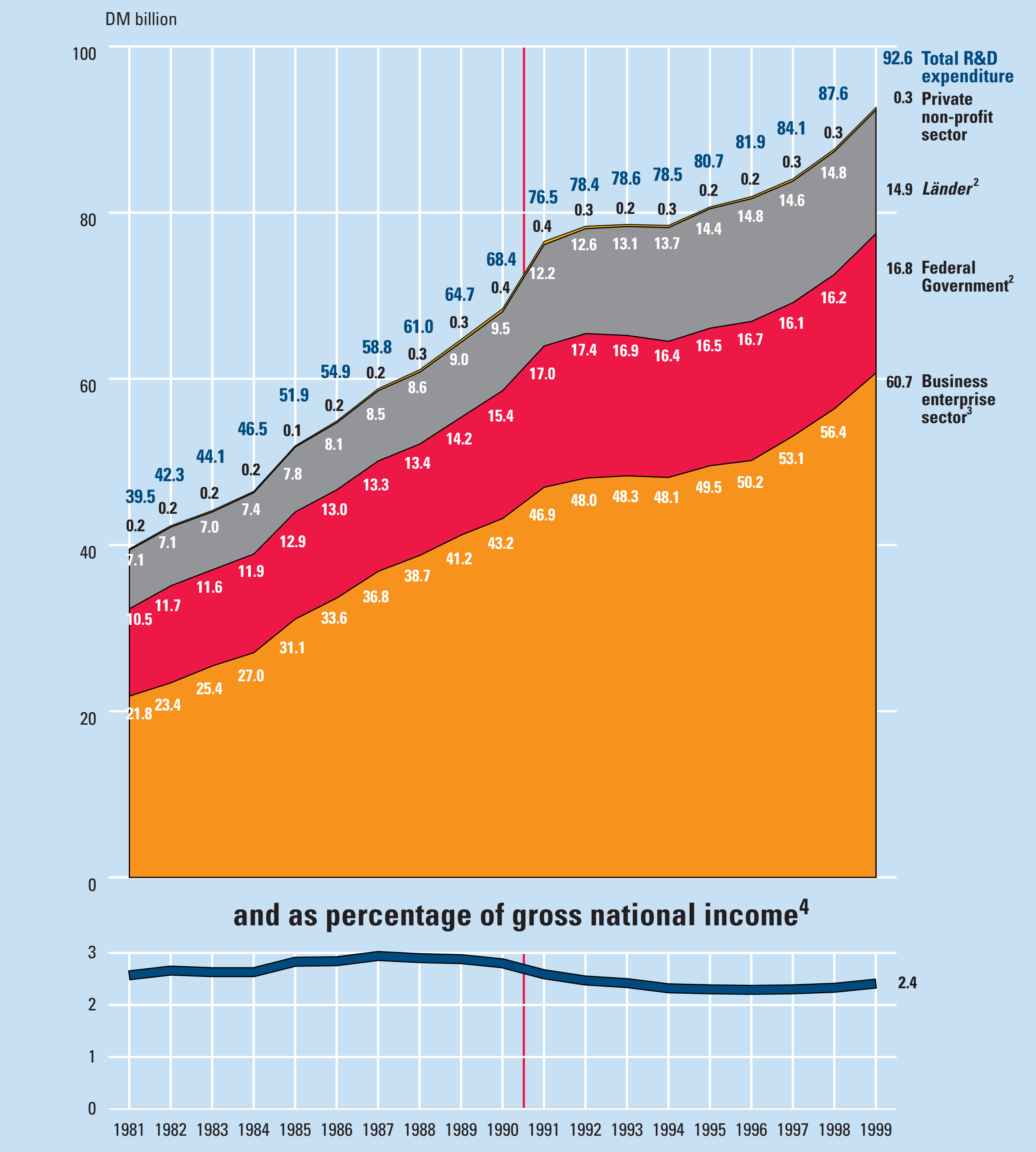
4 Intramural R&D expenditure financed by the business enterprise (BE) sector and BE funds received by other sectors, including entities abroad (source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and BMBF). Revised.

Source: BMBF

Rounding error

Chart 11

R&D expenditure of the Federal Republic of Germany* by financing sector[1]



* Data from surveys conducted in domestic financing sectors. Up to and including 1990 former West Germany, from 1991 onwards Germany.

1 Estimated in some cases, actual figures for Federal Government up to and including 1998, for other sectors up to and including 1997, Federal Government and Länder revised.

2 Federal institutions (from 1981 onwards) and Länder institutions (from 1985 onwards) included only with their R&D shares

3 R&D expenditure of all sectors (including abroad) financed by the business enterprise sector (source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and BMBF). Revised.

4 Since 1991 gross national income in accordance with the European System of Integrated Economic Accounts (ESA) 1995, up to and including 1990 gross national product.

Source: BMBF

BMBF, BuFo 2000

went up by 3.7 per cent and in 1998 by 0.7 per cent, it declined by 4.1 per cent in 1997 (always relative to the previous year).

In 1997, *Länder* R&D expenditure dropped by only 1.0 per cent and rose again by 1.1 per cent in 1998 and 0.5 per cent in 1999.

The contribution made by the business enterprise sector to financing research and development has gone up substantially since 1997. According to the 1999 budget data provided by the business enterprises and institutes for co-operative industrial research and experimental development that were surveyed, this contribution accounted for 65.5 per cent, i.e. just under two thirds, of total expenditure which was more than in the last year before German unification.

When R&D expenditure financed by residents is related to real gross national income, i.e. the economic performance of residents previously referred to as gross national product[1], there is a marked

[1] The term was altered when the system of national accounts was changed to the European System of Accounts (ESA) in 1995. This resulted in a revision of data covering the years after 1991 so that the data are not necessarily comparable with those of previous years.

Table II/3 (cf. Table VII/3)

Gross domestic expenditure on research and development (GERD) in Germany* by performing sector and as percentage of GDP[1]

Performing sectors[2]	1989	1991	1993	1995	1996	1997	1998	1999
I. Higher education sector – DM million[3]	9072	12 019	13 332	14 430	14 967	15 014	15 310	15 460
Index 1991 = 100	(75)	100	111	120	125	125	127	129
% of GERD	*14.2*	*16.2*	*17.5*	*18.1*	*18.5*	*17.9*	*17.5*	*16.8*
II. Government and private non-profit sector non-profit sector[4] – DM million	8559	10 673	11 490	12 255	12 332	12 268	12 771	13 255
Index 1991 = 100	(80)	100	108	115	116	115	120	124
% of GERD	*13.4*	*14.4*	*15.1*	*15.4*	*15.2*	*14.6*	*14.6*	*14.4*
III. Business enterprise sector[5] – DM million	46 086	51 675	51 236	52 835	53 600	56 543	59 329	63 300
Index 1991 = 100	(89)	100	99	102	104	109	115	122
% of GERD	*72.3*	*69.5*	*67.4*	*66.4*	*66.3*	*67.5*	*67.9*	*68.8*
Total gross domestic expenditure on R&D (GERD) – DM million	63 717	74 368	76 058	79 520	80 898	83 825	87 410	92 015
Index 1991 = 100	(86)	100	102	107	109	113	118	124
% of GDP[6]	*2.86*	*2.53*	*2.35*	*2.26*	*2.26*	*2.29*	*2.31*	*2.37*
For information: R&D expenditure to recipients abroad[7] – DM million								
Federal Government	*1465*	*1806*	*1916*	*1720*	*1627*	*1524*	*1586*	*1623*
Business enterprise sector	*757*	*942*	*1232*	*935*	*1000*	*1669*	.	.
Total	*2222*	*2748*	*3148*	*2655*	*2627*	*3193*	.	.
Index 1991 = 100	*(81)*	*100*	*115*	*97*	*96*	*116*	.	.

* Data from surveys conducted in performing sectors. 1989 former West Germany, from 1991 onwards Germany.

1 Gross domestic product.

2 Estimated in some cases, actual figures up to and including 1997, estimates from 1998 onwards.

3 Higher education sector revised up to and including 1994.

4 Non-university institutions. Government: (Research) institutions owned by Federal Government, *Länder* and local government. From 1992 onwards modified surveying concept in government and private non-profit sector.

5 Intramural business enterprise expenditure on R&D including government funds that cannot be broken down, but excluding government funds not accounted for (OECD concept), hence deviations from financing sector data for government funds.

6 From 1991 onwards calculation of GDP in accordance with ESA (European System of Accounts) 1995 (break in series).

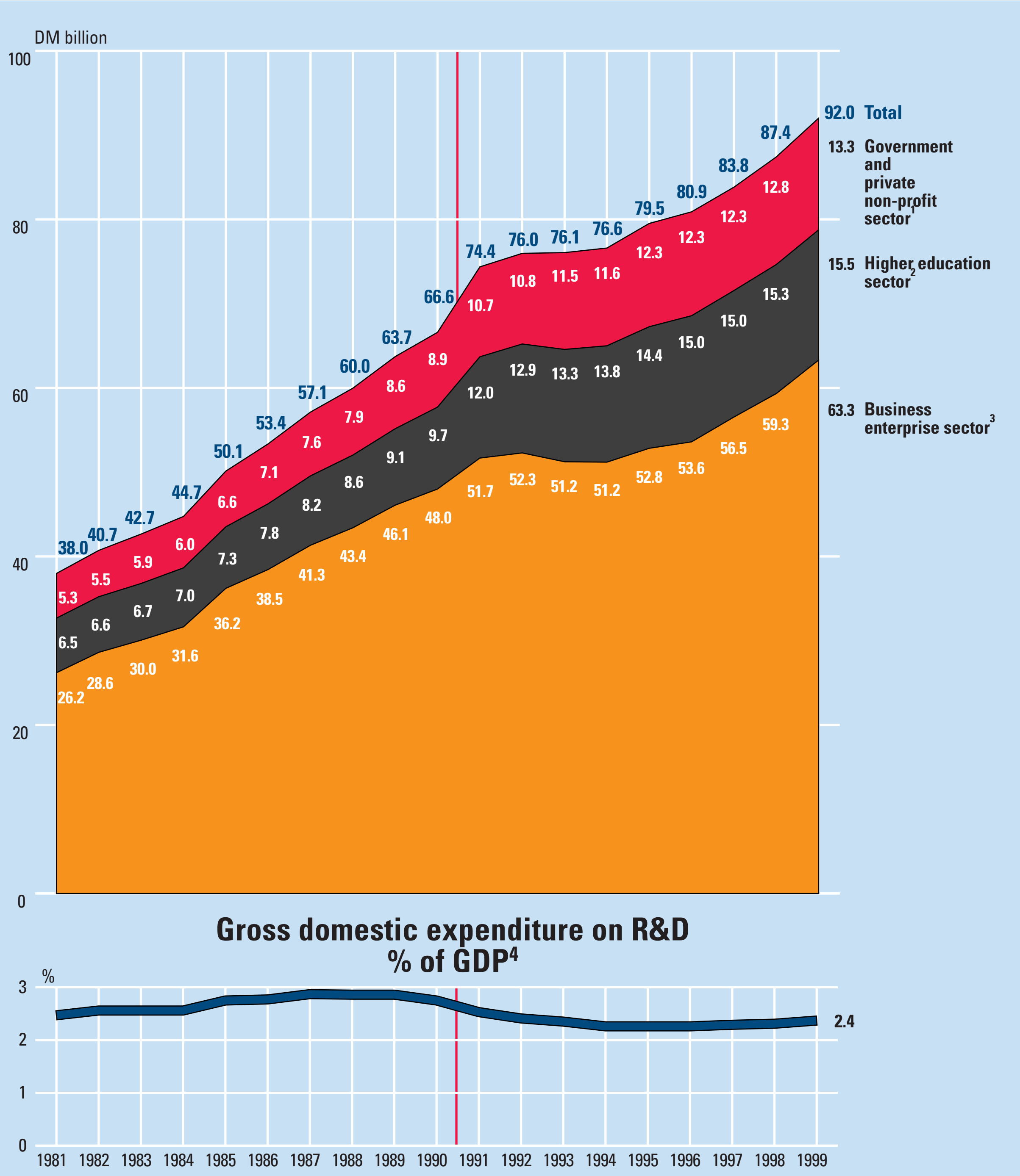
7 Estimated in some cases.

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and BMBF

Rounding error

Chart 12

Gross domestic expenditure on R&D (GERD) in Germany* by performing sector



* Data from surveys conducted in performing sectors. Up to and including 1990 former West Germany, from 1991 onwards Germany. Estimated in some cases, actual figures up to and including 1997.

1 Non-university institutions. Government: (Research) institutions owned by Federal, *Länder* and local governments, federal institutions from 1981 onwards, *Länder* institutions from 1985 onwards included only with their R&D shares. From 1992 onwards modified surveying concept, 1995 extension of coverage.

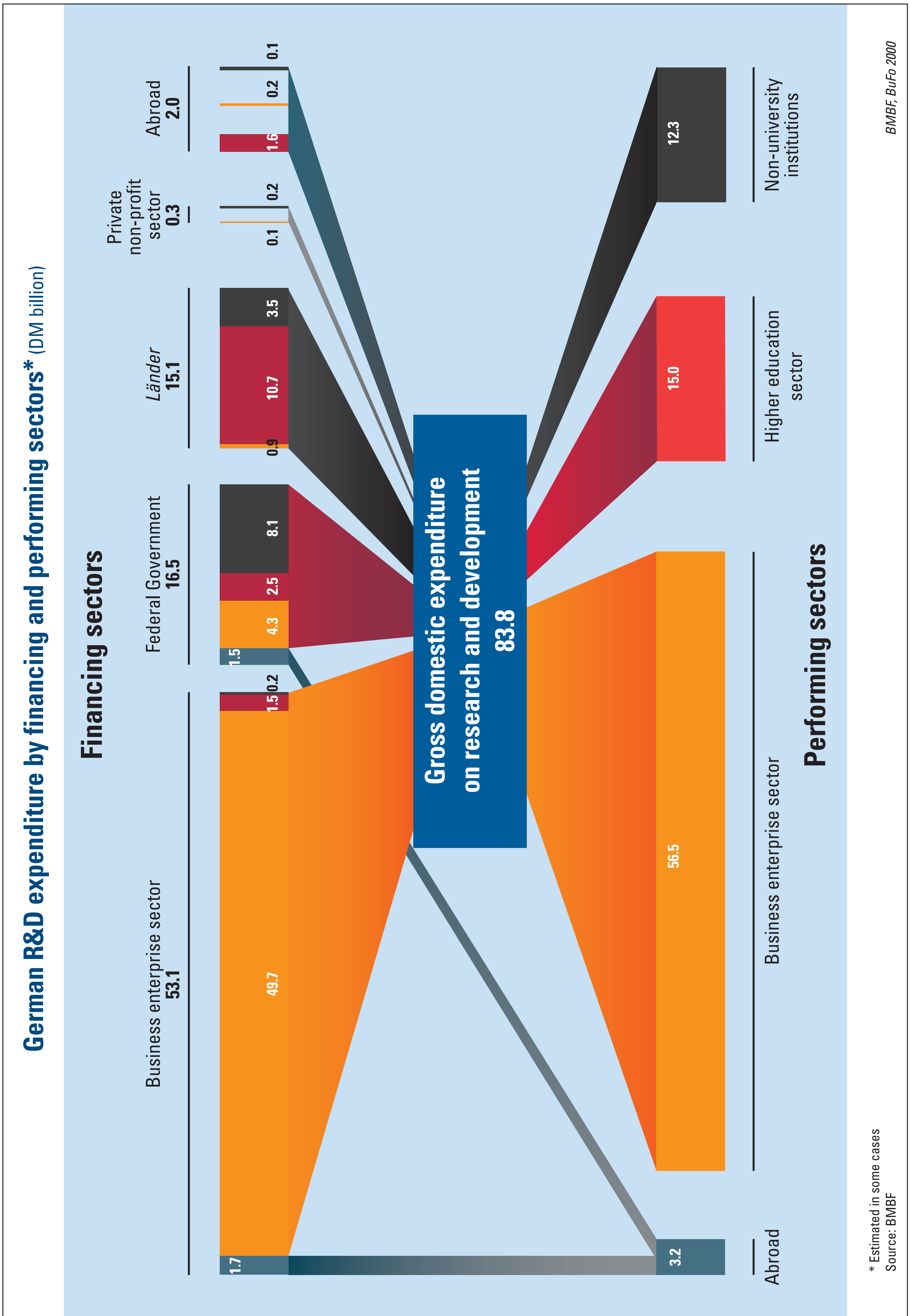
2 Revised up to and including 1995.

3 Intramural business enterprise expenditure on R&D including governments funds that cannot be broken down, but excluding government funds not accounted for (OECD concept), hence deviations from financing sector data for government funds.

4 From 1991 onwards calculation of GDP according to ESA (European System of Integrated Economic Accounts) 1995 (break in series).

Source: Stifterverband Wissenschaftsstatistik. Federal Statistical Office and calculations by BMBF *BMBF, BuFo 2000*

Chart 13


German R&D expenditure by financing and performing sectors* (DM billion)
Financing sectors
Business enterprise sector
53.1
Federal Government
16.5
Länder
15.1
Private
non-profit
sector
0.3
Abroad
2.0
1.7
49.7
1.5
0.2
1.5
4.3
2.5
8.1
0.9
10.7
3.5
0.1
0.2
1.6
0.2
0.1
Gross domestic expenditure
on research and development
83.8
3.2
56.5
15.0
12.3
Abroad
Business enterprise sector
Higher education
sector
Non-university
institutions
Performing sectors
* Estimated in some cases
Source: BMBF
BMBF, BuFo 2000

decline during the first few years after German unification. After the trend hit rock-bottom in 1996, with a share of R&D expenditure in real gross national income of 2.29 per cent, this indicator edged up again to 2.42 per cent in 1999.

The information provided so far relates to R&D expenditure financed by domestic sectors. This includes funding allocated to research performed abroad on which the government and business enterprise sectors spent DM 3.2 billion in 1997. Unlike this concept of funding provided by residents, gross domestic expenditure on research and development (GERD) covers the resources spent on performing R&D in Germany. This concept also includes funding spent by foreign sources, such as the EU or companies based abroad, on R&D performed in Germany. As it eliminates the risk of double counting, gross domestic expenditure on research and development is an important indicator especially for international comparisons of R&D efforts.

In 1997, the last year for which actual data covering all sectors are available, DM 83.8 billion were spent in Germany on performing R&D. GERD was thus 3.6 per cent up on the previous year. R&D expenditure is estimated to rise by 3.6 per cent to DM 87.4 billion in 1998 and by 5.3 per cent to DM 92.0 billion in 1999.

In the 1990s the contributions made by the individual sectors to the development of gross domestic expenditure on research and development varied. While the business enterprise sector's R&D expenditure stagnated in the first half of the decade, it began to increase again after 1997 and its growth has been markedly higher than that of the higher education and government sectors. In 1999, the funds spent on R&D performed in the business enterprise sector accounted for 68.8 per cent of GERD. Growth rates in the higher education sector were even higher in the first few years after German unification so that the higher education sector's R&D expenditure was 18.5 per cent of GERD. But since then the percentage has dropped again and was 16.8 per cent in 1999. In 1995, the R&D expenditure of non-university research institutions, i.e. the government sector, expressed as a percentage of GERD peaked at 15.4 per cent. The 1999 share in GERD was 14.4 per cent.

Expenditure incurred in the performance of research and development in the new *Länder* (including East Berlin) accounted for 10.0 per cent of GERD in 1997. The shares of the various sectors, however, differed substantially: While in the government sector the new *Länder* accounted for 20.1 per cent and in the higher education sector for 16.9 per cent, their share in the business enterprise sector was only 6.0 per cent.

The revision of the data taken from National Accounts had an impact on the gross domestic expenditure on R&D as a percentage of GDP, an indicator used for international comparisons (GDP: the total value of goods and services produced in Germany). This resulted in a minor upward revision of GDP data so that – with GERD unchanged – the quotient is slightly below previous levels. In 1997, GERD accounted for 2.29 per cent of GDP. It is currently estimated to amount to 2.31 per cent in 1998 and to increase markedly to 2.37 per cent in 1999.

3. Personnel devoted to research and development

Apart from expenditure on research and development, R&D personnel is the most important indicator of the input into research and development by a country or a sector of the research system. An advantage this indicator has over R&D expenditure is that in comparisons over time, inflation effects do not play a role; likewise, in international comparisons differences in purchasing power do not have any impact. To eliminate the effects of part-time employment, R&D personnel numbers are expressed as full-time equivalents. This method also takes into account that, as a rule, research and teaching are performed by one and the same person, especially at higher education institutions. The proportion of work accounted for by research is determined by means of R&D coefficients, using a procedure agreed upon by the Federal Ministry of Education and Research, the Standing Conference of *Länder* Ministers of Education, the Federal Statistical Office and the Science Council[1].

3.1 Structure and development

In 1997, the last year for which valid personnel data are available for the business enterprise, higher education and government sectors, a total of about 460,400 persons were engaged in R&D in Germany. This figure had hardly changed relative to 1995. As with R&D expenditure, the business enterprise sector accounted for the largest share in 1997, with 286,300 full-time equivalents or about 62.2 per cent; that is about 3,000 persons or one per cent more than in 1995. In the higher education sector, some 100,600 persons, that is 21.9 per cent, were working in R&D in 1997. In the government sector as defined by the OECD, i.e. publicly financed non-university research institutions, 73,500 persons were engaged in R&D in that year which is 16.0 per cent of total R&D personnel. In this sector, personnel numbers dropped by 2.2 per cent compared with 1995.

[1] Cf. Heinz-Werner Hetmeier, „Methodik und Berechnung der Ausgaben und des Personals der Hochschulen für Forschung und Entwicklung ab dem Berichtsjahr 1995" in Wirtschaft und Statistik, 2/1998.

Overview 3.1

R&D personnel by sector of employment and occupation

– Germany –

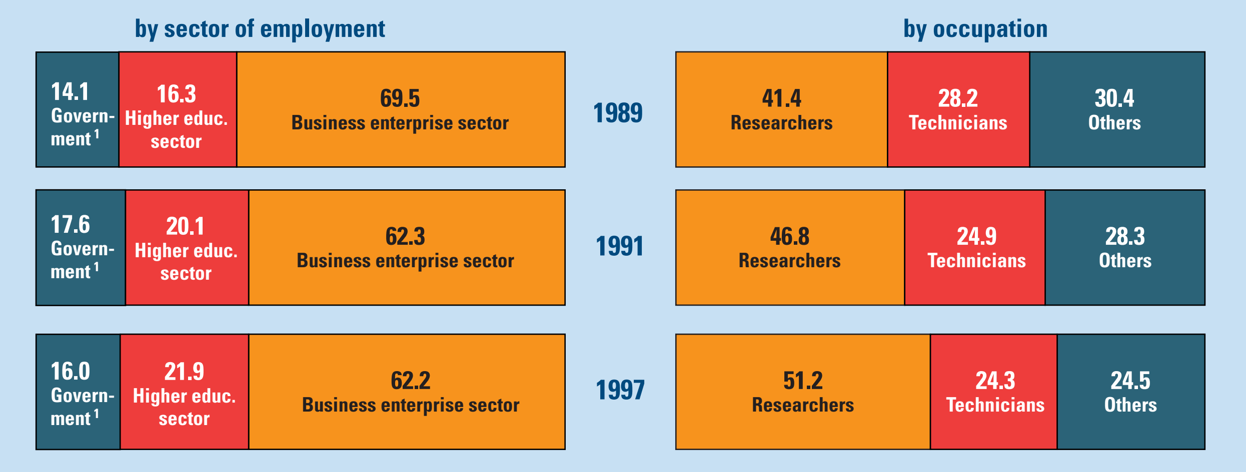
Sector	Year	Total R&D personnel	of which: Researchers	Technicians and others
		– Full-time equivalent (FTE) –		
Business enterprise sector	1995 1997	283 316 286 270	129 370 132 686	153 946 153 585
Higher education sector	1995 1997	100 674 100 646	64 434 65 704	36 240 34 942
Government sector	1995 1997	75 148 73 495	37 324 37 402	37 824 36 093
Total	1995 1997	459 138 460 410	231 128 235 792	228 010 224 618
		– Index 1995 = 100 –		
Business enterprise sector	1995 1997	100.0 101.0	100.0 102.6	100.0 99.8
Higher education sector	1995 1997	100.0 100.0	100.0 102.0	100.0 96.4
Government sector	1995 1997	100.0 97.8	100.0 100.2	100.0 95.4
Total	1995 1997	100.0 100.3	100.0 102.0	100.0 98.5

Source: Federal Statistical Office, Stifterverband Wissenschaftsstatistik and calculations by the Federal Ministry of Education and Research Rounding error

Chart 14

Research and development personnel

Shares in %



1 Government and private non-profit sector (non-university institutions).

Source: Federal Statistical Office, Stifterverband Wissenschaftsstatistik and BMBF *BMBF, BuFo 2000*

Overview 3.2

R&D personnel in the old and new *Länder* by sector of employment

– Full-time equivalent (FTE) –

Year	Total	of which: Business enterprise sector	Higher education sector	Government sector [1]
		– Full-time equivalent (FTE) –		
		old Länder (including West Berlin)		
1991	**430 812**	286 834	84 358	59 619
1993	**.**	271 742	.	58 890 [2]
1995	**401 755**	259 575	81 726	60 454
1997	**401 482**	261 162	81 764	58 556
		new Länder (including East Berlin)		
1991	**82 831** [3]	34 922	19 509	28 400 [3]
1993	**50 820** [2]	22 032	16 680	12 108 [2]
1995	**57 051**	23 741	18 948	14 362
1997	**58 557**	25 108	18 882	14 567
		– Per thousand population –		
		old Länder (including West Berlin)		
1991	***6.7***	*4.5*	*1.3*	*0.9*
1993	***.***	*4.1*	.	*0.9* [2]
1995	***6.1***	*3.9*	*1.2*	*0.9*
1997	***6.0***	*3.9*	*1.2*	*0.9*
		new Länder (including East Berlin)		
1991	***5.2*** [3]	*2.2*	*1.2*	*1.8* [3]
1993	***3.2*** [2]	*1.4*	*1.1*	*0.8* [2]
1995	***3.7***	*1.5*	*1.2*	*0.9*
1997	***3.8***	*1.6*	*1.2*	*0.9*

1 1993 extension of coverage.

2 Revised.

3 Estimate. Including the research personnel of the three former academies of sciences of the GDR receiving transient funding from the Federal Government and the *Länder* up to December 1991.

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and calculations by the Federal Ministry of Education and Research — Rounding error

3.2 Percentage of university graduates

Depending on the type of activities carried out, a distinction is made between researchers, i.e. scientific personnel, and technicians and other supporting staff. Even though qualification is not the decisive criterion for this classification of personnel, it is generally safe to assume that researchers are also university graduates. In 1997, scientific R&D personnel or researchers accounted for an average 51.2 per cent of total R&D personnel. However, this percentage varied from sector to sector: While, at 65.3 per cent, the proportion of university graduates in the higher education sector was clearly above average, the percentage of researchers in the business enterprise sector, at 46.3 per cent, was below average. In all sectors, however, the percentage of academically trained personnel increased at the cost of technicians and other supporting staff. This reflects the continuation of a trend that had started in the old *Länder* as early as the 1980s.

3.3 Percentage of women

Relative to men, women are underrepresented in the ranks of total R&D personnel. 23.7 per cent, that is about 109,000 of the 460,400 persons engaged in R&D in 1997 – all data in this section refer to full-time equivalents – were women. This means that compared with 1995 the number of women engaged in R&D had declined slightly in both absolute and relative terms (cf. Overview 3.3). There are marked differences between the sectors which are slightly boosted by the statistical methods of calculation used. While in the higher education sector and at non-university research institutions – or according to OECD nomenclature, the government sector – women account for about 35 per cent of total R&D personnel, only every sixth person engaged in R&D in the business enterprise sector is a woman. Since the business enterprise sector has the largest number of R&D personnel, the average number of women as a percentage of total personnel is relatively low.

As far as highly qualified women are concerned, differences between the various sectors are less distinct. It is true that with only 16.7 per cent the business enterprise sector still has the lowest percentage of female researchers, but the shares of women researchers in the higher education and government sectors are not much higher at 19.4 per cent and 21.2 per cent, respectively. Of the total of just under 235,800 researchers in Germany 42,800 are female, which is 18.1 per cent.

There are typical female research domains that can be identified in the higher education sector. In medicine women accounted for a respectable 30.5 per cent in 1997. In the humanities and social sciences as well as in agricultural sciences the percentages of women among highly qualified research personnel were 26.6 per cent and 24.8 per cent, respectively. In the natural sciences (female researchers: 14.5 per cent) and the engineering sciences (8.8 per cent), however, men are still dominating.

In the higher education sector in the new *Länder* the total per-

Overview 3.3

Female R&D personnel by occupation and sector of employment

– Full-time equivalent (FTE) –

Sector	Year	Total	of which Women	of which Per cent
R&D personnel				
Business enterprise sector	1995	283 316	47 880	16.9
	1997	286 270	47 800	16.7
Higher education sector	1995	100 674	35 534	35.3
	1997	100 645	35 299	35.1
Government sector	1995	75 148	26 536	35.3
	1997	73 495	25 919	35.3
Total	1995	459 138	109 950	23.9
	1997	460 410	109 018	23.7
Researchers				
Business enterprise sector	1995	129 370	22 170 [1]	17.1
	1997	132 686	22 150 [1]	16.7
Higher education sector	1995	64 434	11 987	18.6
	1997	65 704	12 716	19.4
Government sector	1995	37 324	7504	20.1
	1997	37 402	7913	21.2
Total	1995	231 128	41 661	18.0
	1997	235 792	42 779	18.1

1 Based on percentage of total R&D personnel.

Source: Federal Statistical Office, Stifterverband Wissenschaftsstatistik and calculations by the Federal Ministry of Education and Research — Rounding error centage of women working in research as well as the percentages in the various fields of science were higher than in West Germany. Among the scientific personnel of higher education institutions they accounted for 24.0 per cent in total, ranging from 11.8 per cent in the engineering sciences to 36.5 per cent in medicine.

In 1997, women accounted for an average 35.3 per cent of the research and development personnel of non-university research institutions; 21.2 per cent of researchers and 49.9 per cent of technicians and other supporting staff were female. As in the higher education sector, there were differences between the old and new *Länder*. In the new *Länder* the percentage of women among researchers (26.8 per cent) and among technicians and other supporting personnel (65.7 per cent) was higher than in the old *Länder*. On average, women accounted for 43.2 per cent of the R&D personnel of research institutions in East Germany.

In Germany as a whole, the proportion of women also depends on the type of research institution concerned. The highest percentage of women was found in scientific libraries and museums where in 1997 they accounted for almost half the R&D personnel (49.1 per cent). In the Blue List institutions, 46.8 per cent of the R&D personnel were female. Max Planck Institutes (38.9 per cent), public institutions (38.3 per cent) and other research institutions (35.9) occupied the middle ground, while the Helmholtz Centres and the Fraunhofer Institutes, the two types of institutions that focus on the "classical male domains" of natural and engineering sciences, brought up the rear with 27.0 per cent with 26.4 per cent, respectively.

In the business enterprise sector the percentage of women varies depending on the industry concerned. The concentration of women in some industries is largely in keeping with the general idea of typical male and female occupations. In the vehicle construction industry, for example, female researchers, technicians and other supporting staff accounted for only 10.5 per cent of total R&D personnel; the situation in the mechanical engineering sector was similar (10.8 per cent). In the chemical industry, on the other hand, women accounted for a major proportion (39.1 per cent) of the total R&D personnel; in the pharmaceutical production sub-sector the share of women working in research and development (48.1 per cent) was even almost as high as that of men. In agriculture and forestry, food and tobacco processing as well as textiles and wearing apparel – industries that are less relevant in terms of R&D – women accounted for 45 per cent in each sector. A more interesting point is that also in the service industries that were reviewed women accounted for about one third of the R&D workforce. In real estate and housing, renting and services provided mainly for businesses 30.3 per cent of all R&D personnel were women; the businesses and institutions assigned to the research and development industry and covered by this group as well had 34.5 per cent women among their R&D personnel.

3.4 R&D density (R&D personnel per 1,000 population)

As well as the absolute numbers of R&D personnel, the R&D density, i.e. R&D personnel related to the population, or the manpower potential, is an important benchmark not only for regional, but especially for international comparisons. A comparison of R&D personnel per 1,000 population in the old and new *Länder*, for example, shows that in 1997 there was still a marked difference in terms of R&D intensities (cf. Overview 3.2). Relative to 1995, however, this gap had narrowed a bit. In 1997, there were 6.0 R&D personnel per 1,000 population in the West (1995: 6.1), while in the East the figure was 3.8 (1995: 3.7). In terms of R&D intensity in the higher education and government sectors the new *Länder* had caught up with the West. At 1.2 and 0.9, respectively, the 1997 ratios had remained unchanged compared with 1995. In the business enterprise sector, however, there are still major differences since in West Germany the R&D intensity of 3.9 R&D personnel per 1,000 population is more than twice as high as in the new *Länder* (1.6).

4. Federal expenditure on research and development, 1997 to 2000:

4.1 Structure and development

The trend of the Federal Government's expenditure on research and development (R&D expenditure), and especially the R&D expenditure of the Federal Ministry of Education and Research (BMBF), are important indicators of focal areas where scientific progress is to be furthered also by the use of government funding. In this context, the level of government funds earmarked for R&D and their allocation to the various funding areas and priorities provide important information. The ratio of basic (or statutory) funding for institutions to project funding, the volume of funds channelled to business enterprises and the percentages of funds spent in Germany and abroad are of equal interest.

The following breakdown of federal expenditure on research and development is in keeping with the structure of the federal budget for 2000. In some cases, responsibilities were redistributed among government departments. For the purpose of comparison, R&D expenditure was reassigned according to the new structure also for the years before 1999. Deviations from previous publications are due to this redistribution of responsibilities. In keeping with the federal budget, expenditure by the Federal Government's

Commissioner for Culture and Media Affairs is shown under departmental budget 04, 'Federal Chancellor and Federal Chancellery'

4.2 Federal expenditure on research and development, total and by government department

In 1998, the Federal Government's expenditure on research and development totalled DM 16.2 billion (actual); this was 0.7 per cent up on the previous year. R&D expenditure planned for 1999 amounted to DM 16.76 billion; this equals an increase of 3.7 per cent over actual 1998 expenditure. The draft budget for 2000 appropriated about DM 16.4 billion for R&D, that is a rise of 0.5 per cent relative to the 1999 budget.

The contributions made by the various government departments to financing federal R&D expenditure differ widely. Even after the redistribution of responsibilities among the government departments the Federal Ministries of Economics and Technology (BMWi), of Defence (BMVg) and of Education and Research (BMBF) still accounted for almost 90 per cent of total federal R&D funds. With some 60 per cent the BMBF continued to hold the lion's share (cf. Table VII/7).

A comparison of R&D expenditure based on the 1998 budget structure, on the one hand, and on the new budget structure after 1999, on the other, shows that at the level of government departments there are considerable deviations from previous publications. The following ministries were affected by the restructuring process:

– Federal Ministry of the Interior (BMI), whose responsibilities for cultural and media matters were transferred to the Federal Government's Commissioner for Culture and Media Affairs (1998: about DM 115 million).
– BMBF: The BMBF's 1998 expenditure volume which due to the redistribution of responsibilities in 1999 was transferred to the BMWi amounted to about DM 800 million (cf. Tables II/4a and II/4b).
– Together with the responsibility for research in the field of economics the BMWi transferred about DM 48 million to the Federal Ministry of Finance (BMF) in 1998.
– The R&D expenditure of the Federal Ministry for Transport, Building and Housing (BMVBW) is fully identical with that of the former Federal Ministry for Regional Planning, Building and Urban Development.

Table II/4a (cf. Table VII/7)

Federal Government R&D expenditure by government department*

– Budget structure 2000 –

Government department	1989	1993	1997	1998	1999	2000
	Actual				Budget[2]	
	– DM million–					
Total	**14 185**	**16 897**	**16 062**	**16 171**	**16 770**	**16 849**
of which:						
Federal Ministry of Economics and Technology BMWi	1872	1921	1458	1566	1646	1540
Federal Ministry of Defence BMVg	3156	2662	2842	2665	2707	2608
Federal Ministry of Education and Research BMBF[1]	7551	10 185	10 009	10 193	10 645	10 833
Other ministries[2]	1607	2129	1753	1747	1772	1868
	– Percentage –					
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
of which:						
BMWi	13.2	11.4	9.1	9.7	9.8	9.1
BMVg	22.2	15.8	17.7	16.5	16.1	15.5
BMBF[1]	53.2	60.3	62.3	63.0	63.5	64.3
Other ministries[2]	11.3	12.6	10.9	10.8	10.6	11.1

* Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between Federal Government departments.

1 Total reduction of expenditure taken into account (1999: DM 200 million, 2000: DM 220 million).

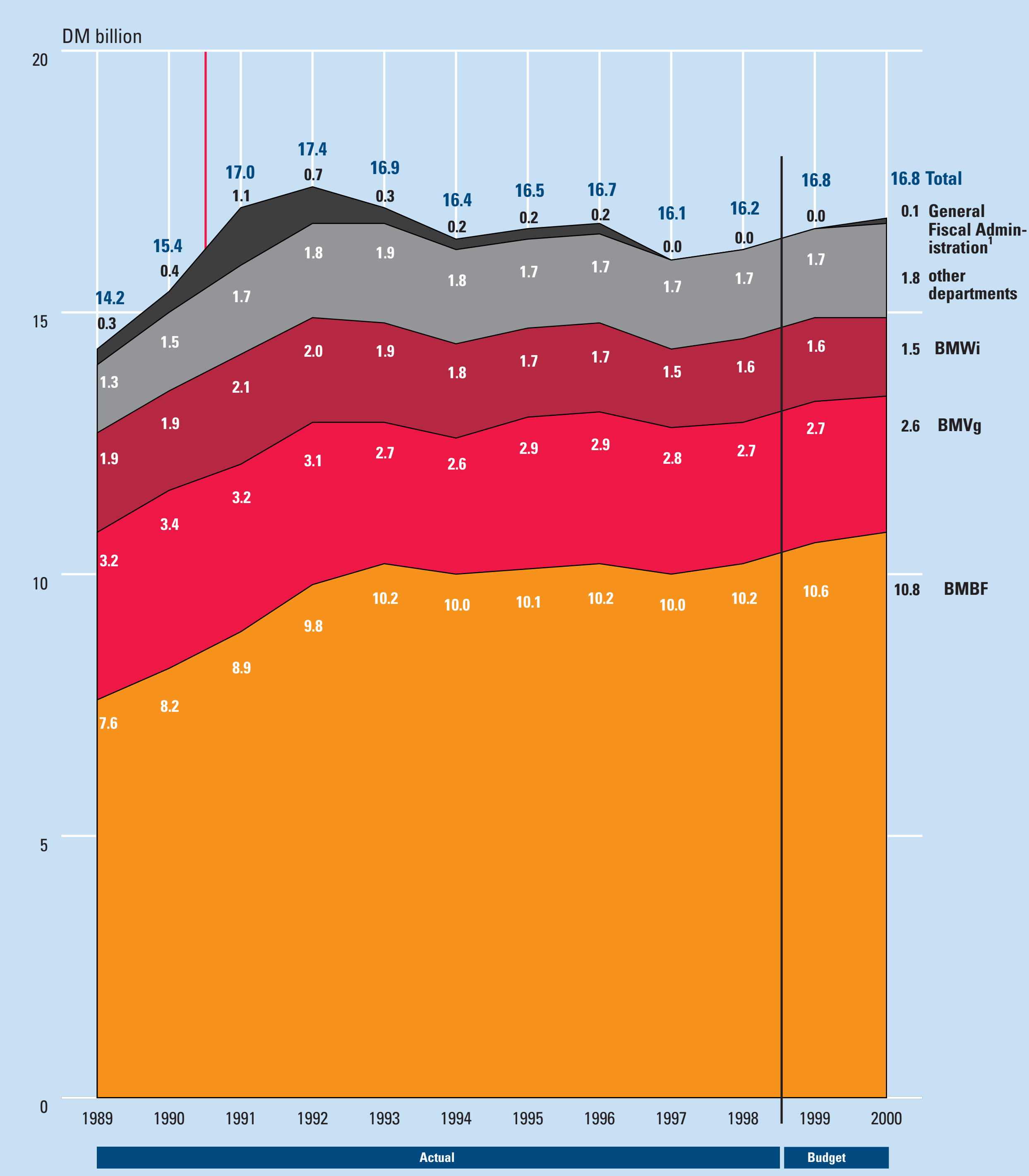
2 Including General Fiscal Administration.

Source: BMBF

Rounding error

Chart 15

Federal research and development expenditure by government departments 1989–2000*



* Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between the Federal Government departments.

1 Including financial weak *Länder* for investments promoting research and technology (1989 to 1992) and including funds for higher education and research and industry-related research centres in the process of German unification (1991 to 1996).

Source: BMBF

BMBF, BuFo 2000

Table II/4b

Federal Government R&D expenditure by government department

– Budget structure 1998 –

Government department	1989	1993	1997	1998
	Actual			
	– DM million –			
Total	**14185**	**16897**	**16062**	**16171**
of which:				
BMWi	989	1228	835	844
BMVg	3156	2662	2842	2665
BMBF	8466	10920	10676	10963
Other ministries [1]	1574	2088	1709	1699
	– Percentage –			
Total	***100.0***	***100.0***	***100.0***	***100.0***
of which:				
BMWi	*7.0*	*7.3*	*5.2*	*5.2*
BMVg	*22.2*	*15.8*	*17.7*	*16.5*
BMBF	*59.7*	*64.6*	*66.5*	*67.8*
Other ministries [1]	*11.1*	*12.4*	*10.6*	*10.5*

1 Including General Fiscal Administration

Source: BMBF — Rounding error

– In the 1999 budget the BMBF's R&D expenditure – on the basis of the 2000 budget structure – was about DM 450 million higher than in 1998 (+4.4 per cent); this was almost the same level that had been reached under the 1998 budget structure. A further increase in funding of DM 188.4 million (+1.8 per cent) has been planned for 2000. It should be noted in this context that the total reduction in expenditure by the BMBF budgeted for 1999 and 2000, which amounts to DM 200 million and DM 220 million, respectively, was exclusively related to the R&D sector.

– Including the former BMBF funds, the BMWi expenditure planned for 1999 rose by 5.1 per cent relative to 1998. The 2000 budget provides for a decline in the BMWi's R&D expenditure by 6.4 per cent, compared with the 1999 budget.

– The 1998 R&D expenditure by the Federal Ministry of Defence (BMVg) was 6.2 per cent down on 1997. While the 1999 budget was slightly up again on 1998, the 2000 budget has been cut by about DM 100 million.

– In the period from 1997 to 2000, the development of R&D expenditure by other government departments varied widely. In 1998, the following ministries could boast relatively high increases relative to 1997: the Federal Ministry for Labour and Social Affairs (BMA) (+24.3 per cent), the Federal Ministry for Economic Co-operation and Development (BMZ) (+9.4 per cent), the Federal Chancellery and the Federal Government's Commissioner for Culture and Media Affairs (BKM) (+4.1 per cent) as well as the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) (+3.1 per cent). The R&D expenditure of the Federal Ministries of Health (BMG) and for Families, Senior Citizens, Women and Youth (BMFSFJ), on the other hand, dropped by 3.4 per cent and 11.9 per cent, respectively.

– With the exception of the Federal Ministries of Justice (BMJ), of Food, Agriculture and Forestry (BML) and the BMZ the R&D expenditure budgeted for 1999 is higher than the actual expenditure of the previous year, with the BMFSFJ, BMF, BMU, BMI and BMVBW recording an above-average increase of 3.7 per cent.

– While in the period under review almost all ministries increased their R&D expenditure, the trend of R&D funding budgeted for 2000 is inconsistent again, compared with the 1999 budget. Except for the growth in expenditure financed from budget 60 (General Fiscal Administration), the relative increases and decreases are between +23.7 per cent (BMF) and –17.0 per cent (BMZ) (cf. Table VII/7).

INFO-BOX

FINANCING OF FEDERAL EXPENDITURE ON RESEARCH AND DEVELOPMENT (R&D EXPENDITURE) CAN BE DIVIDED INTO TWO CATEGORIES:

- Departmental research is aimed at generating scientific knowledge that is directly related to the activities of a given government department (mostly contractual research) and also includes defence research and development. Departmental research also relies on the support of the specific ministry's own scientific institutions (mission-oriented R&D institutions) as well as the facilities jointly funded by the Federal and *Länder* governments.
- R&D funding in the narrower sense (mainly provided by the Federal Ministry of Education and Research [BMBF]) which helps to gain general knowledge and achieve further scientific and technical progress is largely based on applications submitted under the various specialised programmes (direct project funding). Departmental research commissioned by the BMBF focuses in particular on research planning, technology forecasts and projections, technology assessments as well as pilot experiments and programmes to be implemented in the education sector.

The BMBF provides basic funding for the Max Planck Society, the Deutsche Forschungsgemeinschaft and the Fraunhofer Society as well as for basic and applied research through the Hermann von Helmholtz Association of German Research Centres. It contributes to financing the construction and expansion of higher education institutions. Through the Deutsche Forschungsgemeinschaft and through special programmes for researchers, research units and young scientists the ministry funds R&D in the higher education sector. Together with the *Länder,* the BMBF also finances other institutions whose research and development activities are of general supraregional interest (Blue List institutions).

4.3 Federal expenditure on research and development by funding area and funding priority

The breakdown of R&D expenditure by funding area and funding priority is based on the Federal Government's R&D planning system which permits an analysis of expenditure in terms of research themes, irrespective of the financing government department. For the BMBF, expenditure is assigned at project level, for the other ministries at budget item level. The resources appropriated for the basic funding of institutions, including the Hermann von Helmholtz Association of German Research Centres (HGF), and the funding allocated to government-owned scientific institutions are also assigned to one or several funding areas or priorities, in keeping with the institutions' tasks and according to research themes. Departing from this pattern are some separate funding priorities which are grouped to form one funding area. This group includes basic funding for the Max Planck Society (MPG), the Deutsche Forschungsgemeinschaft (DFG) and the Fraunhofer Society (FhG) as well as the funds allocated to the construction of higher education institutions and to university-related special programmes. (For details on funding areas see Part III.)

R&D expenditure by the Federal Government

Federal R&D expenditure on civilian and military funding areas followed different trends. While in 1997 R&D accounted for around 82.5 per cent of the civilian funding areas, the percentage planned for 2000 is 84.8 per cent. The volume of R&D funding in the field of defence research and technology will drop accordingly from 17.5 per cent to 15.2 per cent.

– With 19.3 per cent, the funding area comprising *Research funding organisations; restructuring of research in the new Länder; university construction and mainly university-related special programmes* accounted for the greatest share of federal expenditure in 1998; this percentage was slightly up on 1997. The levels budgeted for 1999 and 2000 will be 19.8 per cent in each year. The lion's share of 6.5 per cent (with increasing tendency) was accounted for by basic funding for the DFG (budget 2000: 6.9 per cent).
– Next in line are the funding areas of *Space research and space technology* (8.8 per cent), *Large-scale equipment for basic research* (6.4 per cent), *Sustainable development* (6.3 per cent) and *Information technology (including multimedia and production engineering)* (5.9 per cent) (cf. Table II/5).

1998 R&D expenditure on the various funding areas and their associated funding priorities differed considerably from the 1997 figures (cf. Table II/5):
– With an average rate of increase of 0.7 per cent *Educational research* (+13.7 per cent), *Innovation and improved basic conditions* (+11.4 per cent), *Biotechnology* (+9.8 per cent), *Energy research and energy technology* (+5.4 per cent) – including *Thermonuclear fusion research* as a priority (+12.6 per cent) –, *Materials research; physical and chemical technologies* (+4.9 per cent) as well as *Research and development to improve working conditions* (+4.7 per cent) enjoyed the highest relative growth rates.
– *Humanities; economic and social sciences* (+3.3 per cent), *Information technology (including multimedia and production engineering)* (+2.7 per cent), *Research funding organisations; restructuring of research in the new Länder; university construction and mainly university-related special programmes* as well as *Research and development in the health* sector (+2.5 pr cent each) also boasted above-average increases.
– *Geosciences and raw material supplies* (-34.0 per cent), *Specialised information* (-16 per cent), *Defence research and technology* (-6.4 per cent), *Regional planning and urban development; building research* (-5.3 per cent) and *Aeronautical research and hypersonic technology* (-4.9 per cent) suffered major cuts in relative terms.

the 1998 trend of R&D expenditure on the various funding areas continued in part in 1999 as a result of previous commitments and the continuation of lead projects, but at the same time it was also influenced by structural changes:
– The average increase in R&D expenditure relative to the last actual figures was 3.7 per cent.
– Increases in the following funding areas were much higher – albeit with highly varying expenditure volumes: *Educational research* (+27.3 per cent), *Research and technology for mobility and transport (including transport safety)* (+23.2 per cent), *Research and development to improve working conditions* (+10.4 per cent), *Information technology (including multimedia and production engineering)* (+7.8 per cent), *Materials research; physical and chemical technologies* (+6.7 per cent), and *Innovation and improved basic conditions* (+5.2 per cent).
– Below-average growth rates were recorded for *Energy research and energy technology* (+3.3 per cent), *Marine and polar research; marine technology* (+3.2 per cent) and *Regional planning and urban development; building research* (+1.7 per cent).
– *Space research and space technology* (-1.0 per cent), *Research and development in agriculture, forestry and fishery* (-2.9 per cent), *Aeronautical research and hypersonic technology* (-3.8 per cent) and *Research and development in the food sector* (-4.2 per cent) suffered cuts in R&D funds.

The 2000 budget provides for an average increase in R&D expenditure of 0.5 per cent. The great majority of funding areas will enjoy increases. However, this development compares with a relatively strong negative growth in some other funding areas.
– The funding areas that will grow in volume and also enjoy higher increase rates include *Information technology (including multimedia and production engineering)* (+5.9 per cent), *Biotechnology* (5.2 per cent), *Humanities; economic and social sciences* (+4.6 per cent), *Sustainable development* (+3.9 per cent), *Research and development in the health* sector (+3.1 per cent) as well as *Large-scale equipment for basic research* (+2.1 per cent).
– After above-average increases in previous years expenditure on *Research and technology for mobility and transport (including transport safety)* (-25.4 per cent) and *Innovation and improved basic conditions* (-4.9 per cent) declined. The drop in R&D funds

Table II/5 (cf. Table VII/8)

Footnotes and sources at the end of the table

Federal R&D expenditure by funding area and funding priority

– DM million –

Funding area Funding priority	**1997**	**1998**	**1999**	**2000**
	Actual		Budget[2]	
A Research funding organisations; restructuring of research in the new *Länder*, university construction and mainly university-related special programmes	**3050.7**	**3127.3**	**3312.8**	**3342.6**
A1 Basic funding MPG	747.8	785.2	830.1	855.0
A2 Basic funding DFG	1017.8	1049.6	1136.8	1170.4
A3 Basic funding FhG	429.2	446.0	468.3	482.3
A5 Expansion and construction of universities[1]	582.9	583.5	646.1	647.0
A6 Mainly university-related special programmes[2]	273.0	263.1	231.6	187.9
B Large-scale equipment for basic research	**1027.3**	**1036.4**	**1076.8**	**1099.1**
C Marine and polar research; marine technology	271.0	273.4	282.1	276.6
C1 Marine and polar research	234.0	239.2	242.8	237.2
C2 Marine technology	37.0	34.3	39.4	39.5
D Space research and space technology	**1449.1**	**1429.7**	**1415.7**	**1426.4**
D1 National funding of space research and space technology	450.6	462.7	445.7	446.4
D2 European Space Agency (ESA)	998.5	967.0	970.0	980.0
E Energy research and energy technology	**791.1**	**833.7**	**861.7**	**834.4**
E1 Coal and other fossil fuels	27.4	37.2	44.6	34.9
E2 Renewable energy and energy conservation	294.4	296.9	317.7	304.6
E3 Nuclear energy research (excluding decommissioning of nuclear facilities)	241.8	246.0	237.4	226.9
E4 Decommissioning of nuclear facilities; risk sharing	15.3	14.7	14.7	15.1
E5 Nuclear fusion research	212.2	239.0	247.2	252.8
F Sustainable development	**1019.0**	**1014.6**	**1066.6**	**1108.0**
F1 Socio-ecological research; regional sustainability	416.2	400.7	464.0	455.4
F2 Sustainable production; cleaner environmental technology	382.5	383.1	336.9	355.4
F7 Global change (including peace-building research)	220.3	230.8	265.8	297.2
G Research and development in the health sector	**756.2**	**775.2**	**815.6**	**840.9**
H Research and development to improve working conditions	**85.1**	**89.1**	**98.4**	**99.5**
I Information technology (including multimedia and production engineering)	**936.0**	**961.2**	**1035.8**	**1096.5**
I1 Computer science	187.4	176.0	188.9	197.1

cont. Tabelle II/5

Footnotes and sources at the end of the table

Federal R&D expenditure by funding area and funding priority

– DM million –

Funding area Funding priority	1997 Actual	1998 Actual	1999 Budget[2]	2000 Budget[2]
I2 Basic information technologies	355.1	381.0	390.9	397.9
I3 Application of microsystems (including application of microelectronics; microperipherals)	158.7	149.8	151.6	151.7
I4 Production engineering	115.0	117.9	118.0	120.0
I5 Multimedia	119.8	136.4	186.5	229.8
K Biotechnology	**420.0**	**461.1**	**481.3**	**506.2**
L Materials research; physical and chemical technologies	**668.3**	**701.0**	**747.9**	**744.2**
L1 Materials research; materials for emerging technologies	282.1	289.5	313.8	316.4
L2 Physical and chemical technologies	386.2	411.5	434.1	427.9
M Aeronautical research and hypersonic technology	**296.9**	**282.4**	**271.8**	**234.6**
N Research and technology for mobility and transport (including traffic safety)	**188.0**	**183.5**	**226.0**	**168.7**
O Geosciences and raw material supplies	**104.0**	**68.7**	**70.5**	**79.8**
O1 Geosciences (especially deep drillings)	101.3	66.1	68.1	77.7
O2 Raw material supplies	2.7	2.5	2.4	2.1
P Regional planning and urban development; building research	**97.9**	**92.7**	**94.3**	**99.2**
P1 Regional planning; urban development; housing	38.2	41.8	42.2	42.2
P2 Building research and technology; research and technology for preserving the architectural heritage; road building research	59.8	50.9	52.1	57.0
Q Research and development in the food sector	**84.3**	**79.6**	**76.3**	**71.1**
R Research and development in agriculture, forestry and fishery	**255.6**	**250.9**	**243.7**	**237.8**
S Educational research	**106.7**	**121.3**	**154.4**	**157.0**
S1 Vocational training research	66.2	70.8	86.3	101.0
S2 Other educational research	40.5	50.6	68.1	56.0
T Innovation and improved basic conditions	**717.5**	**799.4**	**841.3**	**800.4**
T1 Indirect funding of R&D personnel in the business enterprise sector	104.2	90.7	80.0	70.0
T2 Improving the transfer of technology and knowledge	164.5	248.5	269.6	242.8
T3 Sharing the innovation risk of technology-based firms	91.0	98.6	114.6	120.0

cont. Table II/5

Footnotes and sources at the end of the table

Federal R&D expenditure by funding area and funding priority

– DM million –

Funding area Funding priority	**1997** Actual	**1998** Actual	**1999** Budget[2]	**2000** Budget[2]
T4 Other indirect funding measures (excluding indirect specific measures)	150.3	172.0	180.0	175.0
T8 Rationalisation as well as scientific and technical departmental services (BMWi)	3.1	3.6	4.7	4.3
T9 Other funding measures (BMWi)	204.4	186.0	192.4	188.2
U Specialised information	**22.2**	**18.7**	**19.4**	**20.4**
V Humanities; economics and social sciences	**459.5**	**474.8**	**473.7**	**495.4**
W1/W2 Other activities not assigned to other sectors	**450.0**	**468.4**	**635.4**	**762.5**
W1 Structural/innovative (generic) measures	43.4	43.0	199.8	222.7
W2 Other generic activities	406.6	425.4	435.6	539.8
W3 Total reduction of expenditure of BMBF [3]	0.0	0.0	-200.0	-220.0
A-W Total of civil funding areas	**13 256.3**	**13 543.3**	**14 101.6**	**14 281.3**
X Defence research and technology	**2806.0**	**2627.4**	**2668.1**	**2568.0**
Total expenditure	**16 062.3**	**16 170.7**	**16 769.6**	**16 849.3**

1 Including *Bundeswehr* universities.

2 Breakdown estimated in some cases.

3 Breakdown of total reduction of expenditure of BMBF by funding area and funding priority is possible for actual expenditure only.

Source: BMBF

Rounding error

allocated to *Aeronautical research and hypersonic technology* that had already been identified in the period reviewed previously has continued up to the year 2000 (-13.7 per cent).

R&D expenditure by the BMBF

Since the BMBF accounts for approximately 60 per cent of federal R&D expenditure, the development of the various funding areas is very much determined by the BMBF's R&D expenditure. As a result of the 1999 redistribution of responsibilities among the various government departments, emphasis within the funding areas has shifted to less industry-related funding priorities (cf. Table II/6). In addition, emphasis was shifted to some selected priorities even though commitments dating back to previous years are still limiting the possibility of major changes in terms of volume.

– In 1998, *Research funding organisations; restructuring of research in the new Länder; university construction and mainly university-related special programmes* received the lion's share of the BMBF's R&D funds with 30.3 per cent. About one third of these resources was used to provide basic funding for the DFG. Other major recipients in this category included the MPG and the FhG with 7.7 per cent and 4.4 per cent, respectively. Just under 8 per cent were used for the *Expansion and construction of universities* and *Mainly university-related special programmes.* In 1999, this funding area will account for 30.7 per cent and in the 2000 budget for 30.4 per cent, thus exceeding the 1998 level.
– *Space research and space technology* held second place with 14.0 per cent. This included 9.5 per cent allocated to the European Space Agency (ESA). In the 1999 budget appropriations this share was reduced by 0.7 per cent to 13.3 per cent and in the 2000 budget to 13.2 per cent.
– Next in line were *Large-scale equipment for basic research* (10.2 per cent), *Information technology (including multimedia and production engineering)* (8.9 per cent), *Sustainable development* (7.0 per cent), *Research and development in the health* sector (5.7 per cent), and *Materials research; physical and chemical technologies* (5.1 per cent). The 1999 and 2000 budgets provide for slightly increasing or constant percentages.

– The 1999 and 2000 budgets allocate 1.9 per cent and 2.1 per cent, respectively, to structural/innovative (generic) measures (W1), a new funding priority. It includes a special programme for promoting innovative regional development concepts in the new *Länder*, strategies to achieve equal opportunities for women in education and research, and the funding of technology assessments.

Relative to 1997, R&D expenditure in 1998 developed as follows:

Educational research (+13.7 per cent) and *Biotechnology* (+12.6 per cent) are funding areas that enjoyed a much higher growth than the average 1.8 per cent. This also applied to *Energy research and energy technology* (+6.7), a funding area which was mainly influenced by the increase in funds allocated to *Thermonuclear fusion research* (+12.6 per cent). Other funding areas boasting above-average growth were *Research and development to improve working conditions* (+5.5 per cent) and *Research and development in the health* sector (+3.5 per cent).

Research funding organisations; restructuring of research in the new Länder; university construction and mainly university-related special programmes, the funding area receiving the lion's share of R&D funding, also grew at an above-average rate of 2.5 per cent.

The funding areas that had below-average rates of increase or even suffered cuts were *Large-scale equipment for basic research* (+0.9 per cent), *Humanities, economic and social sciences* (+0.7 per cent), *Research and technology for mobility and transport* (-0.1 per cent), *Sustainable development* (-1.3 per cent) and A*eronautical research and hypersonic technology* (-6.7 per cent).

The positive trend that most funding areas had enjoyed in the previous reference period continued in part. This is evidenced by a comparison of the 1998 actual figures with the 1999 plans.

About DM 200 million was allocated to R&D in the new funding area structural/innovative (generic) measures in 1999. This new funding area includes not only previous projects accounting for DM 43 million which had so far been covered by other funding areas, but also new R&D schemes worth DM 157 million. Some measures will be augmented or continued which so far had been financed jointly by the Federal and *Länder* governments under the Programme for Ensuring Academic Efficiency (HSP III) which is scheduled to expire in 2000.

Research and technology for mobility and transport was 27.7 per cent up on 1998 actual figures.

The following funding areas recorded above-average increases: *Educational research* (+27.3 per cent), *Research and development to improve working conditions* (+11.1 per cent) *Humanities; economic and social sciences* (+8.3 per cent), *Materials research; physical and chemical technologies* (+6.6 per cent), *Information technology (including multimedia and production engineering)* (+6.0 per cent), *Research funding organisations; restructuring of research in the new Länder; university construction and mainly university-related special programmes* (+5.9 per cent), *Biotechnology* (+5.6 per cent), *Sustainable development* (+5.5 per cent) and *Research and development in the health* sector (+5.2 per cent).

Aeronautical research and hypersonic technology (-0.3 per cent), *Space research and space technology* (-1.0 per cent) and *Regional planning and urban development; building research* (-27.4 per cent) suffered declines.

A comparison of 2000 budget data with 1999 again shows considerable changes in some areas. They reflect the Federal Government's changed priorities.

Higher expenditure (+170.0 per cent) is planned for *Regional planning and urban development; building research*, a funding area with low absolute expenditure. The funding will exclusively benefit the funding priority *Building research and technology; research and technology for preserving the architectural heritage.* More funding will also be allocated to *Geosciences and raw material supplies* (+18.7 per cent).

As in the year before *Biotechnology* (+7.4 per cent), *Sustainable development* (+5.3 per cent), *Information technology (including multimedia and production engineering)* (+4.7 per cent), *Humanities; economic and social sciences* (+4.2 per cent) and *Research and development to improve working conditions* (+3.6 per cent) will continue to enjoy above-average growth rates.

The relatively small increase of 0.9 per cent planned for *Research funding organisations*; *restructuring of research in the new Länder; university construction and mainly university-related special programmes* is a result of the reduced expenditure under the Programme for Ensuring Academic Efficiency (HSP III) which is jointly financed by the Federal and *Länder* governments and will expire in 2000. The sharp decline in expenditure on *Research and technology for mobility and transport* (-29.4 per cent) is due to the fact that the R&D funding programme for the Transrapid magnetic levitation system is being phased out.

Table II/6

Footnotes and sources at the end of the table

R&D expenditure of BMBF by funding area and funding priority

– DM million –

Funding area Funding priority	1997 Actual	1998 Actual	1999 Budget[1]	2000 Budget[1]
A Research funding organisations; restructuring of research in the new *Länder*, university construction and mainly university-related special programmes	**3007.8**	**3083.8**	**3266.8**	**3295.6**
A1 Basic funding MPG	747.8	785.2	830.1	855.0
A2 Basic funding DFG	1017.8	1049.6	1136.8	1170.4
A3 Basic funding FhG	429.2	446.0	468.3	482.3
A5 Expansion and construction of universities	540.0	540.0	600.0	600.0
A6 Mainly university-related special programmes	273.0	263.1	231.6	187.9
B Large-scale equipment for basic research	**1027.3**	**1036.4**	**1076.8**	**1099.1**
C Marine and polar research; marine technology	**252.5**	**255.8**	**262.7**	**258.4**
C1 Marine and polar research	219.6	225.0	227.7	222.4
C2 Marine technology	33.0	30.9	35.0	36.0
D Space research and space technology	**1449.1**	**1429.7**	**1415.7**	**1426.4**
D1 National funding of space research and space technology	450.6	462.7	445.7	446.4
D2 European Space Agency (ESA)	998.5	967.0	970.0	980.0
E Energy research and energy technology	**428.7**	**457.5**	**464.9**	**473.6**
E1 Coal and other fossil fuels	-	4.4	4.4	4.4
E2 Renewable energy and energy conservation	106.2	100.9	100.7	102.8
E3 Nuclear energy research (excluding decommissioning of nuclear facilities)	95.1	98.5	97.9	98.4
E4 Decommissioning of nuclear facilities; risk sharing	15.3	14.7	14.7	15.1
E5 Nuclear fusion research	212.2	239.0	247.2	252.8
F Sustainable development	**714.6**	**712.6**	**751.5**	**791.6**
F1 Socio-ecological research; regional sustainability	253.2	236.7	293.8	297.3
F2 Sustainable production; cleaner environmental technology	287.3	289.5	236.4	243.4
F7 Global change (including peace-building research)	174.1	186.4	221.3	251.0
G Research and development in the health sector	**558.2**	**577.8**	**607.7**	**618.9**
H Research and development to improve working conditions	**47.8**	**50.4**	**56.0**	**58.0**
I Information technology (including multimedia and production engineering)	**889.9**	**911.7**	**966.1**	**1011.6**
I1 Computer science	163.4	146.8	159.7	163.0
I2 Basic information technologies	351.1	378.0	386.9	394.1

cont. Table II/6

Footnotes and sources at the end of the table

R&D expenditure of BMBF by funding area and funding priority

– DM million –

Funding area Funding priority	1997 Actual	1998 Actual	1999 Budget[1]	2000 Budget[1]
I3 Application of microsystems (including application of microelectronics, microperipherals)	158.7	149.8	151.6	151.7
I4 Production engineering	115.0	117.9	118.0	120.0
I5 Multimedia	101.8	119.1	150.0	182.8
K Biotechnology	**312.1**	**351.6**	**371.2**	**398.5**
L Materials research; physical and chemical technologies	**512.8**	**520.9**	**555.2**	**555.4**
L1 Materials research; materials for emerging technologies	235.9	240.3	263.3	266.6
L2 Physical and chemical technologies	276.9	280.6	291.9	288.8
M Aeronautical research and hypersonic technology	**143.0**	**133.5**	**133.1**	**133.7**
N Research and technology for mobility and transport	**133.2**	**133.1**	**170.0**	**120.0**
O Geosciences and raw material supplies	**56.8**	**52.9**	**54.8**	**65.0**
O1 Geosciences (especially deep drillings)	56.8	52.9	54.8	65.0
O2 Raw material supplies	-	-	-	-
P Regional planning and urban development; building research	**16.3**	**6.9**	**5.0**	**13.5**
P2 Building research and technology; research and technology for preserving the architectural heritage	16.3	6.9	5.0	13.5
S Educational research	**106.7**	**121.3**	**154.4**	**157.0**
S1 Vocational training research	66.2	70.8	86.3	101.0
S2 Other educational research	40.5	50.6	68.1	56.0
V Humanities; economics and social sciences	**135.9**	**136.9**	**148.2**	**154.4**
W1/W2 Generic activities (including technology assessment)	**215.8**	**219.7**	**384.9**	**422.6**
W1 Structural/innovative (generic) measures	43.4	43.0	199.8	222.7
W2 Other activities not assigned to other sectors	172.4	176.7	185.1	199.9
W3 Total reduction of expenditure[2]	**-**	**-**	**-200.0**	**-220.0**
Total expenditure	**10 008.8**	**10 192.5**	**10 645.0**	**10 833.4**

1 Breakdown estimated in some cases.

2 Breakdown of total reduction of expenditure of BMBF by funding area and funding priority is possible for actual expenditure only.

Source: BMBF

Rounding error

4.4 Federal and BMBF expenditure on research and development – profile review –

The profile review provides a quick overview of the development of the basic structure of research funding by the Federal Government and the BMBF. As shown in Tables II/5 and II/7 funding areas and funding priorities were grouped to form functions:

As a result of the redistribution of responsibilities among government departments and of the reorientation of the Government's research policy there are some changes in the assignment to functions compared with previous publications: Funding area W, *Other activities not assigned to other sectors*, was extended to include a new funding priority W1, *structural/innovative (generic) measures*. The expenditure on the former funding priority W1, *Other generic activities*, was shifted to funding priority W2, and *Total reduction of expenditure of BMBF* became funding priority W3. The new funding priority W1, *structural/innovative (generic) measures*, and *Building research and technology; research and technology for preserving the architectural heritage* were assigned to the function *Funding of technology and innovation*.

- The trend of federal R&D expenditure in this profile review which covers a longer period (1989 to 2000) shows that, with a share of just over 40 per cent, *Funding of technology and innovation* has remained largely constant.
- Over the same period the percentages of the other three civilian functions – especially that of *University construction and mainly university-related special programmes* – rose.

Table II/7 (cf. Table II/5)

Federal expenditure on research and development* – Profile review –

– DM million –

Function [1] (associated funding areas and funding priorities)	**1989**	**1993**	**1997**	**1998**	**1999**	**2000**
	Actual				Budget	
1. Knowledge-oriented research and cross-programme basic research .... (MPG, DFG, large-scale equipment for basic research) (A1, A2, B)	2045.9	2439.9	2792.9	2871.2	3043.7	3124.4
2. Research and development to provide for the future .... (C1, F1, F7, G, O1, P1, Q, R, S1, S2, V, W2)	2522.2	3381.7	3078.9	3105.8	3282.1	3451.7
3. Funding of technology and innovation ..... (A3, C2, D1, D2, E1, E2, E3, E4, E5, F2, H, I1, I2, I3, I4, I5, K, L1, L2, M, N, O2, P2, T, U, W1)	6066.8	7420.9	6528.6	6719.7	7098.1	7090.3
4. University construction and mainly university-related special .... (A5, A6)	422.7	1019.6	855.9	846.5	877.7	834.9
5. Defence research and technology .... (X)	3127.6	2635.0	2806.0	2627.4	2668.1	2568.0
8. Defence research and technology BMBF [2] (W3)	-	-	-	-	- 200.0	- 220.0
Total	**14 185.2**	**16 897.1**	**16 062.3**	**16 170.7**	**16 769.6**	**16 849.3**

* Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between Federal Government departments.

1 Functions 6 and 7 relate to expenditure that is not relevant to R&D (including resources appropriated under the Federal Training Assistance Act BAföG).

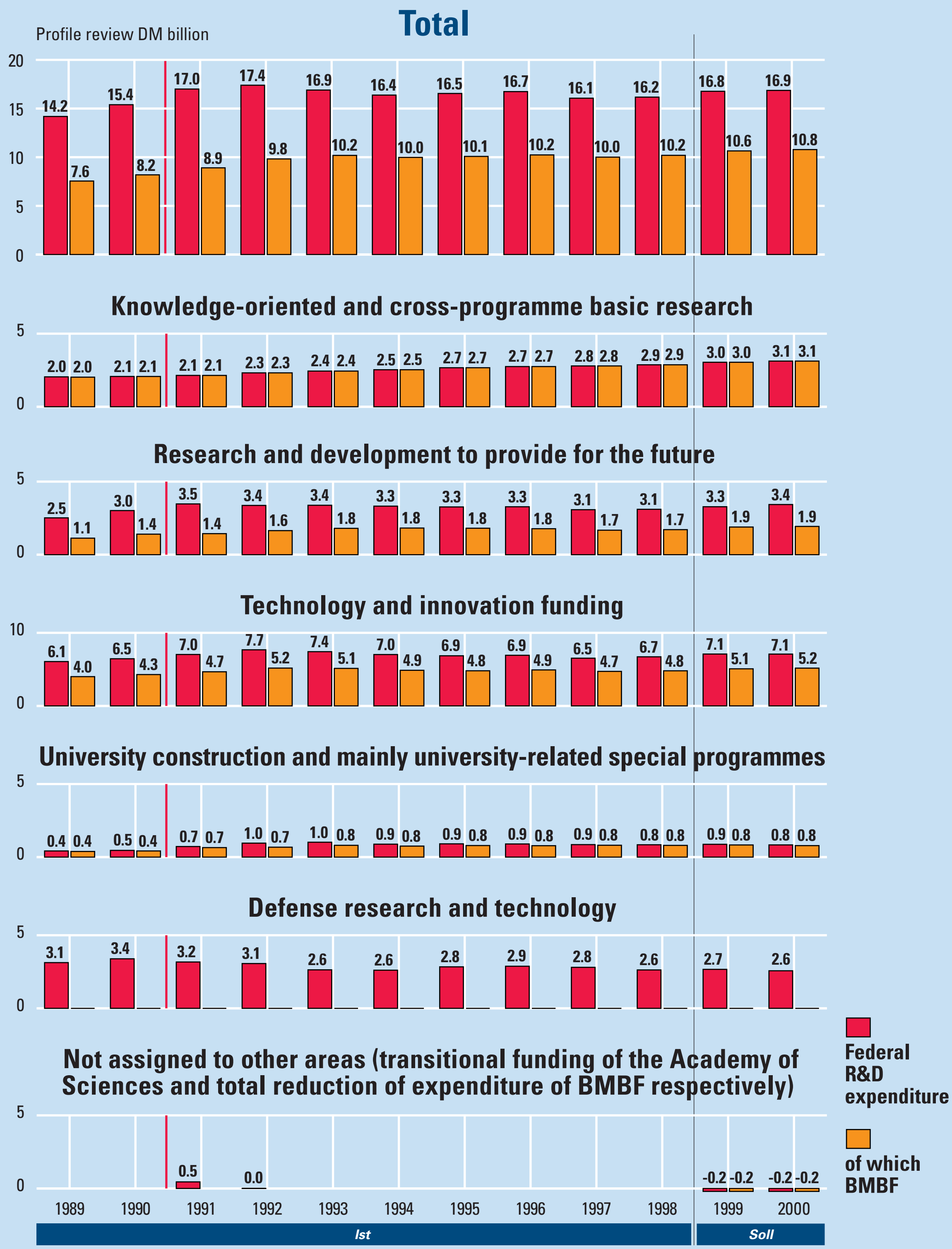
2 Breakdown of total reduction of expenditure (1999 and 2000) of BMBF by function is possible for actual expenditure only.

Source: BMBF

Rounding error

Chart 16

Research and development expenditure by the Federal Government and the BMBF* 1989–2000



* Structure in accordance with the Federal Budget Plan 2000 (draft). Deviation from earlier publications is due to the shifting of responsibilities between the Federal Government departments.

Source: BMBF

BMBF, BuFo 2000

– The share of *Defence research and technology* declined accordingly.

The BMBF profile review reflects a development that differs from that of the Federal Government. The underlying reason is the 1999 redistribution of responsibilities according to which the BMWi alone is responsible for *Innovation and improved basic conditions*. For the purpose of comparison this funding area was completely excluded from the BMBF's profile review – also for previous years (cf. Tables II/6 and II/8):

– Funding for *Technology and innovation* by the BMBF dropped from 53.1 per cent in 1989 to 47.1 per cent in 1998. The 1999 and 2000 budgets provide for a slight increase.
– The decline of funds allocated to this function benefited the other functions whose funding grew accordingly over the period under review.
– Since the Programme for Ensuring Academic Efficiency (HSP III) will be phased out in late 1999, the 2000 budget provides for a decline in the share of the *University construction and mainly university-related special programmes* by half a percentage point.

Table II/8 (cf. Table II/6)

Expenditure of the BMBF on research and development* – Profile review –

– DM million –

Function [1] (associated funding areas and funding priorities)	1989	1993	1997	1998	1999	2000
	Actual				Budget	
1. Knowledge-oriented research and cross-programme basic research (MPG, DFG, large-scale equipment for basic research) (A1, A2, B)	2024.9	2439.9	2792.9	2871.2	3043.7	3124.4
2. Research and development to provide for the future (C1, F1, F7, G, O1, S1, S2, V, W2)	1131.6	1802.9	1676.9	1713.8	1893.1	1965.8
3. Funding of technology and innovation (A3, C2, D1, D2, E1, E2, E3, E4, E5, F2, H, I1, I2, I3, I4, I5, K, L1, L2, M, N, O2, P2, W1)	4006.5	5134.4	4726.0	4804.5	5076.7	5175.2
4. University construction and mainly university-related special programmes (A5, A6)	387.9	807.5	813.0	803.1	831.6	787.9
8. Total reduction of expenditure of BMBF [2] (W3)	-	-	-	-	- 200.0	- 200
Total	**7550.9**	**10 184.7**	**10 008.8**	**10 192.5**	**10 645.0**	**10 833.4**

* Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between Federal Government departments.

1 Functions 6 and 7 relate to expenditure that is not relevant to R&D (including resources appropriated under the Federal Training Assistance Act BAföG).

2 Breakdown of total reduction of expenditure (1999 and 2000) of BMBF by function is possible for actual expenditure only.

Source: BMBF

Rounding error

4.5 Federal expenditure on research and development by type of funding

R&D expenditure is broken down into the following types of funding: project funding, basic funding of institutions (statutory funding), university-related funding and international co-operation. Project funding comprises project-related financing, funds for research commissioned as departmental research and funding for defence research and development. Because they have similar structures (albeit a different legal status) scientific institutions owned by the Federal Government were categorised as institutions receiving statutory funding. The classification of university-related research was based on functional aspects (cf. Table VII/9).

– A comparison covering a longer period of time reveals that project funding plunged by more than 10 percentage points, while over the same period basic funds for institutions rose by about 8 per cent. University-related funding went up by 2 percentage points (cf. Table II/9).
– At 43.7 per cent in 1998, basic funding of institutions was slightly higher than project funding (42.3 per cent). In 1999, project funding (43.9 per cent) and basic funding of institutions (43.5 per cent) are more or less at the same level. The percentages of university-related funding and international co-operation will change only marginally.

The budget for 2000 promises a stronger increase in basic funding of institutions (44.8 per cent), while project funding will fall by slightly more than a percentage point. This decrease will be influenced in particular by declining funds for defence research and development contracts which also fall into the category of project funding.

Table II/9 (cf. Table VII/9)

Federal R&D expenditure by type of funding

Type of funding	1989	1993	1997	1998	1999	2000
	Actual				Budget	
	– DM million –					
Total	**14 185.2**	**16 897.1**	**16 062.3**	**16 170.7**	**16 769.6**	**16 849.3**
of which:						
Project funding [1]	7597.9	7611.0	6802.6	6834.1	7364.5	7216.5
Basic funding of institutions	5048.6	6634.1	6968.0	7069.7	7286.4	7546.7
University-related funding	390.0	962.9	803.6	797.8	811.7	781.4
International co-operation	1148.7	1689.0	1488.1	1469.0	1507.0	1524.7
Total reduction of expenditure of BMBF [2]	-	-	-	-	- 200.0	- 220.0
	– Percentage –					
Total	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***
of which:						
Project funding [1]	*53.6*	*45.0*	*42.4*	*42.3*	*43.9*	*42.8*
Basic funding of institutions	*35.6*	*39.3*	*43.4*	*43.7*	*43.5*	*44.8*
University-related funding	*2.7*	*5.7*	*5.0*	*4.9*	*4.8*	*4.6*
International co-operation	*8.1*	*10.0*	*9.3*	*9.1*	*9.0*	*9.0*
Total reduction of expenditure of BMBF [2]	-	-	-	-	*- 1.2*	*- 1.3*

1 Including expenditure on contracts in the context of departmental and defence research and development.

2 Breakdown of total reduction of expenditure of BMBF by type of funding is possible for actual expenditure only.

Source: BMBF

Rounding error

4.6 Federal expenditure on research and development by recipient group

A breakdown of the Federal Government's expenditure in research and development by recipient group provides an overview of the distribution of federal funding channelled to recipients in the various sectors of the economy for performing R&D or earmarked for financing their R&D (cf. Tables II/10 and VII/10).

– In 1998, non-profit organisations (including DFG, MPG and FhG) received the largest share of federal R&D funding, i.e. 44.9 per cent. Next in line were firms and companies in the business enterprise sector with 26.3 per cent. A longer-term comparison shows that only territorial authorities (regional and local governments), with approximately 19 per cent, and the sector Abroad, with about 10 per cent, enjoyed relatively constant percentages. The percentage allocated to firms and companies in the business enterprise sector, on the other hand, decreased (cf. Table II/10).
– The breakdown of expenditure by recipient groups for 1999 and 2000 which is still preliminary or contains estimations in part, indicates that the percentages of funding channelled to non-profit organisations and territorial authorities will rise again, whereas the shares going to firms and companies of the business enterprise sector will shrink.
– In this breakdown R&D funding allocated to territorial authorities does not include any resources channelled to higher education institutions via the DFG. Under the R&D classification system this funding is not directly assigned to the higher education sector as a recipient but rather to private non-profit organisations. If these funds were included, the trend of R&D appropriations for the higher education sector would be as follows:
1996 (actual) DM 2.3 billion
1997 (actual) DM 2.4 billion
1998 (actual) DM 2.4 billion
1999 (budgeted) DM 2.6 billion
2000 (budgeted) DM 2.6 billion
Table VII/12 shows federal funds allocated to firms and companies in the business enterprise sector broken down by industries.
– About 80 per cent of funding allocated to the business enterprise sector in 1998 went to the manufacturing sector, and just under one third of these resources went to aerospace companies. Compared with 1997, funding for the manufacturing sector decreased at a greater pace (-6.3 per cent) than total funds paid to all companies (-4.6 per cent).

Table II/10 (cf. Table VII/10)

Federal R&D expenditure by recipient group

Recipient group	1989	1993	1997	1998	1999	2000
	Actual				Budget*	
	– DM million –					
Total	**14 185.2**	**16 897.1**	**16 062.3**	**16 170.7**	**16 769.6**	**16 849.3**
of which:						
Territorial authorities	2772.7	3392.9	3068.8	3061.3	3246.9	3181.9
Private non-profit organisations	5031.7	7024.2	7139.9	7267.7	7729.0	8013.4
Business enterprise sector	4916.0	4563.8	4329.3	4255.9	4371.1	4249.0
Abroad	1464.9	1916.1	1524.4	1585.7	1622.6	1625
Total reduction of expenditure of BMBF *	-	-	-	-	- 200.0	- 220.0
	– Percentage –					
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
of which:						
Territorial authorities	19.5	20.1	19.1	18.9	19.4	18.9
Private non-profit organisations	35.5	41.6	44.5	44.9	46.1	47.6
Business enterprise sector	34.7	27.0	27.0	26.3	26.1	25.2
Abroad	10.3	11.3	9.5	9.8	9.7	9.6
Total reduction of expenditure of BMBF *	-	-	-	-	- 1.2	- 1.3

*) Breakdown estimated. Breakdown of total reduction of expenditure of BMBF by recipient group is possible for actual expenditure only.

Source: BMBF

Rounding error

– Funding for the service sector went up; its percentage of total expenditure rose from about 16 per cent in 1996 and 1997 to 18.5 per cent in 1998.
– The strong decline of expenditure on agriculture, forestry and fisheries in 1997 is mainly attributable to methodological reasons; R&D funds for renewable raw materials were no longer assigned to this sector of the economy, but for the first time were assigned to the final recipient at the level of branches of industry.

Funding allocated to firms and companies in the business enterprise sector which until 1995 had been determined on the basis of the old Industrial Classification of Economic Activities (1979 version) was reallocated in part to the appropriate categories of the revised Industrial Classification (1993 version).

Due to the sometimes more detailed classification of activities in the revised version, the inclusion of new economic activities, the shifting of industries within the classification and due to the fact that this new classification was not introduced by all reporting units at the same time, data pertaining to the period up to und including 1995 are not fully comparable with the data relating to the years after 1996, especially at a lower level of aggregation.

It should also be noted that BMBF funding for indirect measures that is channelled to business enterprises through project management agencies is no longer classified by economic activities; this is why such funding could not be included in these considerations.

4.7 Federal expenditure on research and development by region*

About 88.3 per cent of the total of DM 16.2 billion spent by the Federal Government in 1998 to finance research and development remained in Germany (1997: 88.7 per cent) (cf. Table VII/39).

The better part of funds channelled abroad, totalling almost DM 1.7 billion, was accounted for by financial contributions to international scientific organisations and intergovernmental research institutions which received about DM 1.5 billion (cf. Table VII/12).

The new *Länder* including East Berlin accounted for roughly DM 2.5 billion or 17.2 per cent of R&D financed in Germany in 1998. This percentage had dropped to 16.7 per cent in 1997, but exceeded the 17 per cent mark again in 1998. This does not include project funds channelled to the new *Länder* via grantees based in the old *Länder* or West Berlin. *(It should be noted in this context that the increasing interlinkage between companies and institutions makes it difficult for reporting units to determine the East/West ratio of R&D funds going to Berlin so that it had to be estimated in some cases).*

Among the new *Länder,* Saxony, with 4.8 per cent, received the greatest share in 1998, followed by Brandenburg with 3.4 per cent and Saxony-Anhalt with 2.0 per cent. Thuringia with 1.8 per cent and Mecklenburg-West Pomerania 1.7 per cent got almost equal shares.

Among the old *Länder*, the Free State of Bavaria received the highest percentage of total R&D funding in 1998 with 18.3 per cent (1997: 21.3 per cent); runners-up were Baden-Württemberg with 17.5 per cent (1997: 15.5 per cent) and North Rhine-Westphalia with 17.2 per cent (1997: 16.8 per cent).

Table II/11 (cf. Table Tabelle VII/39)

Federal R&D expenditure by region *

– Financing of R&D –

Region	1995 Actual		1996 Actual		1997 Actual		1998 Actual	
	DM million	%	DM million	%	DM million	%	DM million	%
Total	**16 547.2**		**16 740.4**		**16 062.3**		**16 170.7**	
of which								
Domestic expenditure	14 741.9	*100.0*	15 026.9	*100.0*	14 434.8	*100.0*	14 482.5	*100.0*
of which:								
Old *Länder*	12 124.0	*82.2*	12 366.2	*82.3*	12 015.8	*83.2*	11 988.6	*82.8*
New *Länder* and East Berlin[3] ...	2617.9	*17.8*	2660.7	*17.7*	2419.0	*16.8*	2493.9	*17.2*

* The major criterion used in breaking down Federal R&D expenditure by region is usually the headquarters of the institution performing R&D. For joint research funding by the Federal Government and the *Länder* under the Skeleton Agreement on Research Promotion, Federal R&D expenditure was therefore broken down by the funding requirement of institutes or units supported. For Federal research institutions, R&D expenditure is shown for headquarters and branches/units of an institutional nature. The impact of subcontracting and resulting transfer of funds between *Länder* has not been taken into account in regional breakdown. Minor deviations from earlier publications are due to follow-up surveys and in some cases greater detail of breakdown of R&D expenditure.

Source: BMBF

Rounding error

5. Expenditure of the Länder on science, research and development

Länder R&D funding primarily benefits the higher education sector, be it as annual block grants for university research and teaching, be it as external funds including the contribution of the *Länder* to funding the Deutsche Forschungsgemeinschaft (DFG). *Länder* funds for science, research and development go not only to the higher education sector, but also to joint research funding by the Federal and *Länder* governments, i.e. to the institutions of the Max Planck Society, the Fraunhofer Gesellschaft, the Helmholtz Centres, the Wissensgesellschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association) and the projects of the Academies of Sciences. Other beneficiaries of *Länder* science and research funding include *Länder* and local government institutions performing scientific and research activities and the business enterprise sector which receives public funds under research, technology and innovation funding programmes.

In 1997, *Länder* and local governments spent roughly DM 33.7 billion on science, research and development which was one per cent less than in the previous year. Also in 1998 (preliminary actual figures), there was only a minor increase of 0.6 per cent to DM 33.9 billion.

Table II/12 (cf. Table VII/14)

Basic funds * allocated to science by *Länder* and local government

– DM million –

Land	1993	1995	1996	1997	1998	1999
	Actual				Provisional	Budget [1]
Baden-Württemberg	4114.2	4352.7	462.7	4291.0	4434.2	4758.3
Bavaria	4399.8	4908.7	5183.8	5148.0	5212.2	5565.7
Berlin	3248.3	3125.7	3039.0	2910.0	2934.8	2952.9
Brandenburg	424.8	643.4	700.4	713.0	701.6	688.5
Bremen [2]	368.9	381.6	388.1	378.0	408.8	385.1
Hamburg	1039.3	1063.8	1191.8	1094.0	1206.0	1097.7
Hesse	404.9	2387.7	2319.7	2354.0	2337.5	2425.0
Mecklenburg-Western Pomerania	475.6	651.9	774.0	757.0	764.7	769.5
Lower Saxony	2644.7	2656.8	2680.9	2651.0	2712.7	2880.7
North Rhine-Westphalia [2]	5679.5	6003.2	6241.6	6438.0	6174.5	6368.1
Rhineland-Palatinate	1045.1	1127.5	1176.0	1203.0	1245.3	1342.4
Saarland	418.9	411.5	389.7	389.0	393.5	413.3
Saxony [2]	1739.9	2008.4	2184.7	2156.0	2149.5	2179.7
Saxony-Anhalt	863.4	1075.5	1026.1	1126.0	1111.0	1137.7
Schleswig-Holstein [2]	847.2	1026.3	998.9	968.0	926.8	958.9
Thuringia [2]	943.2	1094.1	1256.7	1099.0	1156.9	1241.6
Total	**30 658.8**	**32 918.8**	**34 014.1**	**33 675.0**	**33 869.7**	**35 165.4**
of which:						
Former West Germany including East Berlin	26 210.9	27 445.3	28 072.2	27 824.0	27 986.3	29 148.4
New *Länder* excluding East Berlin	4447.9	5473.5	5941.9	5 849.0	5883.5	6 017.0
of which R&D expenditure of the Länder [3]	*13 546*	*14 381*	*14 769*	*14 618*	*14 784*	*14 860*

* Basic funds: net expenditure minus direct revenues (especially revenues of the *Länder* from patient care in university hospitals).

1 Budgeted figures are not fully comparable with actual figures due to different estimating methods.

2 Cf. comments in Table VII/14.

3 Estimated in some cases; actual figures up to and including 1997.

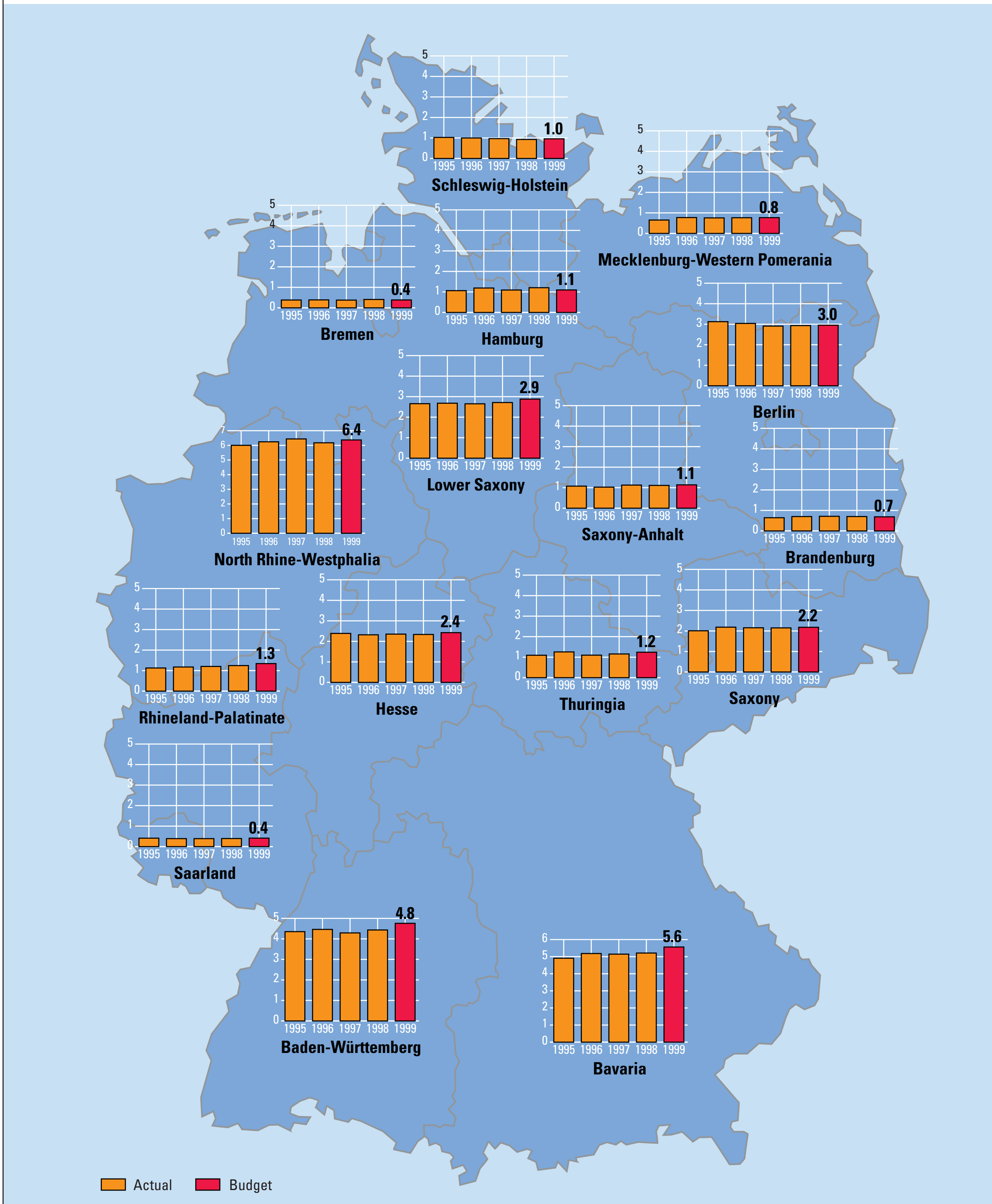
Source: Federal Statistical Office, BMBF

Rounding error

Chart 17

Science expenditure by the *Länder* and local government

– basic funds* DM billion –



* Basic funds: net expenditure minus direct revenues (especially revenues from patient care in university hospitals). Figures for 1998: provisional actual figures. Budgeted figures are not fully comparable with actual figures due to different estimating methods.

Source: Federal Statistical Office, BMBF

BMBF, BuFo 2000

In 1997 and 1998, the new *Länder* accounted for 17.4 per cent of science expenditure; this is slightly less than their share in Germany's total population of 18.7 per cent (1998).

Science expenditure – to be precise, basic funding for science[1] – by *Länder* and local governments was accounted for by the higher education sector including university hospitals with 86.0 per cent of funds in 1997, while the remaining 14.0 per cent went to non-university science and research. This means that in 1997 funding allocated to universities was slightly up on 1996 (85.6 per cent); in subsequent years there was again a shift in favour of non-university science and research (1998: 14.7 per cent; 1999: 15.3 per cent).

Like science expenditure, *Länder* expenditure on research and development covers R&D in the higher education sector as well as in the non-university sector, i.e. non-university institutions and the business enterprise sector. In 1997, *Länder* expenditure on R&D totalled about DM 14.6 billion, which was 1.0 per cent down on 1996.

In 1997, the *Länder* contributed 17.4 per cent to total German R&D funding. The largest contributions were made by North Rhine-Westphalia (19.2 per cent of total *Länder* contributions), Bavaria (16.2 per cent), Baden-Württemberg (13.1 per cent) and Hesse (8.3 per cent) in the West, and Saxony (7.2 per cent) in the East. Compared with 1995, changes occurred in particular in Saxony where R&D expenditure increased by 18 per cent, as well as Thuringia (12 per cent increase) and Mecklenburg-Western Pomerania (11 per cent increase).

Part IV of this report provides a detailed description the *Länder* governments' research and technology policies.

6. Joint research funding by Federal and *Länder* governments

In 1998, Federal and *Länder* governments spent roughly DM 31.0 billion on research and development, while the 1999 budget provided for a total expenditure of DM 31.6 billion. This means that the government financed 35.3 per cent (1999: 34.1 per cent) of the total spent on R&D in Germany (cf. Table II/2). More than a quarter of these government R&D funds was accounted for by basic funding for institutions which is jointly provided by the Federal and *Länder* governments.

The legal basis for joint research funding by Federal and *Länder* governments is provided by Article 91b of the Basic Law (Constitution) which stipulates that "the federation and *Länder* may, pursuant to agreements, co-operate in educational planning and in the promotion of research institutions and projects of supraregional importance. The apportionment of costs shall be regulated in the relevant agreements". The Skeleton Agreement between the Federal and *Länder* governments on the Joint Promotion of Research alluded to in Article 91b lays down in particular which areas or institutions are covered by joint research funding and defines the financing formula which determines the shares to be contributed by the Federal Government and by the *Länder* governments.

The resources provided by the Federal and *Länder* governments for joint research funding are almost exclusively used as basic funding for the institutions listed below. In 1998 (actual) joint research funding totalled DM 8.5 billion and in 1999 (budget) DM 9.0 billion. The 2000 budget provides for DM 9.2 billion. The Federal Government's contribution was just under 70 per cent each year, with the shares contributed by the Federal Government and the *Länder* governments varying from institution to institution (cf. Table II/13, Chart 18). Depending on the type of institution, the *Länder* contribution is made either only by the *Länder* governments concerned or, based on a distribution formula (Königstein formula) by all *Länder* governments.

The institutions receiving joint research funding will be described in detail below. For further information see Part VI of this Report.

Helmholtz Centres

With DM 3.3 billion budgeted for 1999, the largest share of funds provided under the joint research funding scheme went to the national research centres that form the Hermann von Helmholtz Association of German Research Centres. The 2000 budget provides for funding of DM 3.2 billion. In keeping with a financing ratio of 90:10 (Federal and host *Länder* governments), the Federal Government will contribute roughly DM 2.9 billion in both 1999 and 2000, while the *Länder* will provide DM 380 million in 1999 and DM 365 million in 2000. Under the joint research funding scheme the Helmholtz Centres receive the largest share of Federal Government funds. The DM 2.9 billion allocated in 1999 make up 47.6 per cent of total federal R&D expenditure.

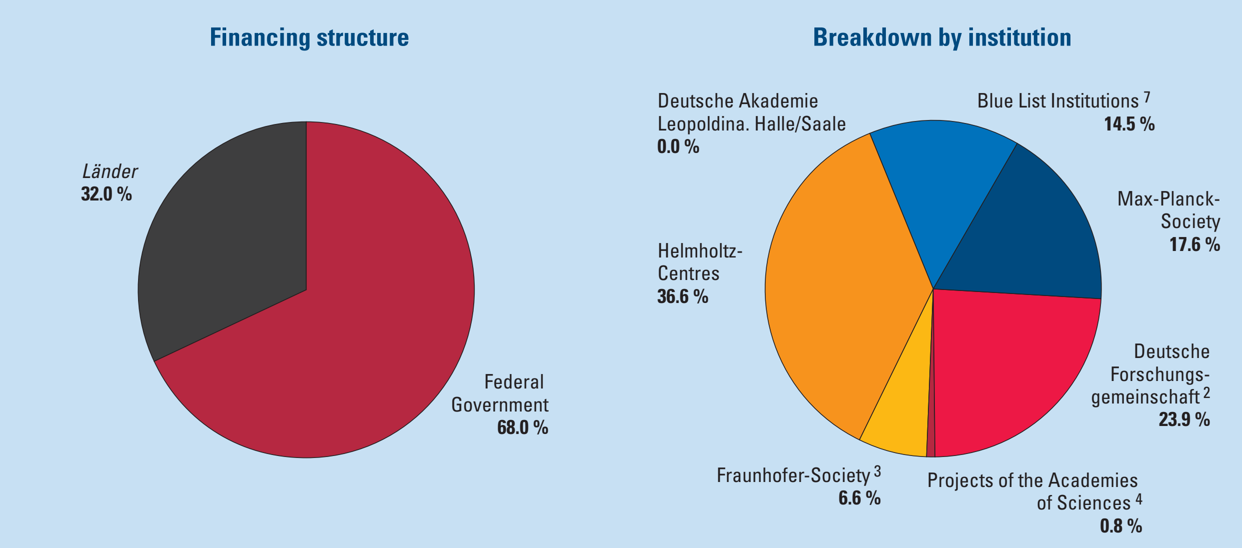
Deutsche Forschungsgemeinschaft (DFG)

The largest share of *Länder* funds provided under the joint research funding scheme goes to the Deutsche Forschungsgemeinschaft (DFG) (1999: 31.5 per cent, which was DM 909 million). Being the central self-governed science institution to fund research at higher education and public research institutions, the DFG channels most of its funds into research in the higher education sector. The con-

[1] Basic funds for science are based on the science expenditure by Länder and local governments adjusted for direct revenues (net expenditure). This concept permits largely to eliminate (especially by subtracting Länder revenues from patient care) the growing distortion of net expenditure caused by the funds spent on patient care in university hospitals.

Chart 18

Joint research funding by the Federal Government and the *Länder* 1999



For comments see table II/13
Source: BMBF

BMBF, BuFo 2000

tributions to financing made by the Federal and *Länder* governments vary from programme to programme: For general research funding schemes the ratio is 50:50, for collaborative research centres and the Leibniz Programme it is 75:25 and for postgraduate research groups 65:35, and 50:50 after 1 January 1999. In 2000, the Federal and *Länder* governments will presumably provide the DFG with DM 2.3 million in basic funding (budget). This is 6.0 per cent up on 1999 (budget).

Max Planck Society (MPG)

The Max Planck Society funds non-university research and conducts basic research in the natural sciences, biosciences and humanities in its own institutes. About 95 per cent of MPG funds are public monies, while the remaining 5 per cent are accounted for by membership dues, donations and the organisation's own income. Basic funding for the MPG amounts to DM 1.6 billion (budget) in 1999 and DM 1.7 billion (budget) in 2000, this is an increase of 7.9 per cent over the previous year. Resources are provided by the Federal and *Länder* governments on a 50:50 basis.

Blue List institutions (BLE) – Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL)

The so-called Blue List includes 84 non-university research institutions and institutions providing services for research. Together, the great majority of these institutions (80) form the Wissensgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association). The Blue List institutions account for 14.5 per cent of the basic funding of institutions jointly provided by the Federal and *Länder* governments, i.e. about DM 1.3 billion (1999 and 2000 budgets). Usually the funding ratio is 50:50, but it may vary for institutions providing services for research.

Fraunhofer Society (FhG)

The Fraunhofer Society, with 47 non-university research institutions, is focusing on applied research. It is financed through basic funding by the Federal and *Länder* governments on a 90:10 basis, one-off grants for specific projects and the FhG's own revenues. A total of DM 595 million was agreed for 1999 and a sum of DM 606 million for 2000.

Projects of the Academies of Sciences

The research programme of the academies comprises 157 long-term projects which are financed by the Federal and host *Länder* governments on a 50:50 basis. Projects will be included in the programme of the Academies when they are of national importance and high scientific quality. Other criteria are a minimum term of ten years and a minimum volume in terms of finance and staff. Joint research funding is planned to total DM 73 million in 1999 and DM 75 million in 2000.

Deutsche Akademie der Naturforscher Leopoldina

The Deutsche Akademie der Naturforscher Leopoldina is a scientific and medical learned society, based in Halle, which does not operate any research institutions of its own The Federal Government and the host Land (state) government provide basic funding on an 80:20 basis. The total envisaged for this institution is DM 4.0 million in 1999 and DM 3.2 million in 2000.

Table II/13

Footnotes and sources at the end of the table

Joint research funding by the Federal Government and the *Länder* 1998 to 2000 (Basic funding of institutions[1])

– DM million –

Institution	1998 Actual			1999 Budget			2000 Budget		
	Total	Federal Government	*Länder*	Total	Federal Government	*Länder*	Total	Federal Government	*Länder*
Max Planck Society	**1553.4**	**765.2**	**788.2**	**1586.0**	**793.0**	**793.0**	**1711.4**	**855.7**	**855.7**
Deutsche Forschungsgemeinschaft[2]	**2008.2**	**1176.9**	**831.3**	**2155.3**	**1246.3**	**909.0**	**2284.2**	**1311.3**	**972.9**
of which:									
– general funding of research	1227.5	613.8	613.8	1330.9	665.5	665.5	1394.6	697.3	697.3
– special research programmes	583.9	437.9	146.0	613.0	459.8	153.3	631.4	473.6	157.9
– Emmy Noether Programme	.	.	.	.	.	.	41.0	20.5	20.5
– funding of cutting-edge research	29.5	22.1	7.4	24.0	18.0	6.0	29.5	22.1	7.4
– funding of postgraduate studies	115.7	75.2	40.5	198.6	129.1	69.5	205.7	133.7	72.0
– funding of professorial candidates	43.0	21.5	21.5	25.0	12.5	12.5	12.6	6.3	6.3
– socio-economic panel	4.4	2.2	2.2	4.5	2.3	2.3	4.6	2.3	2.3
– special grant for general funding of research	.	.	.	.	.	.	18.8	9.5	9.2
Fraunhofer Society[3]	**498.9**	**410.0**	**88.9**	**594.6**	**471.6**	**123.0**	**606.1**	**483.3**	**122.8**
Projects of the Academies of Sciences[4]	**72.0**	**36.0**	**36.0**	**73.0**	**36.5**	**36.5**	**75.0**	**37.5**	**37.5**
Helmholtz Centres	**3101.3**	**2757.3**	**344.0**	**3298.4**	**2918.8**	**379.6**	**3234.1**	**2869.2**	**364.9**
of which:									
– Alfred Wegener Institute for Polar and Marine Research, Bremerhaven (AWI)	135.3	122.0	13.3	143.7	129.3	14.4	149.8	134.3	15.5
– Stiftung Deutsches Elektronen-Synchrotron, Hamburg (DESY)	282.5	254.3	28.2	286.8	258.1	28.7	289.9	260.9	29.0
– German Cancer Research Centre, Heidelberg (DKFZ)	56.6	140.9	15.7	159.3	143.4	15.9	169.8	152.8	17.0
– German Aerospace Centre, Cologne (DLR)	409.4	368.7	40.7	410.9	370.1	40.8	417.7	376.8	40.9
– Research Centre Jülich, (FZJ)[5/6]	492.5	432.5	60.0	462.3	398.0	64.3	523.7	455.3	68.4
– Karlsruhe Research Centre Technology and Environment (FZK)[5]	516.3	463.4	52.9	696.4	621.1	75.3	540.2	484.0	56.2
– National Research Centre for Biotechnology, Brunswick (GBF)	60.4	54.4	6.0	56.9	51.2	5.7	59.2	53.3	5.9
– GeoForschungsZentrum, Potsdam (GFZ)	63.3	57.0	6.3	64.0	57.6	6.4	63.6	57.2	6.4
– GKSS – Research Centre Geesthacht, (GKSS)	111.8	100.6	11.2	117.9	106.1	11.8	108.4	97.6	10.8
– GMD – National Research Centre for Information Technology, St. Augustin near Bonn (GMD)	128.2	115.4	12.8	129.2	116.3	12.9	132.1	118.9	13.2
– GSF – National Research Centre for Environment and Health, Neuherberg near Munich	147.5	133.7	13.8	148.7	134.7	14.0	152.0	137.7	14.3
– Gesellschaft für Schwerionenforschung mbH, Darmstadt (GSI)	124.8	112.3	12.5	125.7	113.1	12.6	128.1	115.3	12.8

cont. Table II/13 Footnotes and sources at the end of the table

Joint research funding by the Federal Government and the *Länder* 1998 to 2000 (Basic funding of institutions[1])

– DM million –

Institution	1998 Actual Total	1998 Actual Federal Government	1998 Actual *Länder*	1999 Budget Total	1999 Budget Federal Government	1999 Budget *Länder*	2000 Budget Total	2000 Budget Federal Government	2000 Budget *Länder*
– Hahn Meitner Institute Berlin (HMI)	112.8	101.5	11.3	111.1	100.0	11.1	115.9	104.3	11.6
– Max Planck Institute for Plasma Physics, Garching near Munich (IPP)	178.4	137.3	41.1	194.4	147.7	46.7	195.1	151.0	44.1
– Max Delbrück Centre for Molecular Medicine, Berlin-Buch (MDC)	90.9	81.8	9.1	92.7	83.4	9.3	92.3	83.1	9.2
– UFZ Centre for Environmental Research, Leipzig-Halle (UFZ)	90.6	81.5	9.1	96.9	87.2	9.7	96.3	86.7	9.6
Blue List Institutions[7]	**1239.9**	**628.8**	**611.1**	**1304.5**	**661.2**	**643.3**	**1291.8**	**654.1**	**637.7**
Deutsche Akademie Leopoldina, Halle/Saale	**4.9**	**3.9**	**1.0**	**4.0**	**3.2**	**0.8**	**3.2**	**2.6**	**0.6**
Total	**8478.6**	**5778.1**	**2700.5**	**9014.3**	**6129.1**	**2885.2**	**9205.8**	**6213.7**	**2992.1**

1 The above amounts also include funds provided on the basis of special agreements between the Federal Government and the *Länder;* this results in deviations from the allocation keys laid down in the Skeleton Agreement on Research Promotion pursuant to Article 91b of the Basic Law; in some cases including special funds provided under the special funding programme for higher education and research HSP III.

2 Including funds provided to DFG by the Federal Government and the *Länder* to be used for specified purposes. Excluding the DFG's own funds and funds from non-governmental sources.

3 Excluding basic funding of institutions by the Federal Ministry of Defence to the amount of approx. DM 56 million p.a. as these resources are not subject to joint funding by the Federal Government and the *Länder*.

4 Project funding.

5 Excluding funds earmarked for the decommissioning and dismantling of nuclear installations and other facilities.

6 Including the Institute for Biotechnology, which is financed 100% by North Rhine-Westphalia.

7 As decided by the BLK, excluding funds from the special funding programmes for higher education and research and from the University Renewal Programme HEP.

Source: BLK, business plans, published in the Federal Budget Plan 2000, and BMBF calculations. Rounding error

7. Resources for research and development in the higher education sector

7.1 Importance of the higher education sector for research and development

In addition to the business enterprise sector and non-university institutions, higher education institutions form the third major sector performing research and development. The contribution of the higher education sector to performing research and development was estimated at 16.8 per cent in 1999. The special feature of higher education institutions is that there is a close interlinkage between research and education so that it is not possible to separate these two activities right from the beginning. R&D expenditure is determined on the basis of so-called R&D coefficients derived from the total expenditure by higher education institutions[1]. The basis for such calculations is provided by higher education financial statistics, the number of students enrolled, examinations passed,

[1] Cf. Heinz Werner Hetmeier, „Methodik und Berechnung der Ausgaben und des Personals der Hochschulen für Forschung und experimentelle Entwicklung ab dem Berichtsjahr 1995" in Wirtschaft und Statistik, 2/1998.

personnel working hour budgets and other information from official statistics. According to the criteria agreed on within the OECD framework, the higher education sector does not include associated institutes, i.e. legally independent entities which frequently, however, have close and diverse ties with the universities with which they are associated.

7.2 Higher education expenditure on education and research

In 1997, the last year for which actual data are available, the higher education sector spent a total of DM 35.2 billion on education and research. 1998 and 1999 expenditures are estimated to amount to DM 35.7 billion per year.

7.3 Higher education expenditure on education and research by field of science

If the costs of central facilities are excluded from the following considerations, medicine accounted for the highest expenditure on education and research in 1997 with DM 8.1 million, i.e. 31.3 per cent. With DM 6.1 billion or 23.6 per cent, the humanities and social sciences had a slightly higher expenditure than the natural sciences with DM 5.7 billion or 22.1 per cent. The 1997 expenditure of the engineering sciences on education and research amounted to DM 5.0 billion (19.1 per cent). The lowest expenditure by far in 1997 was that of agricultural sciences with DM 1.0 billion (3.9 per cent).

All in all, the science expenditure by the higher education sector rose by 12.6 per cent compared with 1993, and by 28.1 per cent compared with 1991, a year that was still affected by German unification. In terms of the breakdown of science expenditure by fields of science there have been only minor changes since 1993. If, however, 1991 were included in the comparison, there would be an above-average increase in the engineering sciences and in the humanities and social sciences, while expenditure in the field of medicine rose at a below-average rate.

7.4 Higher education expenditure on education and research by type of higher education institution

Almost two thirds (63.8 per cent in 1999) of the expenditure on education and research were accounted for by universities and equivalent institutions with the exception of medical facilities. Medical facilities accounted for 23.2 per cent of expenditure on education and research and Fachhochschulen (Universities for Applied Sciences) for the remaining 13.0 per cent.

As in previous years, expenditure at universities in 1997 focused on the natural sciences (DM 5.5 billion or 37.2 per cent), followed by the humanities and social sciences with DM 5.0 billion or 34.0 per cent (this approach does not include expenditure on central facilities). At the Fachhochschulen the better part of funds was allocated to the engineering sciences (DM 1.6 billion or 51.5 per cent). The humanities received DM 1.1 billion (36.0 per cent). The funding expended on the natural sciences of DM 0.2 billion (7.7 per cent) was relatively insignificant. A breakdown of the 1998 and 1999 expenditures is not yet available.

7.5 Total higher education expenditure on R&D

The expenditure of the higher education sector on research and development which was determined by means of R&D coefficients amounted to DM 15.0 billion in 1997, that is 42.7 per cent of the total higher education expenditure on education and research. In 1998, an estimated DM 15.3 billion was spent on R&D. In 1999, the sum total was DM15.5 billion.

Between 1993 and 1999, the R&D expenditure of the higher education sector grew by 16.0 per cent; between 1991 – the year still influenced by German unification – and 1999, the rate of increase was even 28.6 per cent.

7.6 Higher education expenditure on R&D by field of science

The trend of higher education R&D expenditure was not identical in all fields of science. With 21.4 per cent, the humanities and social sciences enjoyed the highest increase (1997 compared with 1993). They were followed by the engineering sciences (16.9 per cent), medicine (13.4 per cent) and the natural sciences (12.3 per cent). R&D expenditure on agriculture remained almost unchanged with an increase of only 1.1 per cent in the period under review. With just under 30 per cent or DM 4.4 billion, the natural sciences received the lion's share of R&D funds in 1997. The second largest amount of R&D funds, DM 3.6 billion or 23.9 per cent, went to medicine. Next were the humanities and social sciences with DM 3.2 billion (21.7 per cent) and engineering sciences with DM 3.1 billion (20.8 per cent). The rear was brought up agricultural sciences with DM 0.6 billion which is equivalent to 4.3 per cent.

The R&D intensity of the different fields of science also varied. R&D intensity is the share of R&D expenditure in the expenditure on education and research in a particular field of science. The natural sciences are particularly research-intensive. 76.0 per cent of total expenditure on education and research were accounted for by R&D. Agricultural and engineering sciences had shares below two thirds, i.e. 63.8 per cent and 62.6 per cent, respectively, while the research intensity of the humanities was 52.7 per cent. With 43.8 per cent, medicine had the lowest R&D share in total science expenditure on this particular field of science.

7.7 Higher education expenditure on R&D by region

In 1997, 83.1 per cent of the total R&D expenditure of the higher education sector of DM 15.0 billion was accounted for by the old *Länder*, 16.9 per cent by the new *Länder* (cf. Table VII/43). The percentage of the new *Länder* which was only 13 per cent in 1991 seems to have stabilised. Based on estimated data for 1998 and 1999, the share of the new *Länder* will remain more or less unchanged at 16.9 per cent and 16.4 per cent, respectively. As higher education institutions in Berlin are growing together, forecasts of trends in the old and new *Länder* are becoming less and less reliable.

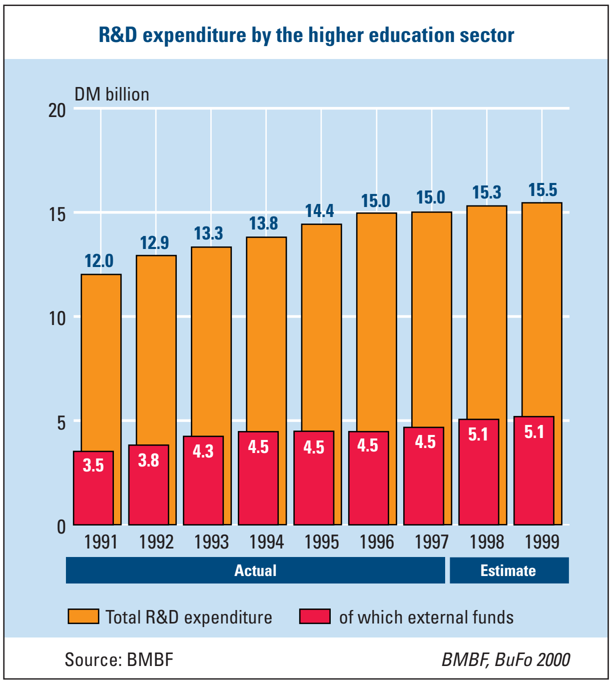
7.8 Financing of higher education expenditure on R&D, especially external funds

In 1997, 88.6 per cent (DM 13.2 billion) of the R&D expenditure of the higher education sector which totalled DM 15.0 billion, was financed by government (Federal and *Länder* governments). The balance of funds was contributed by the business enterprise sector (9.7 per cent) and abroad (1.7 per cent) (cf. Table VII/3). Government funds allocated to the higher education sector consist of different components. They include the shares of annual statutory university funding that are devoted to R&D of which the greater part is provided by the *Länder* governments. They also cover the funding contributed by the Federal Government under the Special University Programmes and allocated to university construction. And they include DFG grants for R&D and the funding the Federal and *Länder* governments grant the universities by way of project funding.

In 1997, the higher education sector received about DM 1.5 billion from the business enterprise sector which accounted for 9.7 per cent of the former's expenditure on R&D. In 1991, however, this contribution was still only DM 0.8 billion or 7.0 per cent. A comparison of funding earmarked by the business enterprise sector for financing R&D in the higher education sector with the total funds provided by industry for R&D in Germany (1997: DM 51.4 billion; 1991: DM 46.0 billion) shows that the business enterprise sector's R&D funds grew by 11.8 per cent between 1992 and 1997. During the same period the R&D funds channelled by industry to the higher education sector soared by a massive 72.8 per cent.

In 1997 – as in previous years – external funds accounted for DM 4.7 billion of total higher education R&D funding which was 31.2 per cent or just under one third,. Between 1992 and 1997, external funds increased by 32.7 per cent, while the higher education sector's R&D funds rose by only 24.9 per cent (cf. Chart 19).

Chart 19



7.9 Total higher education R&D personnel

In 1997, R&D personnel in the higher education sector comprised about 100,600 persons – all personnel data are given as full-time equivalent. The provisional number for 1998 is 101,100 employees. This means that in 1997 21.9 per cent of total R&D personnel (approximately 460,400 persons) were employed in the higher education sector. Compared with 1995 figures, R&D personnel in the higher education sector remained unchanged in both absolute and relative terms.

A breakdown by occupations shows that the trend of previous years continued, i.e. that the number and hence also the percentage of researchers rose slightly. In 1997, this category comprised 65,700 persons, that was 65.3 per cent of total higher education personnel, compared with about 64,400 researchers or 64.0 per cent in 1995. However, the number of technicians and especially the number of other supporting R&D staff declined: The headcount of other supporting staff dropped by 4.6 per cent from 22,600 persons in 1995 to 21,600 in 1997. This was equivalent to 21.4 per cent of total R&D personnel in the higher education sector, the lowest percentage of supporting staff compared with other sectors.

7.10 Higher education R&D personnel by field of science

The breakdown of R&D personnel by field of science basically corresponds with that of R&D expenditure: In 1997, the natural sciences had the highest number with about 28,900 persons or 28.8 per cent, followed by medicine with 24,500 staff or 24.5 per cent, the humanities and the social sciences with 22,600 employees or 22.5 per cent, and the engineering sciences with 19,800 persons or 19.7 per cent. Agricultural sciences came last with just under 4,800 persons or 4.8 per cent of total higher education R&D personnel (cf. Table VII/33).

The distribution of scientific R&D personnel (researchers) across the various fields of science shows a slightly different picture: The humanities and social sciences (1997: 19,400 full-time equivalents or 29.5 per cent of higher education scientific R&D personnel) had an above-average percentage of researchers with 85.8 per cent of R&D personnel. The same applied to the natural sciences with about 21,100 persons, that was 32.1 per cent of researchers in higher education or 72.9 per cent of personnel working in the natural sciences. In medicine, however, the ratio was reversed. The percentage of highly qualified personnel, at 34.5 per cent of total R&D personnel in medicine, was clearly below average. The about 8,400 researchers working in medicine thus accounted for 12.8 percent of scientific personnel in the higher education sector.

There were also distinct differences between the fields of sciences in terms of the percentage of women among the scientific personnel: In medicine a respectable 30.5 per cent of scientific personnel were female; women accounted for 26.6 percent of the researchers working in the humanities and social sciences. The engineering sciences, however, are still a male domain: There were only 8.8 per cent of women among the researchers (1995: 7.5 per cent).

7.11 Higher education R&D personnel by region

About 18.900 of the total of 100,600 persons engaged in R&D in the higher education sector in 1997 worked in the new *Länder*. Accordingly, the old *Länder* accounted for 81.2 per cent and the new *Länder* for 18.8 per cent of R&D personnel which more or less corresponded to the distribution of the population in Germany in 1997.

8. Research and development in the business enterprise sector

8.1 Research and development resources in the business enterprise sector

The business enterprise sector makes the largest contribution to research and development in Germany. It is comprised of business enterprises and the institutions for co-operative industrial research and experimental development, i.e. institutions performing research work especially for small and medium-sized enterprises. The most recent full-fledged survey conducted in the business enterprise sector covers the year 1997, while the data for 1998 were derived from a short survey conducted among big businesses and from the corresponding plan data of small and medium-sized enterprises (SMEs) and the institutions of co-operative industrial research and experimental development. R&D expenditure data for 1999 are also based on the information provided by the companies surveyed on their budgeted R&D expenditure.

The business enterprise sector contributed about two thirds both to the performance and the financing of R&D. In 1999, industry contributed 63.5 per cent, that is DM 58.4 billion, to financing R&D. The importance of this sector for the performance of R&D was even greater. 68.8 per cent, that was DM 63.3 billion, of the estimated total of DM 92.0 billion spent on R&D in Germany in 1999 was accounted for by the business enterprise sector.

What applies to expenditure also applies to the second important R&D resource, i.e. personnel. The largest percentage by far of total R&D personnel, 65 per cent, worked in the business enterprise sector.

8.2 Business enterprise expenditure on R&D

The financial resources spent by the business enterprise sector on research and development are divided into intramural and extramural R&D expenditure. Intramural expenditure covers all funds spent by the economic units surveyed in their own enterprises or their own institutions of co-operative industrial research and experimental development. Extramural expenditure, on the other hand, includes funds channelled to other enterprises, research institutions, higher education institutions or abroad by way of research contracts or co-operative R&D ventures.

8.3 Total intramural business enterprise expenditure on R&D

In 1998, intramural business enterprise expenditure on R&D amounted to DM 59.3 billion, after it had reached DM 56.5 billion in the previous year. The marked increase of 4.9 per cent that occurred between 1997 and 1998 is expected to continue in 1999 with a 6.7 per cent rise to DM 63.3 billion. This shows that after a weak phase in the first half of the 1990s the business enterprise sector's R&D expenditure soared sharply in the second half and contributed substantially to the expansion of total R&D expenditure in Germany. This growth is attributable to business enterprises and institutions of co-operative industrial research and experimental development which also form part of the business enterprise sector.

The institutions of co-operative industrial research and experimental development, however, stepped up their R&D expenditure to a much lesser degree. In 1997, for instance, their expenditure amounted to DM 506 million after they had spent DM 496 million in 1995. They expect a slight increase by 2.8 per cent to DM 520 million in 1998, while no changes are expected for 1999. Between 1995 and 1997, business enterprises raised their R&D expenditure by 7.9 per cent to DM 56.0 million; in 1998, their expenditure totalled DM 58.8 million, that is 4.9 pr cent more than in 1997.

8.4 Intramural business enterprise expenditure on R&D by company size

R&D expenditure is concentrated in the hands of big enterprises: In 1997, almost 50 per cent of intramural R&D expenditure was accounted for by companies with over 10,000 employees, and only 15 per cent was accounted for by small and medium-sized enterprises with fewer than 500 employees. Compared with 1995, however, the balance shifted in favour of smaller companies. In 1995, for instance, SMEs accounted for 14.4 per cent, while in 1991 they had contributed only 12.4 per cent. Between 1991 and 1997, the share of the largest companies dropped from 54.8 per cent to 49.2 per cent (cf. Chart 20, Table VII/18).

8.5 Intramural business enterprise expenditure on R&D by industry

In 1997, the R&D expenditure of the manufacturing sector accounted for 93.5 per cent of the R&D expenditure recorded in the entire business enterprise sector, which does not represent a major change relative to 1991 (95.4 per cent). It should be noted, however, that the statistical collection of data on R&D performed in the German service sector is still patchy at present and will be improved in the future[1].

Within the manufacturing sector 92 per cent of R&D expenditure was accounted for by four industries, i.e. vehicle construction (1997: 36.7 per cent), office, accounting and computing machinery, electrical machinery, precision and optical instruments (23.4 per cent), chemical industry (20.1 per cent) and machinery (11.8 per cent). R&D expenditure should be assigned to a particular industry solely based on the classification of the statistical unit surveyed which in turn is determined by that unit's principal activity. However, no information is provided on product fields, products or processes for which the R&D funding may be earmarked (cf. Table VII/17).

In 1997, the funds spent on R&D by the manufacturing sector totalled DM 52.8 billion which was 5.8 per cent more than in 1995. This rate of increase, however, was lower than that of total expenditure.

8.6 Intramural business enterprise expenditure on R&D by region (old / new Länder)

Between 1995 and 1997 intramural business enterprise expenditure on R&D rose by 6.9 per cent. During that period, however, the old and the new *Länder* followed different trends: While in the West R&D expenditure grew by 6.9 per cent, it leapt up by 24.7 per cent in the new *Länder*.

This difference between East and West Germany was less visible in small and medium-sized enterprises. At 11.4 per cent, the rate of increase of R&D expenditure by SMEs in the old *Länder* was disproportionately high. In the new *Länder* it was 17.8 per cent and thus still higher than in the West, but below the rate of the entire business enterprise sector. This process will result – albeit very slowly – in balanced conditions in the old and new *Länder*. But also in 1997 61.6 per cent of business enterprise expenditure on R&D in the new *Länder* was accounted for by SMEs, due to a lack of large companies, while in the old *Länder* SMEs contributed 12.2 per cent to the sector's R&D expenditure.

The institutions for co-operative industrial research and experimental development also reflect the process of adjustment of the old and the new *Länder*. In the old *Länder* the institutions' R&D expenditure declined slightly, dropping to 0.6 per cent of industry's total R&D expenditure in the Western part of the country, while in the East their share amounted to 5.2 per cent in 1997, after 5.9 per cent in 1995.

As a result of the higher increase in industry's expenditure on R&D in the new *Länder*, the institutions' share in the R&D expenditure of the entire business enterprise sector continued to rise and in 1997 reached 6.0 per cent (1995: 5.2 per cent). Other indicators also reflect this trend towards more balanced conditions; but at the same time they also show quite clearly that there is still a long way to go until the East and the West will play on a level playing field in research and development. In 1997, for instance, R&D expenditure in the new *Länder* accounted for 1.1 per cent of gross value added[2], while it was 2.1 per cent in the old *Länder*. R&D expenditure per head of labour force was DM 729 (1995: DM 555) in the new *Länder* which was just under one third of the expenditure in the West which amounted to DM 2,398 in 1997.

Among the new *Lände*r, Saxony was the state with the highest R&D expenditure. With almost DM 1.5 billion it accounted for 43 per cent of total East German business enterprise expenditure on R&D, which was a 28.4 per cent increase over 1995 and further consolidated Saxony's leading position. Brandenburg and Thuringia whose shares in East German business enterprise expenditure on R&D were 14 and 19 per cent, respectively, also enjoyed high rates of increase in business enterprise R&D expenditure. The state with the lowest R&D expenditure in East Germany was Mecklenburg-Western Pomerania whose business enterprise expenditure on R&D had been relatively low anyway and dropped by almost one quarter between 1995 and 1997, amounting to DM 79 million in 1997 which was 2 per cent of business enterprise expenditure on R&D.

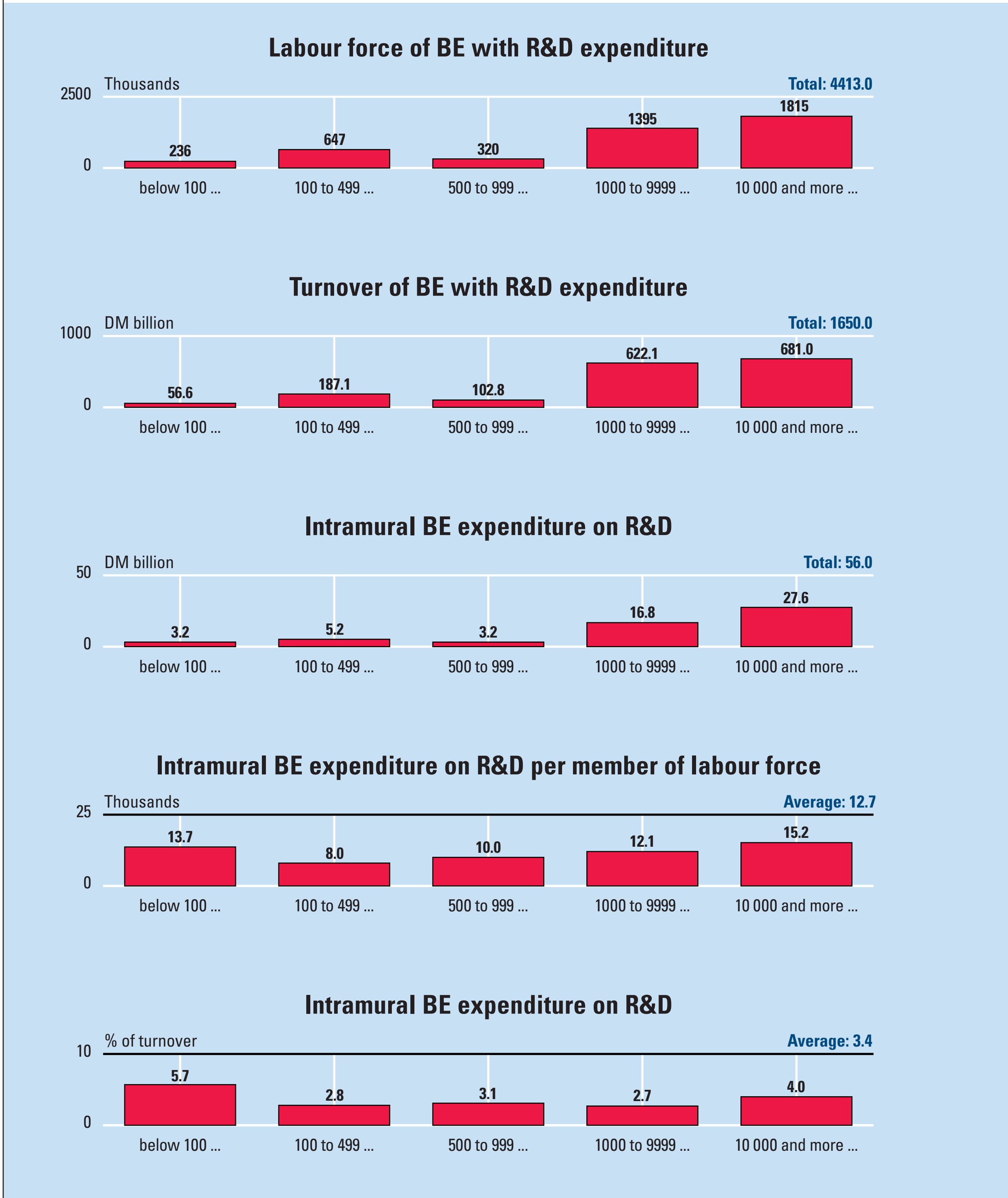
1 Cf. SV-Wissenschaftsstatistik, Rheinisch-Westfälisches Institut für Wirtschaftsforschung e.V., Final Report on the Project "Erfassung und Messung von Forschungs- und Entwicklungsaktivitäten im Dienstleistungssektor", 1999.

2 Regional data used here are not yet in keeping with the definitions of the 1995 European System of Accounts (ESA) on which national evaluations are based.

Chart 20

Intramural R&D expenditure in the business enterprise (BE) sector 1997

– Indicators by company size –



Source: Stifterverband Wissenschaftsstatistik and calculations by BMBF

BMBF, BuFo 2000

Table II/14

Footnotes and sources at the end of the table

R&D expenditure in the business enterprise (BE) sector *

Parameter	in	Intramural R&D expenditure**			
		1995 Actual	1997 Actual	1998 Estimate	1999 Budget
Business enterprises	DM million	51 955	56 036	58 809	62 780
of which SMEs[1]:					
– *In absolute terms*	*DM million*	*7460*	*8419*	*8303*	*8500*
– *Percentage*	*%*	*14.4*	*15*	*14.1*	*13.5*
IfG [2]	DM million	494	506	520	520
Total BE sector [3]	**DM million**	**52 835**	**56 543**	**59 329**	**63 300**
– Percentage of (adjusted) gross value added in BE [4]	%	1.9	2.0	2.0	
– Per member of labour force in BE	DM	1911	2104	2200	
– Percentage of R&D expenditure of all sectors [5]	%	66	68	68	69
– Self-financing ratio	%	89.0	88.0	88.6	89.5
of which:					
Old *Länder* (including West Berlin)					
– Business enterprises	DM million	49 398	52 828	.	.
of which SMEs [1]:					
• *In absolute terms*	*DM million*	*5784*	6444	.	.
• *Percentage*	*%*	*11.7*	*12.2*	.	.
– IfG [2]	DM million	334	329	.	.
Total	**DM million**	**49 732**	**53 157**	**55 776 [6]**	.
– Percentage of (adjusted) gross value added in BE[4]	%	2.1	2.1	2.1	.
– Per member of labour force in BE	DM	2186	2398	2504	.
– Percentage of R&D expenditure of all sectors [5]	%	69	71	.	
New *Länder* (including East Berlin)					
– Business enterprises	DM million	2557	3208	.	.
of which SMEs [1]:					
• *In absolute terms*	*DM million*	*1676*	1975	.	.
• *Percentage*	*%*	*65.5*	*61.6*	.	.
– IfG [2]	DM million	159	177	.	.
Total	**DM million**	**2716**	**3386**	**3553 [6]**	.
– Percentage of (adjusted) gross value added in BE [4]	%	0.9	1.1	1.1	.
– Per member of labour force in BE	DM	555	729	758	.
– Percentage of R&D expenditure of all sectors [5]	%	38	41	.	.

cont. Table II/14

Footnotes and sources at the end of the table

R&D expenditure in the business enterprise (BE) sector *

Parameter	in	Intramural R&D expenditure**			
		1995 Actual	1997 Actual	1998 Estimate	1999 Budget
For information:					
Business enterprises	*DM million*	5881	8564	11 099	12 140
of which:					
– *to BE*	*%*	*61.7*	65.1	.	.
– *to government and other national entities*	*%*	*22.5*	15.4	.	.
– *to recipients abroad*	*%*	*15.8*	19.5	.	.
IfG [2]	*DM million*	*271*	254	260	260
Total in the business enterprise sector	***DM million***	***6152***	***8818***	***11 359***	***12 400***

* For further tables concerning R&D resources of the business enterprise sector see Part VII.

** Intramural R&D expenditure: all expenditures on R&D performed in the business enterprise sector, whatever the source of funds. Extramural R&D expenditure: expenditure on R&D performed outside the funding entity. 1998: survey of selected enterprises, budgeted figures of IfG; 1999 budgeted figures; as of January 2000.

1 SMEs: small and medium-sized enterprises (up to a labour force of 500).

2 IfG: institutions for co-operative industrial research and experimental development.

3 Including funds not related to specific items which, after national consultation, are added to the business enterprise sector.

4 The reference values used have not yet been adjusted to the European System of Accounts (ESA) 1995.

5 Business enterprise, higher education and non-university sectors; estimates.

6 Regional breakdown (old/new *Länder*) based on shares in 1997 (rounded).

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and calculations by BMBF

Rounding error

8.7 Intramural business enterprise expenditure on R&D and sources of funds

In 1997, industry's self-financing ratio was 88 per cent. This means that DM 49.7 billion of the total intramural expenditure of DM 56.5 billion was raised by the business enterprise sector itself. The balance of DM 6.8 billion was provided by government (in the form of R&D grants and by way of R&D contracts awarded by the Federal and *Länder* governments), the higher education sector and private non-profit organisations. This also included funds from abroad.

The self-financing ratio varies from industry to industry. It was particularly high in the chemical industry with 96.9 per cent and the machinery industry with 95.8 per cent. In vehicle construction the self-financing ratio amounted to 80.9 per cent.

8.8 Total extramural expenditure on R&D

Extramural business enterprise expenditure on R&D, i.e. the funds companies pay to other institutions within the business enterprise sector or other sectors of the research system by way of R&D contracts or co-operative projects, developed even more dynamically than intramural expenditure. It was estimated at DM 11.4 billion in 1998 and should rise to DM 12.1 billion in 1999. In 1997, extramural R&D expenditure was DM 8.8 billion, with 65.1 per cent of the funds going to the business enterprise sector, 15.4 per cent to the government sector and other residents and 19.5 per cent abroad.

Growing extramural expenditure – it went up 45.6 per cent between 1995 and 1997 – reflects the trend to hive off research departments from companies and establish them as independent organisations. This means that flows of funds which previously were counted as intramural R&D expenditure now become extramural expenditure. On the other hand, the numbers also document a greater readiness of business enterprises to co-operate in research and development.

8.9 Total business enterprise R&D personnel

In 1997, the most recent year for which the results of a complete survey are available, about 286,300 persons (full-time equivalent, like all R&D personnel numbers given in this part of the Report) worked in R&D in the business enterprise sector. That was 1.0 per cent more than in 1995. The number estimated for 1998 is about 288,100 which implies a further slight increase of 0.6 per cent. This trend is a slightly delayed and certainly weaker reflection of the positive development of R&D expenditure by the business enterprise sector after it had reached an all-time low in 1996.

The various groups encompassed by the category of R&D personnel made different contributions to this overall development. While from 1995 to 1997 the number of researchers grew by 2.6 per cent to 132,700 persons and technical staff increased by 1.1 per cent to reach 79,000 persons, the total of other supporting staff shrank by 1.6 per cent to 74,600 persons. This development confirms that the trend towards a new structure in favour of more highly qualified staff which had been observed for total R&D personnel also applies to the business enterprise sector (cf. Table VII/29).

8.10 Business enterprise R&D personnel by company size

80.0 per cent of total business enterprise R&D personnel work in large companies and 20.0 per cent in SMEs with fewer than 500 employees. Consequently, large companies do not have the same weight in terms of personnel that they have in terms of R&D expenditure where in 1997 they accounted for 85.0 per cent.

Between 1995 and 1997, R&D personnel in small and medium-sized enterprises grew more rapidly than in large companies. While the latter stepped up their R&D staff by 0.8 per cent – with the number of research scientists growing by 3.2 per cent and those of technicians and other supporting staff dropping –, SMEs increased their R&D headcount by 2.4 per cent. This development was mainly accounted for by technicians whose number grew by 15.1 per cent.

As a result, the breakdown by occupation in large companies has continued to approach that of SMEs. In 1997, research scientists accounted for 45.1 per cent of the total R&D personnel of companies with more than 500 employees and for 50.4 per cent of the R&D staff working in small and medium-sized enterprises. Among non-scientific personnel technicians accounted for 26.0 per cent in SMEs and 28.1 per cent in large companies, while other supporting staff made up 23.6 per cent in SMEs and 26.8 per cent in large companies (cf. Table VII/31).

8.11 Business enterprise R&D personnel by industry

The largest percentage by far of R&D personnel (93.1 per cent of total R&D personnel surveyed in the business enterprise sector) worked in the manufacturing sector, the sector that also accounted for the highest percentage of R&D expenditure. It should be noted, however, that the collection of data on R&D resources in the service sector is patchy.

Between 1995 and 1997, the development of R&D personnel varied considerably from industry to industry. Shifts between the manufacturing and service sectors as well as between the individual industries of the manufacturing sector were influenced by corporate restructuring processes which resulted in the fact that companies surveyed were assigned to different sectors of industry. This affected the two industries employing the highest percentage of R&D personnel, i.e. vehicle construction as well as office, accounting and computing machinery, electrical machinery, precision and optical instruments. The chemical and machinery industries, the next largest industries, cut their R&D personnel in the two-year period under review. R&D personnel reduction in the chemical industry was 3.5 per cent, in the machinery industry 0.2 per cent (cf. Table VII/30).

8.12 Business enterprise R&D personnel by region

The slight increase in R&D personnel in the business enterprise sector by a total of 1.1 per cent is made up of a 0.6 per cent growth in the old *Länder* and a 5.8 per cent rise in the new *Länder*.

In the Eastern part of Germany large companies stepped up their R&D personnel by 5.5 per cent, thus making a larger contribution than SMEs (increase: 3.2 per cent) to the growth in R&D personnel in both relative and absolute terms. In the West companies with 500 employees or more increased their R&D headcount by only 0.7 per cent, i.e. less than the SMEs (2.1 per cent). However, due to the uneven regional distribution of large companies and SMEs, large companies in the old *Länder* could still record a higher increase in R&D personnel in absolute terms.

The breakdown of business enterprise R&D personnel by occupation in the new *Länder* differed clearly from that in the West. The structural comparison which was possible for the first time regarding the new *Länder*'s business enterprise sector showed that the R&D personnel increase of 5.8 per cent between 1995 and 1997 was mainly accounted for by technical staff whose number grew by 46.9 per cent to about 4,900 employees. The 10.5 per cent decline in the number of other supporting staff was also more pronounced than in the old *Länder*. The percentage of research scientists working in the business enterprise sector, however, was still higher in the East (1997: more than 60 per cent) than in the West (1997: 51.2 per cent).

In spite of the increase in personnel devoted to research and development in the new *Länder* between 1995 and 1997, the number of R&D personnel as a percentage of labour force in the business enterprise sector was still low[1]. In the new *Länder* five out of 1,000 labour force worked in R&D, while in the old *Länder* the rate was eleven out of 1,000 labour force.

At the *Länder* level the greatest changes in the number of business enterprise R&D personnel were recorded in Saxony and Berlin which enjoyed growth rates of 15.6 and 14.7 per cent, respectively, between 1995 and 1997. On the other hand, Mecklenburg-Western Pomerania in the East and Bremen in the West suffered the most severe cuts in business enterprise R&D personnel with 28.9 and 28.4 per cent, respectively. A breakdown of R&D personnel by *Länder* shows that both in the East and in the West there was a concentration of R&D personnel in the Southern *Länder* in 1997. Baden-Württemberg and Bavaria together accounted for more than half of the R&D personnel working in the old *Länder*, while 45.6 per cent of all business enterprise R&D personnel in the new *Länder* were employed in Saxony and another 19.6 per cent in Thuringia (cf. Table VII/46).

[1] Regional data used here are not yet in keeping with the definitions of the 1995 European System of Accounts (ESA) on which national evaluations are based

Table II/15

R&D personnel in the business enterprise (BE) sector *

Parameter	in[3]	1995	1997	1998[7]	of which researchers 1995	of which researchers 1997
Business enterprises	FTE	279 351	282 439	284 259	*127 247*	*130 434*
of which SMEs[1]						
– *In absolute terms*	FTE	*55 183*	*56 532*	*55 985*	*28 433*	*28 505*
– *Percentage*	%	*19.8*	*20.0*	*19.7*	*22.3*	*21.9*
IfG [2]	FTE	3965	3831	3831	*2123*	*2252*
Total BE sector	**FTE**	**283 316**	**286 270**	**288 090**	***129 370***	***132 687***
– Percentage of BE labour force [4]	%	1.0	1.1	1.1	.	.
– Percentage of R&D personnel/ researchers in all sectors [5]	%	61.7	62.2	62.2	*56.0*	*56.3*
of which: [6]						
Old *Länder* (including West Berlin)						
– Business enterprises	FTE	256 963	258 818	.	.	.
of which SMEs [1]						
• *In absolute terms*	FTE	*39 305*	*40 143*	.	.	.
• *Percentage*	%	*15.3*	*15.5*	.	.	.
– IfG [2]	FTE	2612	2344	.	.	.
Total	**FTE**	**259 575**	**261 162**	**262 820** [8]	***114 393***	***117 350***
– Percentage of BE labour force [4]	%	1.1	1.2	1.2	*0.5*	*0.5*
– Percentage of R&D personnel/ researchers in all sectors [5] *in the old Länder*	%	65	65	65	*58*	*59*
New Länder (including East Berlin)						
– Business enterprises	FTE	22 388	23 621	.	.	.
of which SMEs [1]						
• *In absolute terms*	FTE	*15 879*	*16 389*	.	.	.
• *Percentage*	%	*70.9*	*69.4*	.	.	.
– IfG [2]	FTE	1353	1487	.	.	.
Total	**FTE**	**23 741**	**25 108**	**25 270** [8]	***14 977***	***15 337***
– Percentage of BE labour force [4]	%	0.5	0.5	0.5	*0.3*	*0.3*
– Percentage of R&D personnel/ researchers in all sectors [5] *in the new Länder*	%	42	43	43	*43*	*43*

* For further tables concerning R&D resources of the business enterprise sector see Part VII.

1 SMEs: small and medium-sized enterprises (up to a labour force of 500).

2 IfG: institutions for co-operative industrial research and experimental development.

3 FTE: full-time equivalent.

4 The reference values used have not yet been adjusted to the European System of Accounts (ESA) 1995.

5 Business enterprise, higher education and non-university sectors; estimates.

6 R&D laboratories concept.

7 Survey of selected enterprises, budgeted figures of IfG; as of January 2000.

8 Regional breakdown (old/new *Länder*) based on shares in 1997 (rounded).

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and calculations by BMBF

8.13 Federal funding of research and development in the business enterprise sector

In 1998, federal R&D funds allocated to the business enterprise sector totalled DM 4,347 million[1]. The breakdown by government departments providing funding is as follows:

- DM 975 million (22 per cent) were provided by the Federal Ministry of Education and Research,
- DM 1,027 million (24 per cent) by the Federal Ministry of Economics and Technology,
- DM 2,198 million (51 per cent) by the Federal Ministry of Defence,
- DM 147 million (3 per cent) by other government departments (cf. Table II/16).

The changes in this breakdown relative to previous years reflect the redistribution of responsibilities among government departments, especially between the Federal Ministry of Education and Research and the Federal Ministry of Economics and Technology (BMWi). As a result of this process which was implemented in the autumn of 1998 funding programmes for energy and aeronautical research, indirect R&D funding schemes benefiting small and medium-sized enterprises (SMEs), and the funding of technology start-ups were taken over by the BMWi. As part of its responsibility for SME policies this ministry will now primarily deal with aspects of innovation policy. R&D expenditure by the BMWi will now focus on schemes supporting small and medium-sized enterprises and energy research and civil aviation projects.

Table II/16

Federal R&D funding in the business enterprise (BE) sector including research-related tax revenue shortfall of Länder and local government

Year	Total [1] expenditure	of which						Tax revenue shortfall [3]	Total funding
		BMBF [2]		BMWi [2]		BMVg			
	DM million	DM million	%	DM million	%	DM million	%	DM million	DM million
1989	5086	1002	20	1353	27	2626	52	648	5734
1991	5464	1048	19	1532	28	2747	50	379	5843
1992	5422	1077	20	1359	25	2637	49	-	5422
1993	4635	1009	22	1334	29	2101	45	-	4635
1994	4525	967	21	1242	27	2111	47	-	4525
1995	4574	863	19	1217	27	2336	51	-	4574
1996	4734	948	20	1153	24	2481	52	-	4734
1997	4363	845	19	953	22	2403	55	-	4363
1998	4347	975	22	1027	24	2198	51	-	4347

1 Including funds received by business enterprises abroad.

2 Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between Federal Government departments.

3 R&D investment allowance (section 4 of the Investment Allowance Act InvZulG) and special R&D depreciation (section 82d of the Ordinance Implementing Income Tax Law EStDV), tax revenue shortfall of Federal Government, *Länder* and local government.

Source: BMBF

Rounding error

[1] It should be taken into account that, owing to the shifting of responsibilities between federal government departments, calculations were based on the budget for the year 2000; comparability with the figures of previous years is therefore limited.

8.14 Structure of federal funding of R&D in the business enterprise sector

The structure of federal funding of R&D in the business enterprise sector is characterised as follows:

– In 1999, the funding received by the business enterprise sector under the BMBF's direct project funding schemes (i.e. projects that are individually reviewed and decided upon) amounted to a total of DM 1.062 billion (cf. Table II/17). Since 1997 this sum had risen by 15 per cent, accounting for 35 per cent of total direct project funding granted by the BMBF.

Also in 1999 BMBF project funding in the business enterprise sector focused on promoting key technologies. Production engineering, information technology, microsystems, new technologies and research into mobility together accounted for about 51 per cent of total direct funding in the business enterprise sector. This represents a slight increase of about 5 per cent over the previous three years. In the period between 1996 and 1999 funding for space research and space technology, marine technology, environmental technologies and materials research was cut back.

Direct project funding in particular areas forms part of the development of scientific and technical problem solutions under specialised programmes. It aims at bringing together skills and experience from science and industry. Direct project funding in the business enterprise sector as a percentage of project funding under specialised programmes varied between 13.24 per cent (multimedia) and 80.33 per cent (research and technology for mobility and transport). Support of technology and innovation in total accounted for about 50 per cent (cf. Table II/17).

Supporting small and medium-sized enterprises is one of the R&D funding priorities of the Federal Government in the business enterprise sector. In 1991, funds granted to SMEs reached a total of DM 1.1 billion (1998: DM 1.15 billion; cf. Table II/18). This was approximately 55 per cent of the total funding provided jointly by the Federal Ministry of Education and Research and the Federal Ministry of Economics and Technology to promote research and development in the business enterprise sector. In contrast, the business enterprise sector itself spent only about 15 per cent of its total R&D funding on companies with fewer than 500 employees and on institutions for co-operative industrial research and experimental development. This goes to show that compared with industry's own efforts the Federal Government granted a disproportionately high share of funding to SMEs, thus acknowledging the importance of SMEs for growth and employment and the role they play in the innovation process.

Table II/17

Funding of research and technology by the BMBF in 1999 by function, funding area/funding priority – Direct project funding * –

– Profile review –

Function Funding area/funding priority	**Total** DM thousand	**Share of BE** DM thousand	 %
1 Knowledge-oriented and cross-programme basic research	**152 812**	**923**	**0.60**
of which			
B Large-scale equipment for basic research	**152 812**	**923**	**0.60**
2 Research and development to provide for the future	**806 914**	**34 197**	**4.24**
of which:			
C1 Marine and polar research	80 775	2500	3.09
F1 Ecological research	68 141	1257	1.85
F7 Climate and atmospheric research	63 671	958	1.51
G Research and development in the health sector	203 193	3905	1.92
H Research and development to improve working conditions	24 660	6676	27.07
O1 Geosciences (especially deep drillings)	2915	0	0.00
P2 Building research and technology; research and technology for preserving	1368	136	9.90
S1 Vocational training research	14 256	274	1.92
S2 Other educational research	71 090	2436	3.43
V Humanities; economics and social sciences	48 291	0	0.00
W1 Generic activities (including technology assessment)	228 554	16 056	7.02
3 Support of technology and innovation	**2 041 932**	**1 026 448**	**50.27**
of which:			
C2 Marine technology	21 497	15 382	71.55
D1 National funding of space research and space technology	302 567	135 529	44.79
E4 Decommissioning of nuclear facilities; risk sharing	244 066	106 600	43.68
F2 Environmental technologies	154 048	62 304	40.44
I1 Computer science	76 898	30 540	39.72
I2 Basic information technologies	244 377	184 779	75.61
I3 Application of microsystems (including application of microelectronics, microperipherals)	100 000	66 019	66.02
I4 Production engineering	119 997	62 277	51.90
I5 Multimedia	82 235	10 890	13.24
K Biotechnology	229 978	83 380	36.26
L1 Materials research; materials for emerging technologies	118 902	63 375	53.30
L2 Physical and chemical technologies	200 052	87 041	43.51
N Research and technology for mobility and transport	147 315	118 332	80.33
4 University construction and mainly university-related special programmes	**53 000**	-	-
of which			
A6 Mainly university-related special programmes	53 000	-	-
Total *	**3 054 658**	**1 061 568**	

* Excluding direct project funding under "Other educational expenditure not relevant to R&D". In 1999 direct project funding (including "Other educational expenditure not relevant to R&D") of the BMBF totalled DM 3 540 507 000. All figures based on the 1999 budget structure (excluding areas transferred to the Federal Ministry of Economics and Technology BMWi).

Source: BMBF

Rounding error

Table II/18

Federal Government schemes to fund research and development in small and medium-sized enterprises

– DM million –

Ministry / scheme / further information	1996	1997	1998	1999
BMBF				
1 Project funding under specialised programmes [1/3]	237.0	231.0	240.0	224.0
2 Indirect specific schemes				
Fertigungstechnik (CAD/CAM, Robotik, CIM)	0.8	0.3	0.0	0.0
Information technology (microperipherals, microsystems)	0.4	0	-	-
Bioprocess engineering	7.2	0	-	-
3 Information and consultancy centres	19.2	22.5	7.6	9.0
4 Specialised information	7.5	4.1	-	-
Total BMBF [1]	272.1	257.9	247.6	233.0
BMWi				
1 Project funding under specialised programmes [1]	0.0	0.0	0.0	32.0
2 Industrial co-operative research	169.8	150.3	172.0	167.0
3 R&D personnel funding in the new *Länder* [2]	104.0	102.0	90.0	76.6
4 Funding and support of innovation	111.1	62.4	9.4	0.0
5 R&D project funding [2]	149.5	134.3	168.7	177.4
6 Technology transfer (including patent depository libraries) [4]	27.4	15.4	17.1	10.6
7 New technology-based firms	76.6	86.7	89.8	143.2
8 R&D credit scheme for SMEs to encourage the application of new technologies	6.1	4.3	5.9	0.4
9 Funding of additional R&D personnel	12.2	2.0	0.3	0.0
10 Contract research and development	36.7	10.1	3.4	0.6
11 Research co-operation between the business enterprise sector and science	120.1	135.3	222.5	228.4
12 Funding of design	2.3	0.8	0.5	0.5
13 Indirect specific schemes				
250 MW-Wind	44.3	35.3	35.0	32.2
Solar thermal power 2000	4.2	3.2	3.4	4.4
Total BMWi [1]	864.3	742.1	818.0	873.3
Total	**1136.4**	**1000.0**	**1065.6**	**1106.3**

1 From 1999 onwards: transfer of funding areas from the BMBF to the BMWi as a result of the re-organisation of Federal Government departments.

2 From 1 January 1998 joint guideline on funding research, development and innovation in small and medium-sized enterprises and extramural industrial research institutions in the new *Länder*, with R&D project funding and R&D personnel funding programme lines. Budgeted figures not broken down by programme line.

3 Figures for 1996 excluding the space projects MIR 1996 and Abrixus with a total volume of approx. DM 18 million.

4 From 1999 onwards: programme to encourage investments and technology transfer in SMEs (skilled trades, industry, commerce, service sector and independent professions).

Source: BMBF, BMWi

9. Technological performance indicators

Knowledge, technological and entrepreneurial skills as well the creativity of a society determine the quality and dynamism of the innovation-creating systems of that national economy and hence – in the final analysis – its growth and prosperity. Using a host of indicators, an attempt is being made to determine the 'technological performance' of an economy and – as far as possible – make it ascertainable and quantifiable in terms of social innovation capabilities. The report on technological performance[1] which is published annually by the Federal Ministry of Education and Research discusses indicators of production and of the application of technical knowledge which in terms of input cover the development of human capital, science as a basis for the entire body of knowledge, and industrial activities in research and development. The output side covers innovations, patents, market research results concerning domestic production and demand, and foreign trade.

This Federal Government Report on Research which on the input side provides a detailed analysis of science and R&D expenditure concentrates primarily on output indicators. It looks in particular into data on gross value added, patents, and foreign trade related to various product fields. Research-intensive products include all product groups whose production requires above-average research activities. Within the group of research-intensive products a distinction is being made between high technologies and advanced technologies. The former include goods whose R&D expenditure accounts for more than 8 per cent of turnover, such as telecommunications, turbines, advanced electrical machinery, agrochemical products and medical electronic devices. Advanced technologies cover products whose R&D expenditure accounts for 3 to 8 per cent of turnover, e.g. rail vehicles, paper-making machinery, motor vehicles, medical instruments and electricity distribution equipment[2].

At about 10.5 per cent each, the contributions made by research-intensive industries to value generation and employment are relatively large. It is only in Japan that R&D-intensive industries make a greater contribution to the aggregate value added. Both Germany and Japan hold strong positions with regard to advanced technologies (machinery and vehicle construction, industrial chemicals, electrical machinery). An international comparison shows that high technologies have the greatest overall weight in the Japanese economy (4 per cent). In the USA they account for 3.5 per cent, in the United Kingdom for 3 per cent and in Germany for 2.5 per cent.

The German industry's core expertise rather tends to be in the field of complex "mature technologies" such as automobile and machinery construction. Here the fundamental positions in the international technological division of labour among the developed economies turn out to be relatively robust, since the technological specialisation of the industrialised countries in the area of research-intensive products has hardly changed in spite of the sometimes strong fluctuations in the individual countries.

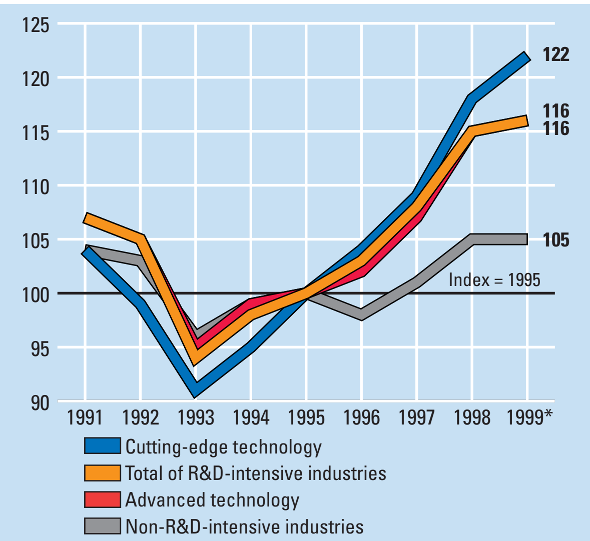
9.1 Structural change in favour of R&D-intensive industries

The R&D-intensive industries came out of the economic slump in 1993 and 1994 in better shape than industries not depending on R&D. In fact, they are expected to grow their production by three to five per cent in 2000 (1999: one per cent). High-tech industries boast higher growth rates than industries engaged in advanced technologies. After a drop of 0.5 per cent in 1999 growth in non-R&D-intensive industries will probably only reach 2.5 to 3 per cent in 2000.

Chart 21

Net production in R&D-intensive industries in Germany 1991–1999

– Kind-of-activity units. 1995 = 100 –



* Rough estimate
Source: Federal Statistical Office: Internet database; figures and facts, manufacturing sector statistics. – NIW calculations. *BMBF, BuFo 2000*

Higher growth rates in R&D-intensive industries will also result in another shift of the industrial structure in favour of these industries. In terms of the economy as a whole, however, both non-R&D-intensive industries and R&D-intensive industries will lose some weight, since the growth rates of the service sector are higher than those of the manufacturing industries.

In the 1990s, industrial growth in the new *Länder* was clearly stronger than in the old *Länder*. Between 1993 and 1998, East German R&D-intensive industries (new *Länder*: 7.7 per cent; old *Länder* 3.9 per cent) developed in a more dynamic fashion than non-R&D-intensive industries (new *Länder*: 5.4 per cent; old *Länder*: 3.9 per cent). High-tech industries boasted an above-average growth rate (new

[1] BMBF, Germany's Technological Performance, 1999 Summary Report, (2000).

[2] This approach differs from the analysis of R&D expenditure by industry as discussed in section 9.1.

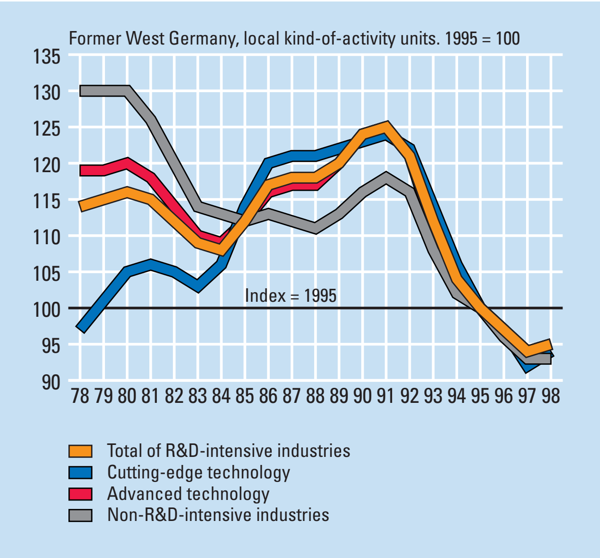
Länder: 11.2 per cent; old *Länder*: 4.9 per cent). However, in East Germany R&D-intensive industries accounted for a much smaller share of industry as whole than in the Western part of the country.

9.2 Development of employment in R&D- and knowledge-intensive industries

The increase in production, however, did not lead to the creation of additional jobs in industry. It was only in 1998 that the plunge of employment in industry could be stopped. Although high-tech industries saw the strongest reduction in industrial employment in the 1990s, it is only in these industries that employment is more or less at the level of the 1970s. Both in advanced technology industries and in non-R&D-intensive sectors employment has hit an all-time low. However, new jobs are being created in the service sector.

Chart 22

Employment in R&D-intensive industries 1978–1998



Source: Federal Statistical Office: Fachserie 4. R. 4.1.1. data from the Federal Statistical Office – DIW: Görzig. et al. (1999). – NIW calculations and estimates.

BMBF, BuFo 2000

9.3 Development of production capacities

Since the mid-1990s the expansion of production capacities in industry has clearly slowed down. This applies to R&D-intensive industries and even more so to non-R&D-intensive industrial sectors.

In 1998, investment in plant and equipment by R&D-intensive industries again reached a level similar to that before the recession. Almost the entire increase in investment in industry was accounted for by R&D-intensive sectors. This is clearly highlighted in a medium-term analysis: Between 1994 and 2000 investment rose by 90 per cent. Another, albeit slower, increase is expected for the year 2000. In the non-R&D-intensive industries investment is still clearly below the level of the early 1990s. These industries are not likely to raise their investments in 1990 and 2000, either.

Comparatively strong investment activities have continued in the new *Länder*. The level of investment per labour force in industry is still higher than that of the old *Länder*.

9.4 Position in world trade with R&D-intensive goods

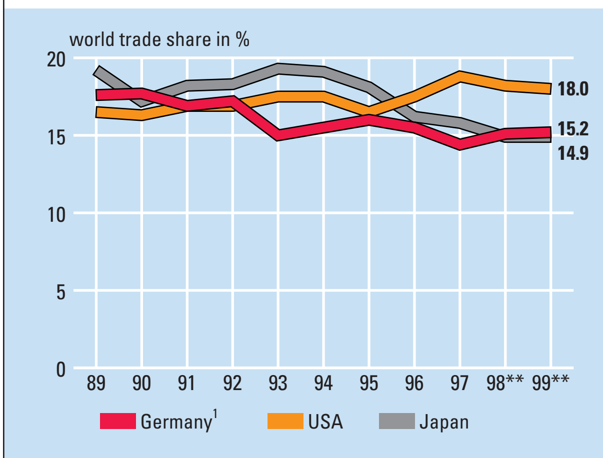
Industrial growth depends on the vitality of foreign trade. R&D-intensive industrial goods account for a growing share of German exports. In the period between 1994 and 1997, exports of R&D-intensive goods rose by an average 10 per cent, while the export of non-R&D-intensive goods grew by a mere 8 per cent. Growth of high-tech exports was substantially higher. A similar pattern is also emerging for the new *Länder* which in recent years succeeded in sharply raising their exports. But with the exception of a few industries, the export rate in the new *Länder* is still considerably lagging behind that of the old *Länder*.

In 1998, R&D-intensive industries accounted for just under half of the revenues generated abroad. The new *Länder* whose export rate for R&D-intensive goods had already reached 32 per cent still fell short of this average which applies to the entire German R&D-intensive industry. Also, the new *Länder* contributed only 3.5 per cent to the revenues generated by R&D-intensive industries abroad.

In the 1990s, Germany's share in global trade in R&D-intensive goods was shrinking, but it is expected to pick up again from

Chart 23

World trade shares held by Germany, the USA and Japan in R&D-intensive goods 1989–1998/99*



* Data for 1989–1994 calculated on the basis of OECD-29.
** Rough estimate.
1 From 1991 onwards West and East Germany; figures therefore not fully comparable with previous years. Decline in 1993 primarily due to changes in the survey method, which no longer covers all shipments between EU countries.

Sources: OECD: Foreign Trade By Commodities; unpublished data for 1989–1995. 1995 CD-ROM. Federal Statistical Office. – NIW calculations and estimates.

BMBF, BuFo 2000

1997 onwards. The USA is still the largest exporter of R&D-intensive goods, followed by Germany and Japan which both hold second place. In terms of R&D-intensive imports Germany is second to the USA which accounts for one quarter of all imports of R&D-intensive goods.

Germany's particular strength in foreign trade is still in the area of goods that require sophisticated, above-average R&D efforts (advanced technology) but it is not so much products requiring extremely high R&D expenses (high technology). This is particularly highlighted by a comparison with the USA and Japan, as Germany's deficits in high technology are mostly attributable to its trade with these two countries. Trade with the EU member states, however, has yielded above-average export surpluses also in the case of high-tech products. At the European level Germany is the technological leader also in many high-tech areas.

9.5 Patents relevant for the global market

The number of patents relevant for the world market ("triad patents") has risen sharply since 1994, and especially so at the end of the period under review, i.e. in 1996 und 1997. Since 1993 the growth in Germany of the number of patents relevant for the world market has paralleled that in the USA. However, the slump in patent activities in the early 1990s which is particularly highlighted by a comparison with the USA could not be compensated for.

Nevertheless, Germany – together with the USA and Japan – is still among the most patent-intensive countries in the world (triad patents per capita or per labour force).

Recently, there has been a shift in the German patent structure in favour of research-intensive sectors. But the basic positions in the international division of technological labour are mostly stable: High technology is primarily the domain of the USA, Japan and – most recently – also Sweden. Germany, France, Switzerland and Italy specialise in advanced technologies, mostly in traditional sectors such as the automotive, machinery and equipment industries.

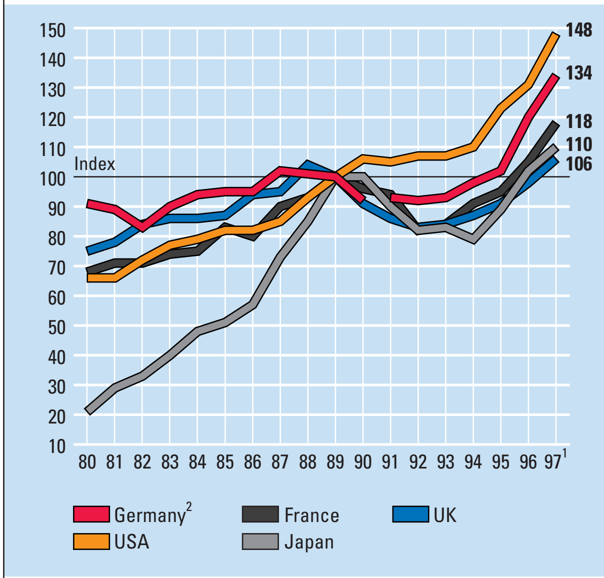
In terms of the technological specialisation of industrialised countries – i.e. the areas mostly covered by national patents compared with the priorities of world-wide patent activities – there are shifts from one country to another rather than within the various countries. In the "major national economies", however, specialisation patterns tended to flatten so that structures became more similar. Only Canada and Sweden which nowadays specialise in high-tech patents were able to change their technological specialisation dramatically over the last decade. This is mainly the result of the increasing concentration of these countries' R&D activities on telecommunications.

High technology has traditionally been the domain of the USA and Japan. Germany, France, Switzerland and Italy, on the other hand, concentrate less on high-tech patents. In recent years, however, Germany has continuously improved its relative position in high technology. Japan suffered a persistent decline in its specialisation in high technology, though this trend has changed slightly since 1997.

Germany is still specialising in advanced technologies. This is also where German industry is channelling a major part of its R&D

Chart 24

Triad patents of major industrialised countries 1980–1997



1 1995 and 1996 reliable projections;
1997 rough projections.
2 Up to and including 1990 former West Germany.

Sources: EPAT; INPADOC. – OECD: OECD in Figures. – FhG-ISI calculations. *BMBF, BuFo 2000*

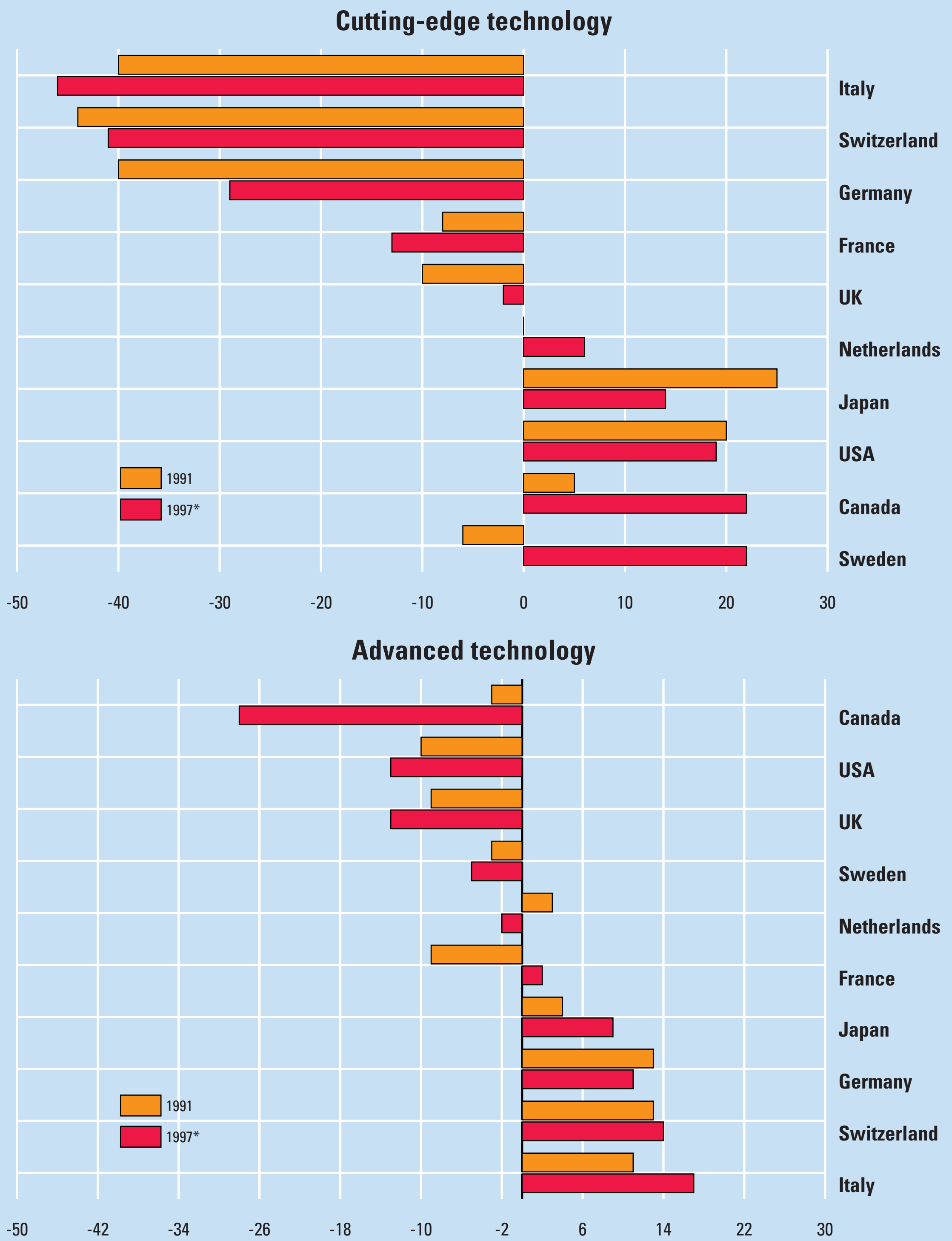
resources and where the percentage of "user patents" is particularly high; outstanding original scientific achievements are less dominant. Germany primarily combines different technologies and integrates top scientific and research achievements into traditional sectors. Switzerland, Italy and increasingly France are also looking to advanced technologies to maintain and enhance their technological performance.

In the case of generic technologies Germany's patent specialisation appears to differ considerably from that of the USA. Germany has an above-average percentage of patents in environmental protection (polymer recycling, improved recycling and reuse of cars, biological water purification and treatment of residential waste) and in the field of aluminium and magnesium structures. It has relative disadvantages in information technology and telecommunications (wideband communications and intelligent network technology, flat screens) as well as in biotechnology (DNA sequencing, genetically modified plants, vaccines from genetic production and recombinant pharmaceuticals). Here it is the USA – and in some areas also Japan – that is the technology leader.

The technological specialisation of patent activities is paralleled by the specialisation of foreign trade activities. The reason is that often patent protection is applied for in order to increase export opportunities and protect the import substitution sector from imitations. It is in particular in the area of advanced technologies where the links between invention, innovation, production and export are rather close in Germany.

Chart 25

Patent specialisation of major industrialised countries 1991 and 1997

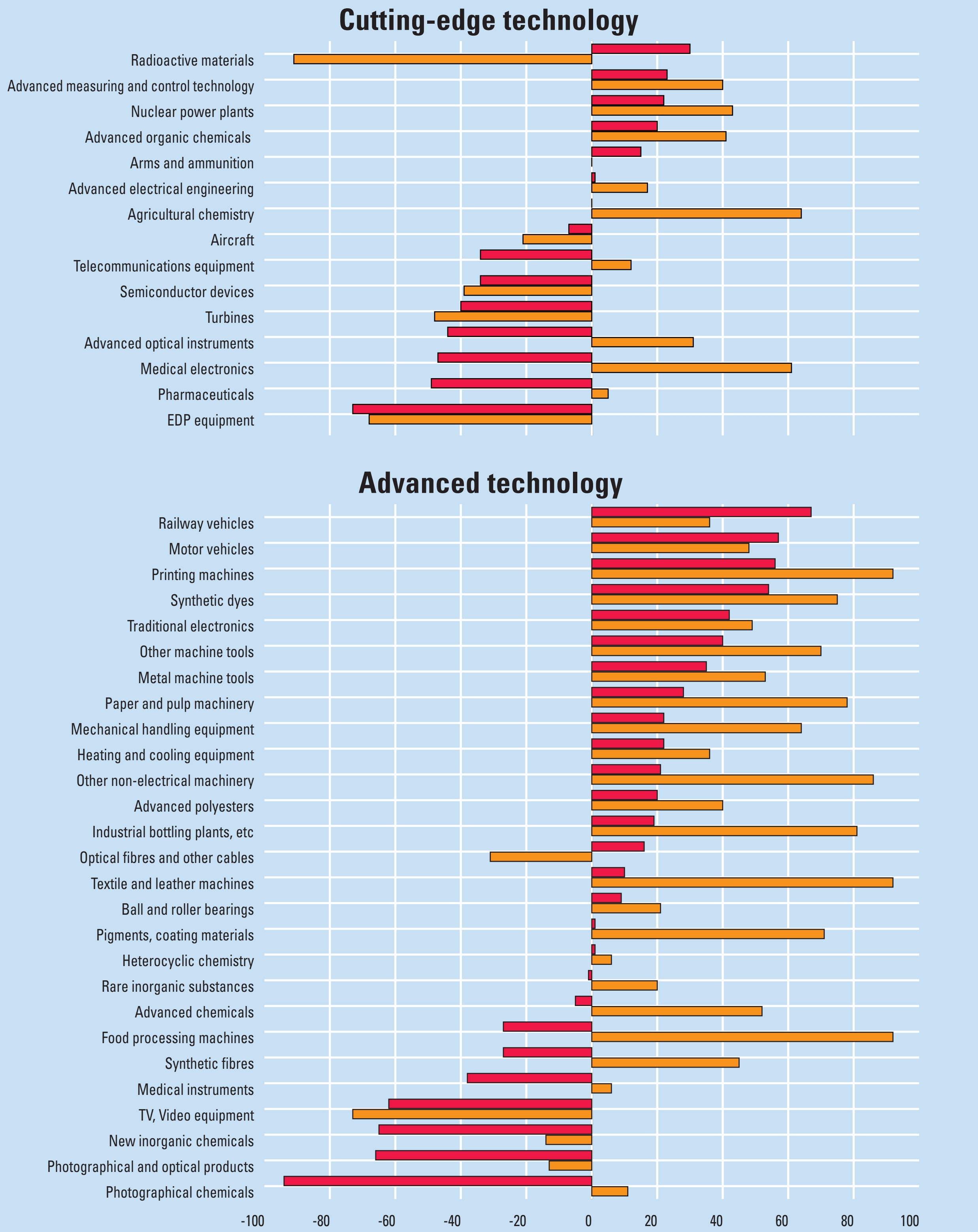


Comment: Relative Patent Activity (RPA). A positive value indicates that the share of patents in this area is larger than for total patents.
*1997 projected

Source: EPAT. PCTPAT; FhG-ISI calculations. *BMBF, BuFo 2000*

Chart 26

Germany's technology and trade portfolio in R&D-intensive goods



RPA 1995–97 (Relative Patent Activity). A positive value indicates that the share of patents in this area is larger than for total patents.

RCA 1995 (Revealed Comparative Advantage). A positive value indicates that the export/import ratio is higher for this product group than for the total of manufactured goods.

Source: EPAT. – FhG-ISI calculations.

BMBF, BuFo 2000

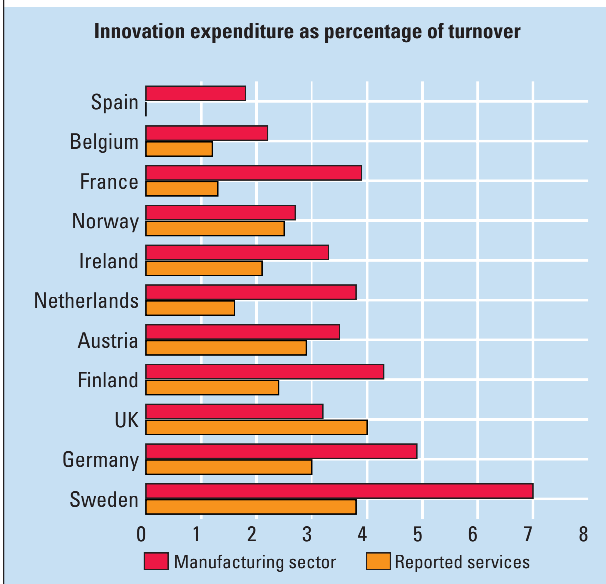
9.6 Innovation activities in the business enterprise sector

More and more business enterprises implement innovations in industry and in knowledge-intensive service sectors, i.e. they offer new or substantially improved products or services or introduce new or substantially improved manufacturing or process technologies. The increase in the number of innovative business enterprises (companies that have made innovation efforts over a period of three years) is attributable to the fact that additional firms have started innovations and that non-innovative companies are pushed out of the market faster than innovative ones. Also, the funding business enterprises spent on innovations has tended to rise in recent years, but these funds – like investments and R&D expenditure – grow rather slowly.

In terms of innovation intensity (innovation expenditure related to sales) in the manufacturing sector Germany (with 4.9 per cent) came second in Europe in 1996 after Sweden (7.0 per cent).

Chart 27

Innovation intensity in Europe (1997)



Source: OECD 1999; Science, Technology and Industry Scoreboard 1999, for Germany ZEW Mannheimer Innovationspanel. *BMBF, BuFo 2000*

In Germany itself the innovation intensity of industry and the service sector in the new *Länder* is still slightly higher than in the old *Länder*.

Since 1994 sales of those business enterprises that had introduced product innovations (i.e. products new to the enterprise) have grown substantially. Most of these product innovations rather tend to be step-by-step further developments of existing products, product differentiations and imitations; the fact that they account for such a high percentage is indicative of an accelerated diffusion of technical knowledge and know-how. Sales of market novelties and the number of business enterprises launching these novel products have also risen.

Financing problems are often described as a major impediment to innovation. But a comparison at the European level shows that the German innovation system is in a much better position to ensure the provision of funding for innovative companies than the funding systems in other EU member states. Nevertheless financing problems regarding innovation activities are still a major barrier for German small and medium-sized enterprises that wish to expand their activities. On the other hand, German companies tend to think more often than their European competitors that profitability problems due to high costs are an obstacle to innovation.

This situation is also reflected in the innovation goals. This is why for German companies the reduction of labour, material and energy costs as an objective of innovation plays a more important role than for the average European enterprise.

9.7 New companies in R&D-intensive industries

During the 1990s, the number of new companies in Germany tended to increase, especially in the high-tech and communications industries (Internet and telecommunications). At the same time, the market for equity capital (venture capital) expanded considerably, above all in the areas of seed and start-up capital. Germany has considerably narrowed the gap between itself and countries like the USA and the Netherlands, a gap which only a few years ago seemed to be unbridgeable. In Europe, Germany is today one of the largest markets for capital needed to finance the start-up phases of new companies. The financing volume in the venture capital market rose from about DM 1.2 billion in 1995 to DM 5.8 billion in 1999.

New jobs were created as new companies were set up. In the manufacturing sector a start-up company creates four to five new jobs on average, in the knowledge-intensive service sector, however, it is only two additional jobs. Also in terms of growth, start-ups in R&D-intensive branches of industry or of the service sector are in a better position than new companies in non-R&D-intensive industries.

10. International comparison of resources for research and development

Information on research and development in Germany can be better assessed and understood when it is considered in relation to data from other countries. In order to ensure the international comparability of national data the member states of the Organisation for Economic Co-operation and Development (OECD) agreed on common guidelines published in the so-called Frascati Manual which lays down the definitions of research and development to be used and jointly developed classifications. Even though the rules compiled in the Frascati Manual are not binding, the regular co-operation of the OECD member states ensures that the statistical material is mostly compatible. As well as information on the resources allocated to research and development, the OECD and Eurostat also collect data on other indicators such as innovation activities, patents or information on other areas of science and technology. The comparisons made here cover the G7 countries, i.e. Canada, Germany, France, Italy, Japan, the UK and the USA, for which data are available up to and including 1997, in some cases 1998.

10.1 Gross domestic expenditure on research and development (GERD)

According to the definition adopted by the OECD, gross domestic expenditure on research and development (GERD) comprises the total intramural expenditure on R&D performed on the national territory during a given period, whatever the source of funds. It includes R&D performed within a country and funded from abroad and by international organisations, but excludes payments made abroad or to international organisations for R&D (cf. Frascati Manual 1993, para. 385).

In 1997, GERD by the G7 countries, which was converted into US$ purchasing power parities to ensure the comparability of all countries, totalled US$ 418.4 billion. This was 10.2 per cent up on 1995 when the countries under review spent US$ 379.5 billion on research and development. After growth had been rather moderate in the early 1990s, R&D expenditure clearly picked up again from 1995 onwards but still could not reach the growth rates of the 1980s.

Development in the individual G7 countries varied. Between 1995 and 1997, North America enjoyed the highest growth of gross domestic expenditure on research and development. In this two-year period the USA raised its expenditure by 15.4 per cent, and thus, also due to its weight within the G7, made a substantial contribution to the overall growth in this group of countries. In Canada, the country with the second highest growth rate in the G7, GERD rose by 9.9 per cent which, however, was below the weighted average of all G7 countries. With 1.1 per cent, France had the lowest growth between 1995 and 1997. Italy and Germany with growth rates of 6.9 per cent and 6.5 per cent, respectively, held middle positions, followed by Japan with 5.8 per cent and the UK with 4.7 per cent.

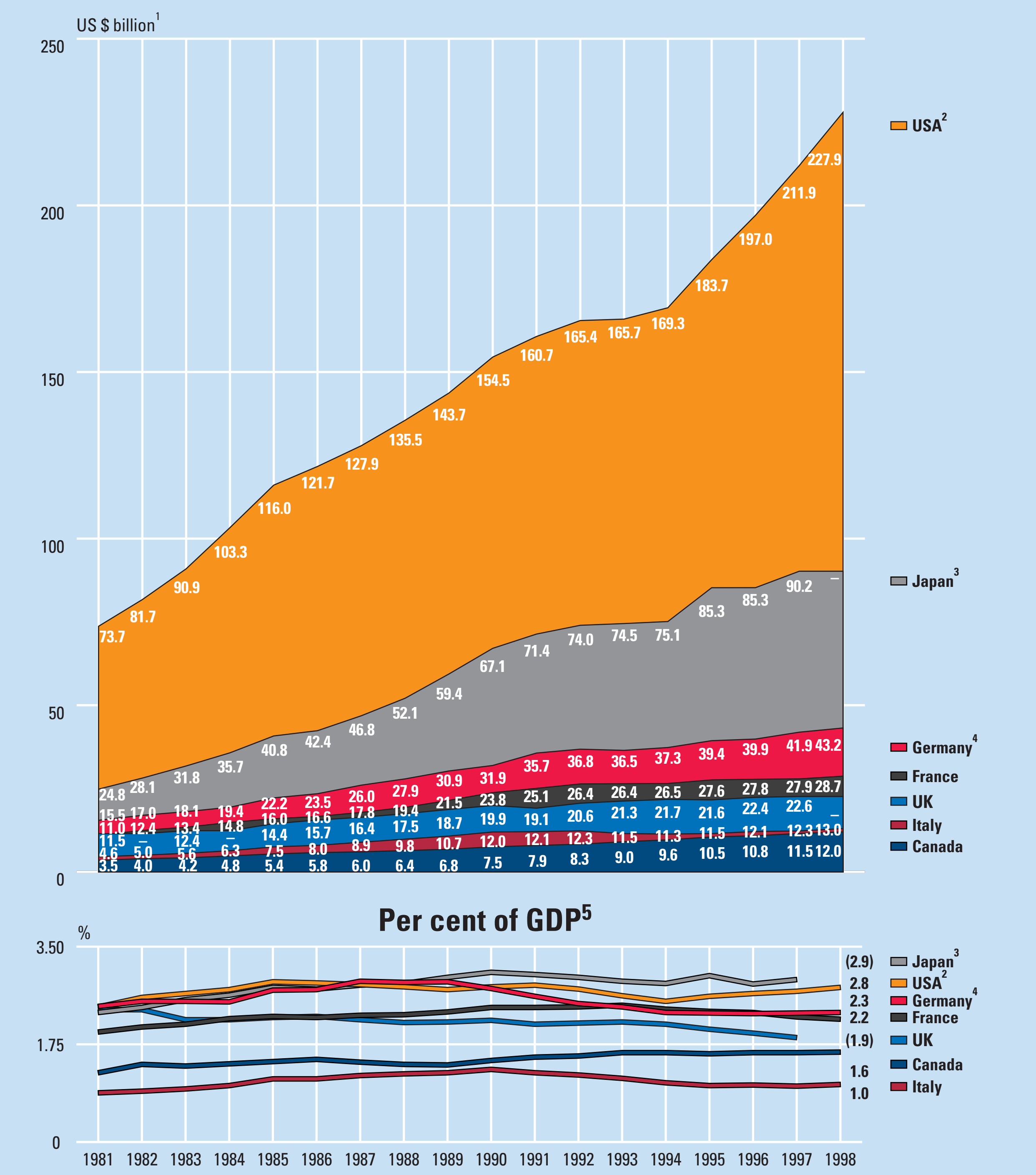
The ranking of the G7 countries in terms of their GERD has remained unchanged for the last quarter of a century. With R&D expenditure of US$ 211.9 billion in 1997, which accounted for more than half of total GERD of the G7 states, the USA was clearly the front runner, followed by Japan with US$ 90.2 billion and Germany with US$ 41.9 billion. France (US$ 27.9 billion) and the UK (US$ 22.6 billion) held fourth and fifth places. The two countries with the least weight were Italy (US$ 12.3 billion) and Canada (US$ 11.5 billion). However, the absolute figures primarily provide information on the weighting of the various countries in terms of GERD. To compare national research performance one also needs to consider the different sizes of the national economies under review which is why GERD as a percentage of gross domestic product is used as an appropriate indicator.

10.2 Gross domestic expenditure on research and development (GERD) as percentage of gross domestic product (GDP)

In terms of R&D intensity, i.e. gross domestic expenditure on research and development as a percentage of gross domestic product of a national economy, Japan has been the leader for the last decade; in 1997 it devoted 2.91 per cent of its GDP to R&D. The gap between Japan and the USA narrowed due to the strong increase in US R&D expenditure which even surpassed US economic growth; in 1997 US R&D intensity was 2.70 per cent. With 2.31 per cent[1] Germany came third in 1997, leading ahead of France again for the first time since 1993. The UK where this indicator had been below two per cent since 1996 reduced its percentage to 1.87 per cent in 1997. With 1.60 per cent and 1.00 per cent, respectively, Canada and Italy devoted similar percentages of their GDP to R&D as in the two previous years.

Chart 28

Gross domestic expenditure on research and development (GERD) in selected countries



1 Nominal expenditure, in US $ purchasing power parities.
2 Excludes most or all capital expenditure; 1991 break in series.
3 R&D expenditure overestimated up to and including 1995. 1996 break in series.
4 1991 and 1992 break in series; even years estimated; up to and including 1990 former West Germany, from 1991 onwards Germany.
5 GDP: Gross domestic product. For international comparison (not in national statistics), GDP based on the European System of Integrated Economic Accounts (ESA) 1979.
Provisional OECD data, partly based on national estimates, partly on OECD estimates.

Source: OECD (1999/2) *BMBF, BuFo 2000*

Table II/19 (cf. Table VII/25)

Gross domestic expenditure on R&D (GERD) in selected countries

Country	1989	1991	1992	1993	1994	1995	1996	1997[1]	1998[1]
	– US$ million[2] –								
Germany[3]	30 271	35 654	36 814	36 459	37 310	39 366	39 851	41 913	43 175
France	21 458	25 053	26 383	26 442	26 520	27 595	27 791	27 900	28 711
UK	18 729	19 106	20 599	21 258	21 743	21 604	22 362	22 618	.
Italy	10 741	12 069	12 308	11 482	11 343	11 481	12 101	12 276	12 976
Japan[4]	59 374	71 355	73 987	74 506	75 116	85 256	85 271	90 208	.
USA[5]	143 676	160 652	165 440	165 868	169 270	183 694	196 995	211 928	227 934
Canada	6776	7912	8295	9043	9606	10 476	10 839	11 515	11 977
	– % of GDP[6] –								
Germany[3]	2.87	2.61	2.48	2.42	2.32	2.31	2.30	2.31	2.32
France	2.33	2.41	2.42	2.45	2.38	2.34	2.32	2.24	2.20
UK	2.15	2.11	2.13	2.15	2.11	2.02	1.95	1.87	.
Italy	1.24	1.24	1.20	1.14	1.06	1.01	1.02	1.00	1.03
Japan[4]	2.95	3.00	2.95	2.88	2.84	2.98	2.83	2.91	.
USA[5]	2.73	2.81	2.74	2.62	2.52	2.61	2.66	2.70	2.77
Canada	1.38	1.52	1.54	1.60	1.60	1.58	1.60	1.60	1.61

1 Provisional OECD data, based partly on national estimates, partly on OECD estimates.
2 Nominal expenditure, converted into US $ purchasing power parities.
3 1991 and 1992 break in series; even years estimated; 1989 former West Germany, from 1991 onwards Germany.
4 Up to and including 1995 R&D expenditure overestimated. 1996 break in series.
5 Excludes most or all capital expenditure; 1991 break in series.
6 GDP: gross domestic product. For international comparison (not in national statistics), GDP based on the European System of Accounts (ESA) 1979.

Rounding error

Source: OECD (1999/2)

10.3 Gross domestic expenditure on research and development per capita

Gross domestic expenditure on research and development as a percentage of GDP is not the only indicator used in international comparisons. The ratio of R&D expenditure to the population also serves as an indicator in comparing national research efforts because it can compensate for the differences in size between the various countries.

In terms of per capita R&D expenditure the USA, with US$ 794, was the leading nation in 1997, followed by Japan with US$ 715. This differs from the ranking of these two countries in terms of GERD as a percentage of GDP. For the rest, the ranking of the G7 countries in terms of per capita R&D expenditure tallied with that for R&D intensity. Germany (US$ 511) and France (US$ 476) held middle positions. With almost identical sums the UK (US$ 383) and Canada (US$ 380) followed by a margin of about US$ 100, holding fourth and fifth places. Italy, on the other hand, could no longer keep pace with the other G7 countries as it spent only US$ 213 (1995: US$ 200) per capita on research and development (cf. Table II/20).

Table II/20

Gross domestic expenditure on R&D (GERD) per capita in selected countries

– US$ * –

Country	1989	1993	1995	1996	1997
Germany[1]	488	449	482	487	511
France	380	459	475	476	476
UK	327	365	369	380	383
Italy	189	201	200	211	213
Japan[2]	482	598	679	678	715
USA[3]	581	643	698	742	794
Canada[4]	248	312	354	362	380

* Nominal expenditure, converted into US$ purchasing power parities.
1 1989 former West Germany, from 1993 onwards Germany.
2 Up to and including 1995 R&D expenditure overestimated.1996 break in series.
3 Excludes most or all capital expenditure; 1991 break in series.
4 1997 provisional.

Source: BMBF

Rounding error

10.4 Financing of gross domestic expenditure on research and development

In all G7 countries, except Italy, the business enterprise sector made the greatest contribution to financing gross domestic expenditure on research and development. However, there were major differences between the various countries. In Japan the business enterprise sector provided almost three quarters of R&D funds, in the USA and Germany it financed more than 60 per cent. In France, the UK and Canada industry contributed about 50 per cent, in Italy 43.3 per cent.

A comparison of 1995 and 1997 shows that the contribution made by the business enterprise sector increased in all G7 countries. The most substantial changes occurred in Japan (plus 6.9 percentage points) and the USA (plus 3.9 percentage points). Canada also enjoyed an increase of more than two percentage points. In Germany, the increase in the contribution made by industry was at the bottom end of the scale with only 0.3 percentage points.

With 18.1 per cent, Japan made the lowest government contribution by far to financing GERD among the major industrialised countries under review in this report. In the other six countries, government contributions ranged from 31.9 per cent in the USA to 51.2 per cent in Italy.

In keeping with the increased contribution made by the business enterprise sector, the most substantial drop in government funds allocated to financing GERD occurred in Japan (minus 4.7 percentage points), the USA (minus 3.7 percentage points) and Canada (minus 3.1 percentage points). But it was only in Japan that this development also meant a decline in the absolute level of government funding of GERD. In Canada and the USA the absolute levels of government expenditure remained stable or increased. The percentage of publicly financed GERD did not rise in any of the countries under review.

Other financing sources, including the sector "Abroad" as well as international institutions and national institutions such as private non-profit organisations or in some cases universities as donors of funds, are covered by the category "Others". In the two countries with two-digit percentages contributed by this group, i.e. the UK and Canada, substantial shares were received from abroad (UK: 14.9 per cent; Canada: 13.5 per cent) (cf. Chart 29 and Table II/21).

Table II/21 (cf. Table VII/25)

Financing of gross domestic expenditure on R&D (GERD) in selected countries

– Percentage –

Country	Financed by: Business enterprise sector				Government				Others			
	1989	1993	1995	1997	1989	1993	1995	1997	1989	1993	1995	1997
Germany[1]	63.3	61.5	61.1	61.4	34.1	36.5	36.8	35.9	2.6	1.9	2.1	2.7
France[2]	43.9	47.0	48.3	50.3	48.1	43.5	41.9	40.2	8.0	9.4	9.7	9.5
UK	50.6	51.5	48.0	49.5	36.4	32.5	33.2	30.8	13.0	16.0	18.8	19.7
Italy[3]	46.4	44.3	41.7	43.3	49.5	51.3	53.0	51.2	4.1	4.4	5.3	5.5
Japan[4]	72.3	68.2	67.1	74.0	18.6	21.6	22.8	18.1	9.1	10.2	10.0	7.9
USA[5]	52.2	58.3	60.4	64.3	45.6	37.7	35.6	31.9	2.2	4.0	4.0	3.8
Canada	41.5	44.1	46.2	48.9	44.7	40.3	35.4	32.3	13.8	15.6	18.4	18.7

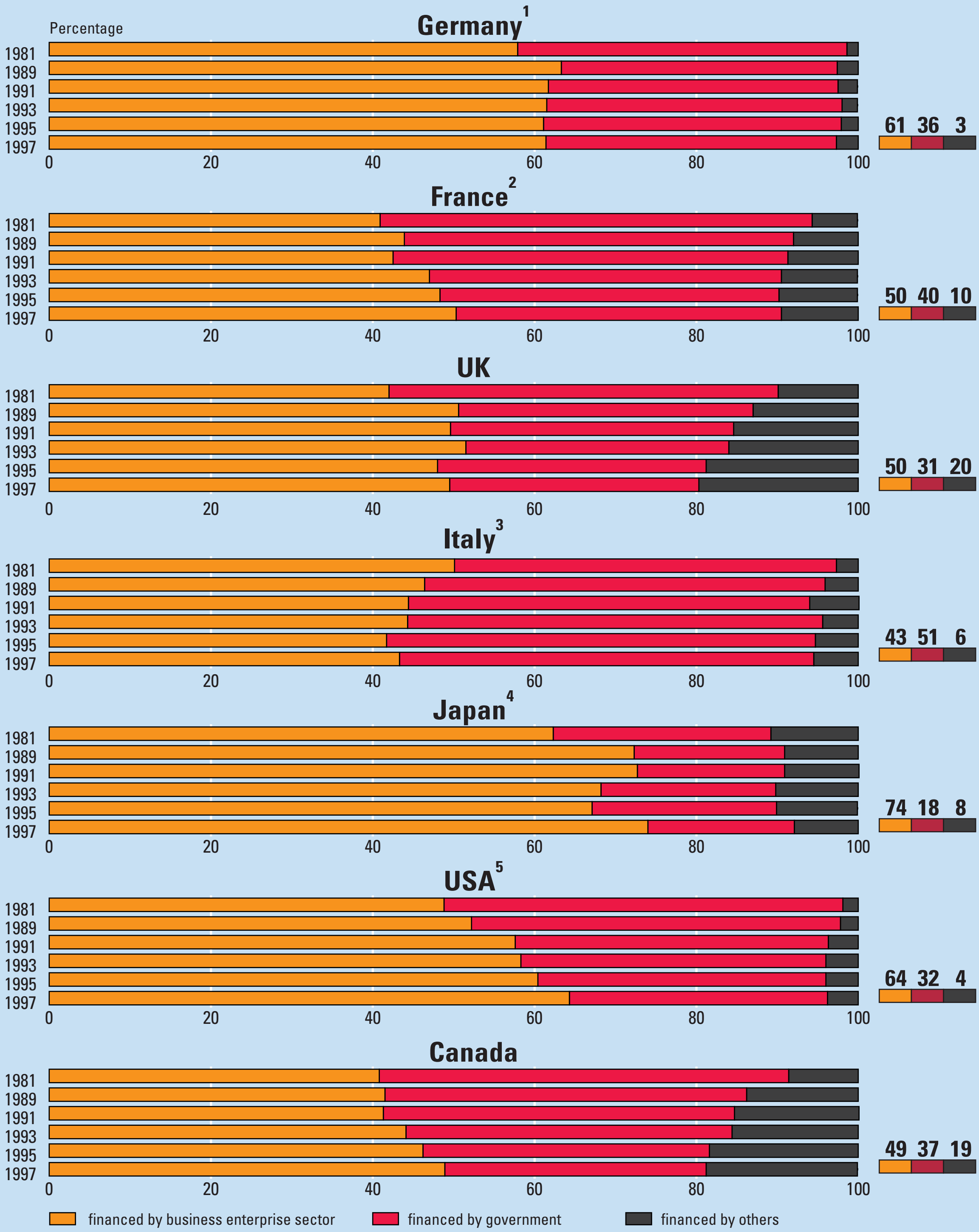
1) 1989 former West Germany, from 1993 onwards Germany. 1997 estimates.
2) 1993 break in series.
3) 1997 provisional.
4) 1996 break in series.
5) Excludes most or all capital expenditure.

Source: OECD (1999/2) and calculations by BMBF

Rounding error

Chart 29

Financing of gross domestic expenditure on research and development (GERD) in selected countries



1 1981. 1989 former West Germany, from 1991 onwards Germany. 1997 estimated.
2 1993 break in series.
3 1997 provisional.
4 1996 break in series.
5 Excludes most or all capital expenditure.

Rounding error

Source: OECD (1999/2) and calculations by BMBF

BMBF, BuFo 2000

10.5 R&D personnel per 1,000 labour force

AS well as R&D expenditure, human resources devoted to research and development are also used in both the national and the international context to describe a research system. The advantage of using R&D personnel as an indicator is that it is not affected by currency fluctuations and hence can reflect real changes in research systems much better than gross domestic expenditure on research and development as a percentage of GDP. Due to the different sizes of the G7 countries reviewed in this Report the comparison of the absolute numbers of R&D personnel is not very conclusive. This is why a comparison is made of R&D personnel expressed in full-time equivalents – as far as this indicator is available – related to the total labour force.

Compared with the other indicator reviewed in this report the situation is slightly different in the four countries for which 1997 data are available. In terms of R&D personnel per 1,000 labour force the Japanese R&D efforts, at a ratio of 13.2, were still greater than in France (12,3) or Germany (11.6), but the difference was much smaller than in the case of R&D expenditure. The ranking of France and Germany was reversed as well, while in Italy the ratio was considerably lower (6.0).

In the three European countries reviewed research scientists accounted for about half of the entire R&D personnel in 1997, while in Japan their percentage was much higher, i.e. 70 per cent (cf. Table II/22).

Table II/22

R&D personnel per 1,000 labour force in selected countries

– Full-time equivalent –

Country	1989		1993		1995		1997	
	Total	of which researchers	Total	of which researchers	Total	of which researchers	Total	of which researchers
Germany[1]	14.3	5.9	.	.	11.6	5,9	11.6	5.9
France[2]	11.7	4.9	12.5	5.8	12.6	6.0	12.3	6.0
UK	9.9	4.7	9.5	4.7	.	5.1	.	.
Italy[3]	5.8	3.1	6.1	3.2	6.1	3.2	6.0	3.2
Japan[4]	13.8	8.9	14.3	9.7	14.2	10.1	13.2	9.2
USA[5]	.	7.3	.	7.4	.	.	.	.
Canada	7.9	4.4	8.3	5.0	8.7	5.4	.	.

1 1989 former West Germany, from 1993 onwards Germany.

2 1997 break in series.

3 1993 break in series.

4 Up to and including 1995 R&D expenditure overestimated. 1996 break in series.

5 Underestimated.

Source: OECD (1999/2)

Rounding error

10.6 Government R&D expenditure as a percentage of gross domestic product

Whereas the indicators discussed so far in this section are based on data collected from R&D performing sectors, the OECD and Eurostat have compiled comparisons of government-financed R&D expenditure based on national budget appropriations. The data obtained in this way are much more recent. On this basis it is also possible to compare total government research expenditure, i.e. including the funds spent on R&D performed abroad. To neutralise the difference in size between the G7 states, government R&D expenditure derived from public budgets is again expressed as a percentage of GDP.

In all G7 countries – with the exception of Japan – government R&D expenditure as a percentage of GDP dropped continuously; in Italy it has remained unchanged since 1995 at around 0.6 per cent. France which had always had the highest percentage in the period under review also dropped to less than one per cent in 1998, reaching only 0.99 per cent. With 0.89 per cent and 0.84 per cent the USA and Germany achieved relatively high percentages. The UK held a middle position with government R&D expenditure accounting for 0.72 per cent of GDP. By continuously increasing the share of its government R&D expenditure to 0.6 per cent in 1998 Japan not only surpassed Canada (0.73 per cent) for the first time, but also Italy (0.59 per cent).

As far as the share of GDP devoted to civil R&D expenditure only is concerned, the ranking changes as a result of the differences in priorities that the various countries have defined for their R&D activities.

In 1998, Germany had the highest percentage of GDP allocated to civil R&D at 0.77 per cent which – like total government-funded R&D expenditure – was less then in previous years (1997: 0.78 per cent; 1995: 0.84 per cent). The percentage of GDP devoted to civil R&D by the French government reached a similar level (0.75 per cent), followed by Japan (0.58 per cent) in third place. Like Germany, Italy and Canada, Japan spent more than 90 per cent of government R&D funds on civil research and development. In the UK and the USA, on the other hand, considerable percentages of public R&D funds, i.e. 40 per cent and more than 50 per cent, respectively, served non-civil purposes. Accordingly, the UK government spent 0.44 per cent of GDP on civil R&D and the US government 0.41 per cent (cf. Chart 30 and Table II/23).

Table II/23

Total government R&D expenditure* as a proportion of the gross domestic product in selected countries

– Percentage –

Country	Total percentage					of which civil R&D expenditure				
	1989	1993	1995	1997	1998 [5]	1989	1993	1995	1997	1998 [5]
Germany [1]	1.06	0.99	0.92	0.86	0.84	0.93	0.91	0.84	0.78	0.77
France	1.36	1.26	1.13	1.05	0.99	0.86	0.84	0.79	0.75	0.75
UK	0.90	0.86	0.80	0.75	0.72	0.51	0.50	0.51	0.46	0.44
Italy	0.73	0.69	0.58	0.62	0.59	0.66	0.64	0.55	0.59	0.57
Japan [2]	0.45	0.48	0.52	0.59	0.61	0.43	0.45	0.49	0.56	0.58
USA [3]	1.18	1.10	0.98	0.91	0.89	0.41	0.45	0.45	0.41	0.41
Canada [4]	0.56	0.60	0.42	0.36	0.37	0.52	0.57	0.39	0.34	0.35

* Budget appropriations.

1 1989 former West Germany, from 1993 onwards Germany.

2 Excluding funds for humanities and social sciences.

3 Federal expenditure only; excluding General University Funds and most or all capital expenditure.

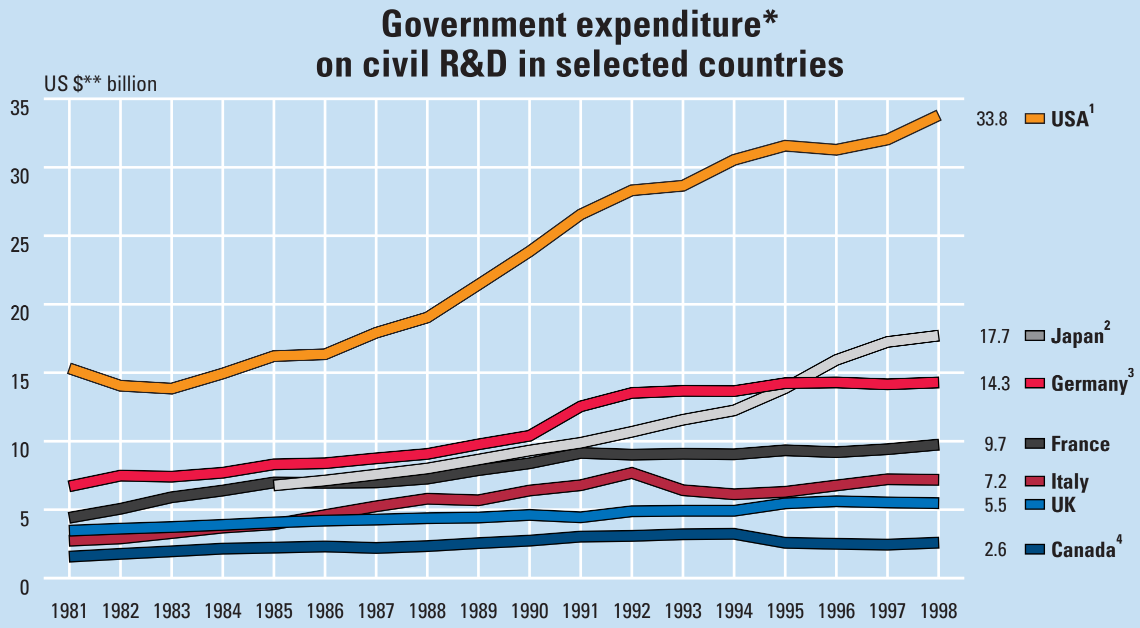
4 Federal expenditure only. 1997 break in series.

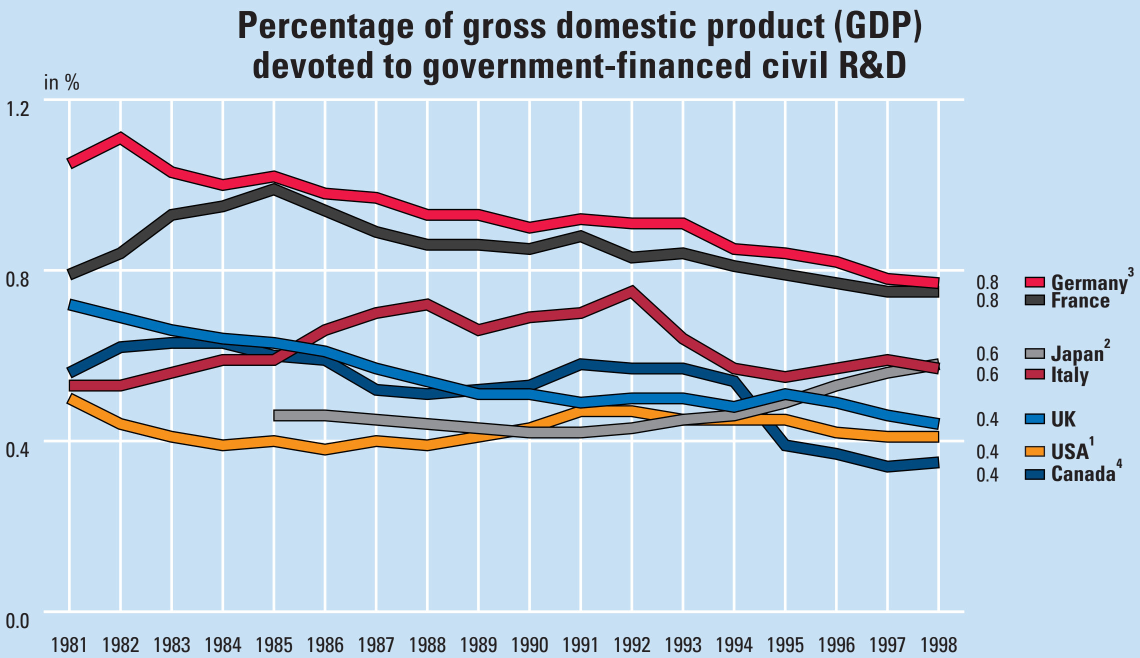
5 Provisional OECD data, based partly on national estimates, partly on OECD estimates.

Source: OECD (1999/2) and calculations by BMBF

Chart 30

Government expenditure on civil research and development





* Budget appropriations. Provisional OECD data, partly based on national estimates, partly on OECD estimates.
** US $ purchasing power parities.
1 Federal expenditure only. Excluding General University Funds and most or all capital expenditure.
2 Excluding R&D expenditure in the social sciences and humanities. OECD estimates in some cases.
3 Up to and including 1990 former West Germany, from 1991 onwards Germany.
4 Federal expenditure only. 1997 break in series.

Source: OECD (1999/2) and BMBF calculations

BMBF, BuFo 2000

10.7 Government-financed R&D expenditure in the European Union

In 1998, Germany, France, the UK and Italy together accounted for about three quarters of total publicly financed R&D expenditure in the EU (budget appropriations). National shares ranged from 25.3 percent (Germany) to 12.2. per cent (Italy). All the other EU member states had single-digit percentages, with Spain (6.4 per cent) leading ahead of the Netherlands (4.8 per cent), Sweden (2.8 per cent) and Belgium (2.6 per cent). Greece (0,7 per cent) and Ireland (0.5 per cent) contributed less than one per cent to funding total publicly financed R&D expenditure. The eleven countries that are members of the European Monetary Union accounted for about 80 per cent of the EU's total R&D expenditure (cf. Table II/24).

Using the budget appropriations of the EU member states as a basis, it is possible to make a comparison of funds allocated to particular research programmes and objectives. In 1998, France and the UK spent more than other countries on research and development activities that served the research objective "Defence" (France: 24.8 per cent of total French government R&D expenditure; UK: 39.5 per cent). However, these percentages were clearly lower than in 1988: In France this share had dropped by 12.5 percentage points, in the UK by 9 percentage points. Spain, on the other hand, raised the share of R&D funding spent on defence to 30 per cent in 1998 (1988: 14.5 per cent). Across all EU countries "Research financed from General University Funds" accounted for the lion's share of civil R&D expenditure. In 1998, this sector's share – at 31.7 per cent – was almost twice as large as that allocated to "Defence". In the technological sector the most important research objectives were "Industrial production and technology" with a share of 8.9 per cent, "Exploration and exploitation of space" with 6.0 per cent as well as "Protection and improvement of human health" with 5.8 per cent. The EU itself allocated most of its research funds to "Industrial production and technology" which accounted for 38.1 per cent of expenditure (cf. Table II/25).

Table II/24

EU government R&D expenditure by member states [1]

– Percentage –

Country	1993	1997	1998 [2]
Germany[3]	23.1	26.0	25.3
France	27.0	26.1	22.8
UK	17.3	14.5	15.2
Italy	14.5	13.5	12.2
Total	81.9	80.1	75.5
Belgium	1.6	2.0	2.6
Denmark	1.4	1.2	1.3
Greece	0.4	0.4	0.7
Spain	3.7	4.9	6.4
Ireland	0.3	0.2	0.5
Netherlands	4.2	4.0	4.8
Austria	1.4	1.6	2.0
Portugal	0.5	0.7	1.3
Finland	1.2	1.4	2.1
Sweden	3.5	3.5	2.8
Total EU-15	100.0	100.0	100.0
of which EUR-11[4]	*77.3*	*80.3*	*79.8*

1 At 1990 purchasing power parities and prices. Rounding error
2 Provisional budget; Denmark and Greece estimated.
3 From 1991 onwards including new *Länder* and East Berlin.
4 Euro zone (excluding Luxembourg)

Source: Statistical Office of the European Communities (Eurostat)

Table II/25

Government R&D expenditure of EU member states by research objective,

– Percentage –

Research objective in accordance with NABS chapters (NABS 1992)[1]	Belgium		Denmark		Germany		Greece		Spain		France		Ireland	
	1988	1998	1988	1998	1988	1998	1988	1998	1988	1998	1988	1998	1988	1998
1. Exploration and exploitation of the Earth	3.8	0.6	1.7	.	2.2	1.9	5.8	.	6.5	1.8	1.8	0.9	0.2	0.4
2. Infrastructure and general planning of land use	0.7	0.8	1.8	.	2.1	1.7	0.6	.	0.3	0.6	1.0	0.6	1.0	2.6
3. Control of environmental pollution	2.3	1.7	2.4	.	3.4	3.5	3.2	.	1.6	2.4	0.8	2.2	0.9	0.9
4. Protection and improvement of human health	2.6	1.3	1.7	.	3.1	3.2	8.0	.	8.1	4.6	3.2	5.5	5.1	3.9
5. Production, distribution and rational utilisation of energy	9.3	2.5	3.2	.	7.0	3.6	3.4	.	2.5	3.5	3.9	5.1	2.9	0.0
6. Agricultural production and technology	6.7	2.9	8.1	.	2.0	2.7	21.5	.	6.3	3.9	4.1	3.8	16.3	10.5
7. Industrial production and technology	13.0	19.7	17.8	.	14.0	12.2	12.7	.	19.4	15.1	12.8	5.7	33.9	34.2
8. Social structures and relationships	0.5	4.0	6.1	.	2.6	2.6	5.8	.	0.7	0.5	0.5	1.2	8.8	6.1
9. Exploration and exploitation of space	10.6	11.3	2.3	.	5.5	4.7	0.3	.	6.8	5.4	6.9	10.9	2.9	2.6
10. Research financed from General University Funds	22.2	29.7	34.6	.	31.1	39.2	29.2	.	17.7	25.5	11.7	17.1	25.8	22.4
11. Non-oriented research	24.6	21.0	20.0	.	14.4	15.8	7.3	.	12.1	5.4	15.6	20.4	2.2	16.2
12. Other civil research	3.0	4.0	0.0	.	0.1	0.2	0.4	.	3.4	1.2	0.4	1.8	0.0	0.0
Total of civil R&D	**99.3**	**99.6**	**99.6**	**.**	**87.6**	**91.3**	**98.1**	**.**	**85.5**	**70.0**	**62.7**	**75.2**	**100.0**	**100.0**
13. Defence	0.7	0.4	0.4	.	12.4	8.7	1.9	.	14.5	30.0	37.3	24.8	0.0	0.0
Total	**100.0**	**100.0**	**100.0**	**.**	**100.0**	**100.0**	**100.0**	**.**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

* 1988 final budget, 1998 provisional budget (Portugal final).

1 Breakdown in accordance with the Nomenclature for the Analysis and Comparison of Science Programmes and Budgets (1988 data in accordance with NABS 1983, 1996 data in accordance with NABS 1992).

2 Euro zone.

3 Excluding Luxembourg, Austria and Finland.

Source: Statistical Office of the European Communities (Eurostat)

Part II

(budget appropriations)*

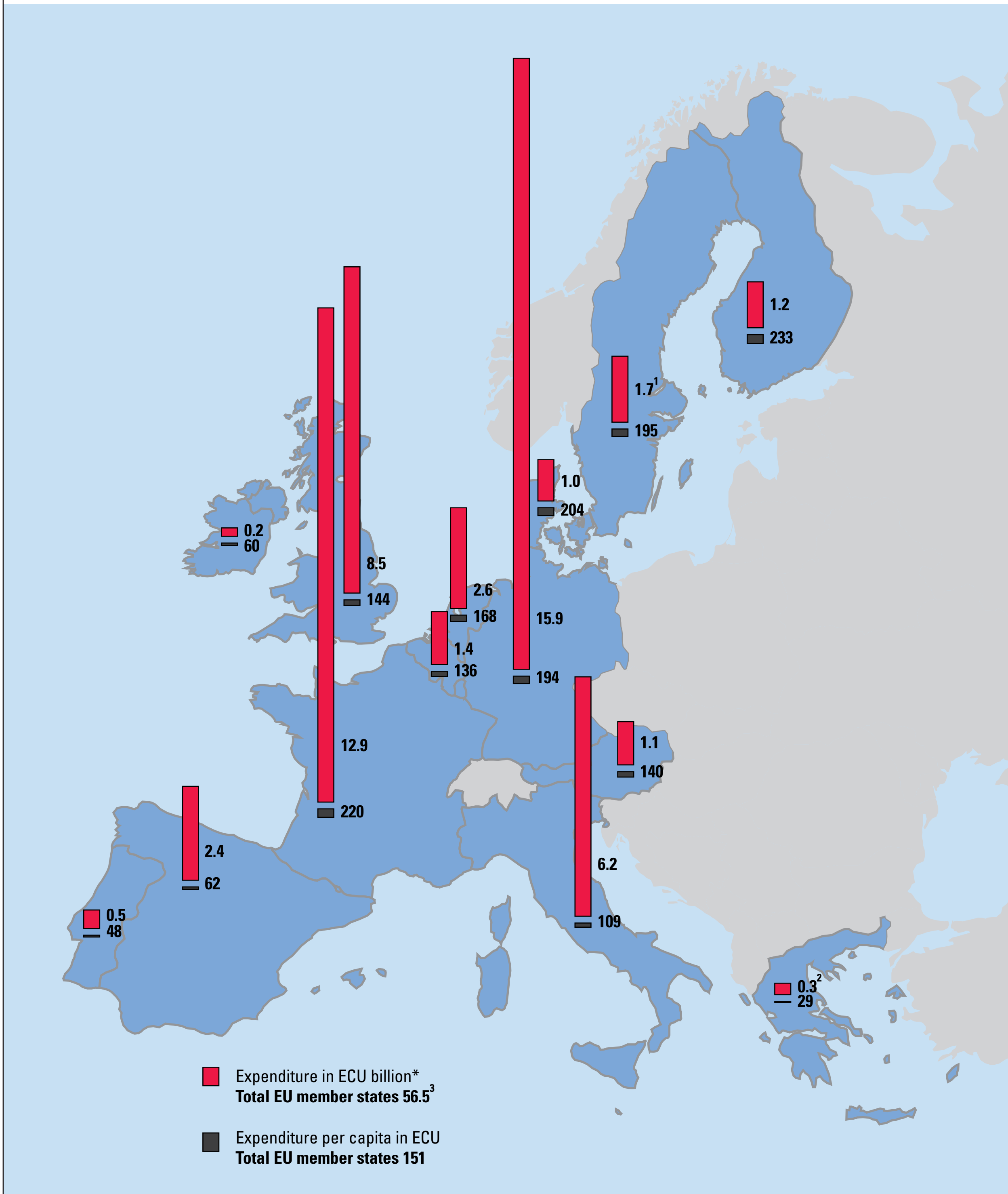
– Percentage –

Italy		Nether-lands		Austria		Portugal		Finland		Sweden		UK		EUR 11 [2]		EU-15		EU	
1988	1998	1988	1998	1988	1998	1988	1998	1988	1998	1988	1998	1988	1998	1988[3]	1998	1988	1998	1988	1998
1.3	1.6	0.6	0.5	.	1.7	11.1	3.1	.	1.3	.	1.2	2.1	1.4	2.0	1.4	.	1.4	2.9	2.2
0.6	0.6	4.7	3.6	.	2.0	3.9	3.3	.	2.9	.	5.9	1.4	1.6	1.5	1.3	.	1.5	1.9	5.6
2.2	3.4	3.3	2.7	.	2.2	3.4	5.0	.	2.3	.	0.9	1.2	2.3	2.1	2.9	.	2.7	6.5	6.1
4.8	5.6	2.5	2.3	.	2.6	3.9	6.1	.	7.6	.	0.9	4.6	14.5	3.6	4.3	.	5.8	3.8	7.1
8.7	5.0	3.4	3.1	.	0.6	2.1	1.7	.	6.4	.	4.4	3.9	0.6	5.9	4.1	.	3.6	42.4	10.9
2.3	1.8	4.3	3.8	.	3.2	16.0	13.3	.	6.3	.	1.8	4.4	4.3	3.3	3.3	.	3.4	2.5	5.9
15.2	8.1	19.6	13.2	.	5.8	15.4	8.9	.	26.8	.	5.0	8.0	0.8	14.4	10.6	.	8.9	33.8	38.1
1.8	3.6	2.0	2.0	.	2.2	1.9	5.2	.	5.5	.	6.9	2.1	2.2	1.6	2.3	.	2.4	1.1	2.6
9.0	8.3	3.3	3.0	.	0.0	0.1	0.6	.	1.9	.	2.4	3.1	2.6	6.7	6.9	.	6.0	2.5	2.1
31.7	48.0	38.0	46.4	.	65.8	40.5	38.3	.	25.9	.	50.1	15.8	18.1	24.1	33.6	.	31.7	0.0	0.0
8.5	11.1	11.1	11.3	.	13.8	0.4	8.7	.	11.9	.	13.2	4.6	11.7	13.6	15.5	.	14.8	2.5	8.5
3.6	0.0	4.2	5.1	.	0.2	1.2	5.2	.	0.0	.	0.0	0.3	0.4	1.3	1.2	.	1.0	0.1	10.9
89.6	**97.4**	**97.0**	**97.0**	**.**	**100.0**	**100.0**	**99.4**	**.**	**98.6**	**.**	**92.7**	**51.5**	**60.5**	**80.0**	**87.4**	**.**	**83.3**	**100.0**	**100.0**
10.4	2.6	3.0	3.0	.	0.0	0.0	0.6	.	1.4	.	7.3	48.5	39.5	20.0	12.6	.	16.7	0.0	0.0
100.0	**100.0**	**100.0**	**100.0**	**.**	**100.0**	**100.0**	**100.0**	**.**	**100.0**	**.**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**.**	**100.0**	**100.0**	**100.0**

Rounding error

Chart 31

Government expenditure on research and development in the member states of the European Union in 1997



* ECU = European Currency Unit; average exchange rate 1997: 1 ECU = 1.96 DM.
1 Preliminary result 1998. 2 Preliminary result 1996. 3 Estimate by Eurostat.

Source: Statistical Office of the European Communities (Eurostat). BMBF

BMBF. BuFo 2000

11. Patent and licence transactions with foreign countries

When compiling balance of payment statistics the Deutsche Bundesbank also identifies Germany's receipts from and expenditure on technological services. This part of the balance on current account which is sometimes also referred to as *technological balance of payments* covers expenditure on patents and licences, research and development services as well as IT and engineering services. When interpreting the data it should be noted that these indicators do not provide a complete picture of international technology transfer, because important areas such as foreign trade in manufactured high-tech goods, direct investment abroad by business enterprises and sales of industrial plants are not included. Consequently, the technological balance of payments provides only indications for measuring international links concerning the output of research and development, but on its own it is not an adequate basis for assessing the technological performance of a region.

The development of technological services between 1989 and 1998 shows that expenditure was invariably higher than the receipts. In the years following German unification the balance varied between just under DM 3 billion and some DM 5 billion. This ratio of receipts to expenditure cannot per se be viewed as positive or negative. The traditionally negative German balance rather shows that the German business enterprise sector depends on buying in technological services from other countries; on the other hand, one might say that Germany is taking advantage of technologies developed abroad. As well as technological reasons, the fiscal framework and the general economic setting also influence the development of this balance.

11.1 Total receipts from and expenditure on transfrontier technological services – trend and structure

Between 1989 and 1998, transfrontier patent and licence transactions had grown steadily in terms of both receipts and expenditure, thus reflecting ever closer economic links with other countries. In 1998, receipts amounted to DM 22.6 billion, comparing with expenditure of DM 26.7 billion. Over the ten-year period under review the balance had always been negative, even though it was subject to certain fluctuations. In 1998, expenditure exceeded receipts by DM 4.1 billion (cf. Table II/26).

Payments for technological services cover patents and licences (1998: 32.3 per cent of expenditure), research and development services (25.2 per cent of expenditure), engineering services (22.5 per cent) and IT services (20.0 per cent). Especially the latter gained greatly in importance during the decade under review. IT services nowadays account for about one fifth of the total flow of funds in terms of both receipts and expenditure. In 1989, they amounted to only about one twentieth

Of the various components making up the technological balance of payments only research and development services achieved a revenue surplus; at DM 0.7 billion, however, it was not that high compared with the total receipts for research and development services of DM 7.4 billion in 1998.

Between 1989 and 1998, receipts from and expenditure on technological services rose by a factor of more than 2.5. At 274 per cent, expenditure grew slightly more than receipts.

Growth of transactions with other countries was strongest in the area of IT services. During the decade under review both expenditure and receipts grew by a factor of ten. The mostly negative balance was at a low level.

Traditionally, expenditure on patents and licences have exceeded receipts. The negative balance of DM 2.9 billion (1998) thus made a substantial contribution to the total deficit incurred in the area of technological services.

Between 1989 and 1998, engineering services developed considerably. Receipts and expenditure gained by about 200 per cent and 370 per cent, respectively. But as a result of the relative stronger growth of expenditure on engineering services the balance that had still been positive in 1989 (DM 0.5 billion) was clearly negative. In 1998, expenditure exceeded the receipts by DM 1.6 billion.

Table II/26

Longer-term trend in international payments for technological services

– DM million –

Year	Techno-logical services, total	Patents and licences			Research and develop-ment	EDP services	Engineering services
		Total	Patents, inventions, processes	Other property rights			
			Receipts				
1989	8253	2519	2110	409	3110	465	2158
1990	10 237	3180	2499	681	4208	415	2433
1991	10 426	3129	2514	614	4169	599	2529
1992	11 393	3234	2624	610	4326	741	3092
1993	11 959	3403	2639	765	4366	1161	3028
1994	13 284	3892	2792	1100	4656	1458	3278
1995	15 308	4488	3198	1290	5388	2012	3420
1996	16 269	5081	3696	1386	5029	2398	3761
1997	20 589	5577	4010	1567	7336	3727	3949
1998	22 568	5721	4529	1192	7448	4942	4456
			Expenditure				
1989	10 527	5681	4084	1596	2673	551	1622
1990	11 217	6115	4742	1373	2675	567	1860
1991	13 242	7009	5328	1681	3257	744	2232
1992	15 798	7034	5015	2019	4425	889	3449
1993	17 008	7328	5041	2287	4510	1369	3801
1994	16 634	7312	5010	2302	4294	1410	3618
1995	19 115	8508	5749	2759	4343	2119	4146
1996	21 529	8855	5431	3424	5364	2806	4504
1997	23 967	8181	5041	3139	5995	4464	5328
1998	26 663	8600	5545	3055	6723	5330	6010
			Balance				
1989	- 2274	- 3162	- 1975	- 1187	+ 437	- 86	+ 537
1990	- 980	- 2935	- 2242	- 692	+ 1534	- 152	+ 573
1991	- 2816	- 3881	- 2814	- 1067	+ 912	- 144	+ 297
1992	- 4405	- 3800	- 2391	- 1409	- 99	- 148	- 357
1993	- 5050	- 3925	- 2403	- 1522	- 144	- 208	- 773
1994	- 3350	- 3421	- 2219	- 1202	+ 363	+ 48	- 340
1995	- 3808	- 4020	- 2550	- 1469	+ 1045	- 107	- 727
1996	- 5260	- 3774	- 1735	- 2038	- 335	- 408	- 743
1997	- 3378	- 2603	- 1031	- 1572	+ 1341	- 736	- 1379
1998	- 4095	- 2879	- 1016	- 1863	+ 725	- 388	- 1553

Source: Deutsche Bundesbank

Rounding error

11.2 Research and development services

R&D services which include in particular transfrontier payments for the development of new products and processes are the only area with a positive balance. In recent years, however, this balance was subject to fluctuations due to different trends in the growth of receipts and expenditure.

Receipts from technical research and development rose from DM 7.3 billion in 1997 to DM 7.4 billion in 1998, while expenditure increased from DM 6.0 billion to DM 6.7 billion. This was primarily the result of higher expenditure in the chemical industry (cf. Table VII/24).

A breakdown by partner countries shows that it is mainly the EU member states including EU organisations and non-European industrialised countries that were responsible for the shrinking of the positive balance between 1997 and 1998. But whereas in the case of EU countries higher expenditure coincided with lower receipts, expenditure to non-European industrialised countries, above all the USA, rose markedly while receipts hardly changed.

11.3 Patent and licence trade by sector of economic activity

A closer look at patents, inventions and processes shows that it was in particular business enterprises holding participating interests abroad or enterprises in which foreigners hold participating interests that contributed to transfrontier transactions. As is to be expected, companies in which foreigners hold major participating interests financed more than half of the total expenditure on patents. As far as receipts are concerned, those German companies that hold major participating interests abroad contributed more than 50 per cent to receipts from the patent and licence trade (cf. Table II/27).

In 1998, 45.7 per cent of the receipts from patents, inventions and processes totalling DM 4.5 billion were generated by the chemical industry. Apart from this sector, the metal-producing and metal-processing industries with 22.0 per cent (DM 1.0 billion) and the electrical industry and IT with 16.3 per cent (DM 0.7 billion) also figured prominently. Expenditure, on the other hand, focused on technical consultancy and planning services as well as other services

Table II/27

German* receipts from and expenditure on patents, inventions and processes (excluding copyright) by enterprises holding participating interests abroad, enterprises with foreign participating interests and other enterprises

– DM million –

Year	Receipts				Expenditure				Balance			
	Total	Enterprises			Total	Enterprises			Total	Enterprises		
		holding participating interests abroad 1	with foreign participating interests 2	Other enterprises		holding participating interests abroad 1	with foreign participating interests 2	Other enterprises		holding participating interests abroad 1	with foreign participating interests 2	Other enterprises
1989	2110	1722	199	189	4084	674	3164	247	- 1975	1048	- 2965	- 58
1990	2499	1955	381	163	4742	793	3670	279	- 2242	1162	- 3288	- 116
1991	2514	1776	573	166	5328	780	3984	564	- 2814	995	- 3411	- 399
1992	2624	1701	737	185	5015	704	3955	356	- 2391	997	- 3217	- 171
1993	2639	1556	828	254	5041	747	3945	349	- 2403	809	- 3117	- 95
1994	2792	1747	805	240	5010	764	3702	544	- 2219	983	- 2897	- 305
1995	3198	2148	884	167	5749	1434	3828	487	- 2550	714	- 2944	- 320
1996	3696	2512	983	200	5431	1369	3520	543	- 1735	1144	- 2536	- 342
1997	4010	2924	888	198	5041	1386	3191	465	- 1031	1539	- 2304	- 266
1998	4529	2936	1267	326	5545	1431	3498	616	- 1016	1505	- 2231	- 290

* From July 1990 onwards including the external transactions of the former GDR.

1 Enterprises without major foreign capital influx, but with major capital interests abroad. Participating interest of more than 20% (at least 25% until 1989) are considered to be major interests.

2 Enterprises in which there is a major foreign capital interest, i.e. an interest of more than 20% (at least 25% until 1989).

Source: Deutsche Bundesbank

Rounding error

with 35.7 per cent or DM 2.0 billion, followed by the chemical industry (22.3 per cent) and the electrical industry including IT (16.3 per cent). Profits were generated in the manufacturing sector, especially in the chemical and automotive industries; expenditure on technical consultancy and planning services was DM 1.6 billion higher than receipts. This confirms that the strength of German industry is still in the manufacturing sector, while the service sector buys in expertise and know-how from abroad at an ever increasing rate.

11.4 Patent and licence trade by partner countries

A comparison of the different groups of countries shows that in 1998 about 80 per cent of expenditure on patents, inventions and processes went to the industrialised countries (cf. Table VII/23). The USA received more than half (54.3 per cent) of total expenditure. The most important partners among the EU countries were the Netherlands (8.7 per cent), France (5.9 per cent) and the UK (4.6 per cent).

Almost 80 per cent of all receipts came from the industrialised countries, about 5 per cent from the reform countries and approximately 15 per cent from developing countries including OPEC member states. In this wider range of countries the USA was again the most important partner country, accounting for 35.4 per cent of receipts. Within the EU Spain (7.7 per cent) und the UK (5.7 per cent) were the most important buyers of German patents. Among Germany's partners in Asia were Japan (7.2 per cent) and also less developed countries (contribution by developing countries in Asia and Oceania to German receipts: 8.9 per cent).

In its patent, invention and process transactions with other EU member states Germany achieved a mostly even balance of receipts and expenditure (1998: some DM 1.4 billion).

Germany's most important partner country by far for buying patents, developments and processes was the USA. In 1998, expenditure of more than DM 3 billion compared with receipts of DM 1.6 billion which resulted in a deficit of DM 1.4 billion in favour of the USA. Between 1993 and 1998, however, receipts from patent and licence trade more than doubled while expenditure remained virtually unchanged. Consequently, the 1998 deficit was less than half the balance of 1993.

11.5 Patents and licences in the balances of payments of selected countries

The International Monetary Fund compiles international data on patent and licence trade. In order to ensure international comparability – there are still some methodological differences involved in compiling statistics which need to be taken into account when interpreting the data – the following comparisons, unlike national surveys, also include copyrights (cf. Table VII/28).

In the group comprising the EU countries, the USA, Japan and Australia only the UK and the USA had positive balances.

Among the EU countries, Ireland (US$ 4.0 billion), Germany (US$ 1.5 billion) and Spain (US$ 1.4 billion) incurred the highest net expenditure in 1997. Compared with 1995, the deficit in Ireland had grown substantially due to higher expenditure. In Germany, on the other hand, there was a recent decline which primarily resulted from changes in the level of expenditure.

The Japanese deficit in patent and licence trade shrank between 1995 and 1997 and dropped to US$ 2.3 billion in 1997. Both receipts and expenditure, at US$ 7.3 billion and US$ 9.6 billion, respectively, were twice as high as in Germany which indicates that – also given the size of the Japanese economy – Japan has stronger links abroad than Germany.

The most important licensee in the EU in 1997 was Germany with expenditure of US$ 4.7 billion, followed by Ireland and the UK. Among the non-European countries, both Japan (US$ 9.6 billion) and the USA (US$ 9.4 billion) spent even more on licences.

Among the licensors, the USA clearly came first in the world league with US$ 33.7 billion, followed by Japan (US$ 7.3 billion), the UK as the leading EU country (US$ 4.8 billion) and Germany (US$ 4.7 billion).

These international data are also based on highly complex interdependencies; this is why it is not possible to make a clear qualitative assessment of a positive or negative balance.

Part III

Funding priorities of the Federal Government in research and technology

Introduction

This part of the report describes the individual funding areas and priorities of the Federal Government's research and technology policy. It focuses in particular on the research policy goals of funding, thematic priorities, funding structures as well as major developments and results. Particular importance is attached to the national and international co-operation structures in the various funding areas.

This description follows the format of the 1998 Facts and Figures Report which updated the 1996 Report of the Federal Government on Research. It contains a graphic representation of the Federal Government's spending on each individual research area for the years 1997 and 1998 (actual expenditure) and for 1999 and 2000 (budgeted expenditure). Details on the financing of the funding and supporting organisations are provided in Part VI.

The funding areas and priorities reflect the research and development activities of all federal ministries.

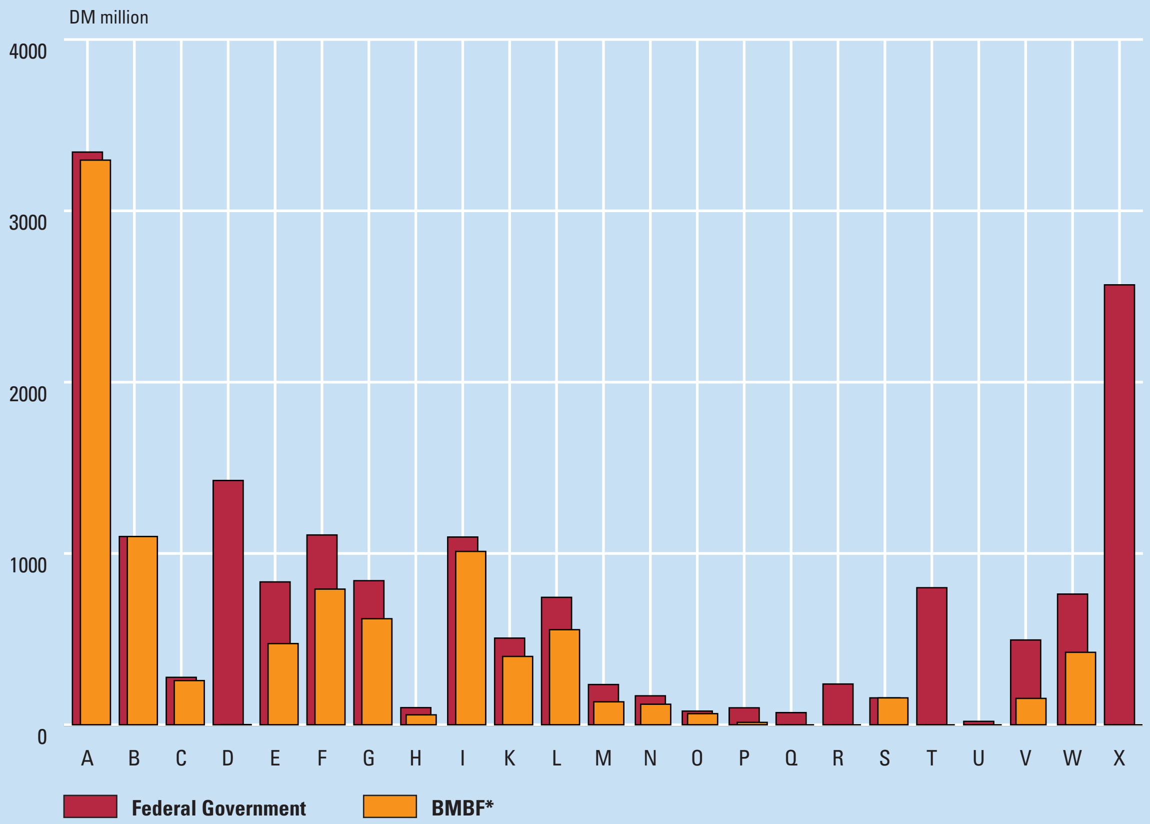
In addition to research funding aimed at advancing general knowledge and scientific and technical progress in selected areas, this part of the report also covers departmental research, i.e. R&D activities directly related to the specific tasks of the federal ministries or their subordinate authorities (see definitions of terms in the Infoboxes).

The main focus is on the following funding areas: *Funding organisations; university construction and mainly university-related special programmes*, *Defence research and technology*, *Space research and space technology* and *Large-scale equipment for basic research*. A sizeable proportion of R&D expenditure is on *Environmental research; climate research* and *Information technology (including multimedia and production engineering)*. Under the heading of life sciences, *Health research* and *Biotechnology* taken together constitute another priority in the Federal Government's funding policy.

The description of funding areas is structured as follows:
- Research policy objectives / objectives of departmental research
- Thematic priorities of funding
- Funding structures / Results, developments and prospects
- Literature / sources of information.

Chart 32

Federal R&D expenditure by funding areas (budget 2000)



Funding areas

A Research funding organisations; university construction and mainly university-related special programmes
B Large-scale equipment for basic research
C Marine and polar research; marine technology
D Space research and space technology
E Energy research and energy technology
F Sustainable development
G R&D in the health sector
H R&D to improve working conditions
I Information technology (including multimedia and production engineering)
K Biotechnology
L Materials research; physical and chemical technologies
M Aeronautical research and hypersonic technology
N Research and technology for mobility and transport
O Geosciences and raw material supplies
P Regional planning and urban development; building research
Q R&D in the food sector
R R&D in agriculture, forestry and fishery
S Educational research
T Innovation and improved basic conditions
U Specialised information
V Humanities; economics and social sciences
W Other activities not assigned to the other sector
X Defense research and technology

* BMBF without total reduction of expenditure of DM 200 million

Source: BMBF

BMBF, BuFo 2000

1. Funding organisations; university construction and mainly university-related special programmes (Funding area A)

1.1 Basic funding of the Max Planck Society

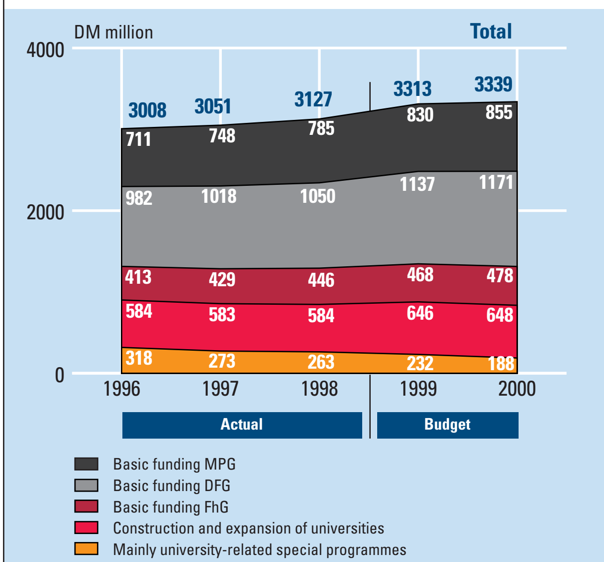
The Max Planck Society for the Advancement of Science (MPG) independently manages a number of research institutes that are primarily dedicated to knowledge-oriented basic research to be used for various applications, with a view to creating internationally competitive centres of excellence. The MPG is an integral part of the functionally structured system of institutional, government-funded, non-industrial research in Germany. Its task is to focus on cutting-edge research and complement other research activities, especially those conducted in the higher education sector.

As a research organisation, the MPG is currently running a total of 79 institutes (MPIs) and research facilities, 61 of which are based in the western German *Länder*. A permanent process of scientific renewal is vital for fulfilling the MPG's core function of performing basic research at top international level. This means that it has to subject its own research institutions to constant critical evaluation. Restructuring existing institutions is of prime importance, ensuring optimum development of MPG institutes and the incorporation of new innovative areas of research in their work. Such restructuring measures encompass both thematic reorientation of working areas and discontinuation of certain lines of research at the institutes – and sometimes can also lead to a facility being closed down altogether.

The position of the Max Planck Society within Germany's overall research system as well as its principles and methods of research funding have been assessed in a system evaluation carried out by an international commission on behalf of the Federal/*Länder* Commission for Educational Planning and Research Promotion (BLK). Its final report submitted in May 1999 concludes that the MPG occupies an eminent position within the German research system as well as at the international level, and it provides suggestions for future structural development.

Chart 33

Basic funding of research funding organisations, university construction and university-related special programmes



Source: BMBF *BMBF, BuFo 2000*

In founding institutes in the new *Länder*, the MPG's objective has been – right from the beginning – to establish institutes as a core element of its work in eastern Germany as well and thus make a substantial contribution towards restructuring the German research system and strengthening its innovative capacity. Since 1991, the MPG has set up 18 institutes in eastern Germany and Berlin, one sub-institute of the MPI for Plasma Physics (IPP) in Greifswald and one research laboratory. At the end of this process, the MPG will have almost the same presence in the east as it has in the west.

A special concern of the MPG is the promotion of young scientists. This also includes the participation of German and foreign students (1,192 in 1998) as auxiliary staff in the institutes' research projects, the promotion of German and foreign doctoral candidates (2,405 in 1998) and of young postdoctoral scientists (2,180 postdoctoral fellows in 1998) as well as special promotion schemes for young scientists (Dieter Rampacher Award, Otto Hahn Medal, Schloessmann fellowships, postdoctoral scientists). In addition, a total of 14 independent junior research groups are currently working at the various Max Planck institutes for a term of five years each. The heads of these groups are given the opportunity to qualify for a leading scientific position inside or outside the MPG by independently leading such a research group, using their own human and financial resources, and through the merits of their scientific work.

In close co-operation with the universities, the MPG is founding International Max Planck Research Schools as a special new instrument for training outstanding German and foreign PhD students. Doctoral theses on closely related subjects, together with the special opportunities offered by the co-operation between Max Planck institutes and universities, are expected to produce synergies – and thus value added compared to isolated dissertations.

At the level of research policy, the MPG participates in the international debate on the goals of research policy and the orientation of research funding, for example by giving its opinion on the

Part III

preparations for the Fifth and Sixth RTD Framework Programmes of the European Union. Moreover, it is a member of various multinational bodies and organisations.

The MPG boosts the international orientation of its individual institutes in various ways by encouraging the exchange of scientists and joint research projects, by concluding co-operation agreements and by providing financial support for selected international research institutions and major research projects. Framework agreements have been signed with the *Centre national de la recherche scientifique* (CNRS) and with the Chinese Academy of Sciences (CAS). Scientific co-operation with Israel enjoys a special form of support through the Minerva Stiftung GmbH, a subsidiary of the MPG.

The MPG has a staff of approx. 11,500, of which 27 per cent are scientists. In addition, 6,500 young scientists and visiting scientists provide inputs into the ongoing research work. Institutional funding for the MPG is shared between the Federal Government and the *Länder* on an equal basis.

1.2 Basic funding of the *Deutsche Forschungsgemeinschaft* (DFG)

As a self-governing organisation of science, the *Deutsche Forschungsgemeinschaft* (DFG) primarily supports research in the higher education sector, covering all disciplines from the humanities and social sciences to the biosciences including medicine, to the natural and engineering sciences.

The DFG (see also Part VI, section 1.1) funds individual projects (especially under its individual grants programme) as well as collaborative research (research units, priority programmes, special research programmes and postgraduate research groups). It also finances research infrastructure (e.g. the research vessel Meteor) and the scientific library system, including the development of new information structures in the higher education sector. It plays a crucial role in co-ordinating the provision and replacement of large-scale scientific equipment needed in the higher education sector (University Construction Act).

The DFG represents the German scientific community in major international science organisations and maintains bilateral scientific relations with a large number of countries. Through the Koordinierungsstelle EU der Wissenschaftsorganisationen (KoWi – German R&D liaison office in Brussels), it supports greater use of EU funding structures. Priority programmes involving European partners are aimed at strengthening cross-border co-operation in research.

The DFG has made a major contribution to strengthening and integrating research in the new *Länder*. The centres of excellence, financed by special funds from the BMBF, represent a different type of funding specifically designed to enhance the research structure in the higher education sector of the new *Länder*. Under its various programmes, the DFG also provides grants for humanities research centres, set up in close co-operation with universities.

Since 1998, the DFG's funding programmes have also been open to scientists working at the institutes of the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association, the former Blue List association) (see Part VI, section 5), irrespective of their main line of work. To this end, 2.5 per cent of these institutes' budget funds are included in the DFG's budget.

In recent years, the steady increase in funds allocated to the DFG has contrasted with a disproportionate growth both in the number of applications for grants and in the amounts requested. In 1998, for the first time since 1992, the number of applications received was lower than in the previous year (-13.9 per cent), with the total financial volume declining by 24.2 per cent.

The work of the DFG has been evaluated by an international commission. Its report was presented in May 1999. The DFG has submitted its comments on the various suggestions, proposed improvements, recommendations and points of criticism contained in the report. A final report with conclusions for the Federal and *Länder* governments has been presented for adoption to the Federal/*Länder* Commission for Educational Planning and Research Promotion.

1.3 Basic funding of the Fraunhofer Society

The Fraunhofer Society for the Advancement of Applied Research (FhG) is the leading supporting organisation for applied research institutes in Germany. It conducts contract research for industry, service providers and public authorities, and offers information and other services. The FhG's activities are strictly oriented towards the goal of translating research results into new and innovative products, processes and services.

The FhG is currently running 48 research institutions in 14 *Länder*, employing 9,200 staff. The basic funding provided by the Federal and *Länder* governments enables the FhG to develop and maintain its scientific potential in its own choice of research areas and to develop and continuously monitor innovative technologies. The FhG offers services in eight research areas to businesses enterprises and the public sector:

- Materials engineering, component behaviour
- Production engineering, manufacturing technology
- Information and communications technologies
- Microelectronics, microsystems
- Sensor systems, testing technology
- Process engineering
- Energy technology and construction engineering, environmental and health research
- Technical and economic studies, information services.

To accelerate the implementation of innovative developments, the FhG set up two innovation centres in late 1997 to close the gap between completed technological development and commercialisation at the end of the innovation process. These innovation centres help the Fraunhofer institutes to launch their technological developments in co-operation with customers. A typical service would be the production of small quantities of materials, subassemblies or equipment for field tests and test markets.

The FhG depends on close co-operation with the higher education sector, because it needs to attract a steady flow of young scientists and does not have any appreciable resources for basic research. A typical feature of this co-operation is the joint appointment of scientists to chairs or honorary professorships and to the management boards of Fraunhofer institutes.

In February 1999, the report of the commission for evaluating the Fraunhofer Society was presented to the BMBF. It gives the FhG credit for scientific research activities at top international level, primarily geared to the needs of industry and highly beneficial to the national economy. The commission also recommended that the FhG should

– develop existing potential with regard to emerging fields of technology (e.g. communications technologies);
– increase orientation towards market requirements without abandoning the principle of determining the direction of research activities or maintaining a broad range of competences;
– increase its profits to 40 per cent in the medium term, provided that the donors give the FhG the necessary scope for acting more competitively on the market and ensure adequate funding for pre-competitive research;
– extend opportunities for involvement in high-tech companies for a limited period of time;
– continue activities aimed at increasing internationalisation.

In line with the agreement on the joint funding of the FhG, signed by the Federal and *Länder* governments in 1977, the FhG's contract research activities follow a model of performance-driven basic funding. The volume of public funding depends on the level of revenue generated by the FhG's R&D activities for third parties.

1.4 Building and extension of institutions of higher education

Building and extending institutions of higher education including university hospitals is a joint responsibility of the Federal and *Länder* governments (Article 91a of the Basic Law). In the case of university construction projects included in the joint overall economic plan (acquisition of land, construction costs, initial equipment including large-scale facilities), the Federal Government defrays 50 per cent of the costs which qualify for co-financing.

Since entering into force in 1971, this joint responsibility has been constantly developed. Cross-regional and cross-*Länder* proposals and thematic planning initiatives have been regularly submitted; they include increased development of Fachhochschulen (Universities of Applied Sciences) and the inclusion of the new *Länder* in the purview of the University Construction Act in 1991. The *Länder* have made extensive use of the possibility, available since 1996, of obtaining co-funding for projects financed in advance by third parties. Thus construction projects totalling DM 2.077 billion were put forward for co-financing (as per the 30th overall economic plan). Further projects with an overall volume of DM 1.4 billion have either been registered by the *Länder* for advance finance by third parties or have a third-party advance financing option.

To modernise and extend higher education institutions in the new *Länder*, the Federal Government provided funding worth DM 3.7 billion between 1991 and 1999 for projects worth DM 8.6 billion. The money was primarily used for urgent construction and rehabilitation projects and for furnishing higher education institutions with large-scale scientific equipment, computers and basic stocks of books as quickly as possible.

Joint funding also includes the purchase and replacement of large-scale scientific equipment for teaching and research at university hospitals. Part of the funds allocated to university construction was used to provide universities with modern information and communications technologies, university networks, supercomputers as well as computers provided under the Computer Investment Programme (CIP) and the Workstations for Scientists Programme (WAP). The Federal Government's contribution towards the cost of large-scale equipment including CIP and WAP amounted to approx. DM 500 to 600 million a year.

To accomplish the joint task of university construction, adequate funds will continue to be provided in the federal budgets for the next few years. In 1999, for the first time after years of stagnation, the Federal Government increased its funding for university construction by DM 200 million. The 2001 draft budget provides for another increase of DM 150 million to DM 2.15 billion (plus DM 69 million in special funds).

1.5 Mainly university-related special programmes

The Federal Government and *Länder* governments support the advancement of higher education and research as well as the promotion of young scientists through a number of specific programmes. Outstanding examples of such programmes are the Special University Programme III, the Immediate Action Programme for the Innovative Development of Computer Science Courses and the special programmes of the DFG.

Science and research policy objectives

Germany needs high-quality universities occupying leading positions in teaching and research on an international level. The Federal and *Länder* governments have initiated joint programmes specifically providing the necessary support for universities' innovation policies; they include the Special University Programme III and the special programmes of the Deutsche Forschungsgemeinschaft (DFG). Above and beyond measures to improve the structures of higher education institutions and enhance international co-operation, another priority of these programmes is the promotion of junior scientists, and in particular of women in science.

The BMBF programme for *Application-oriented research and development at higher education institutions (aFuE)* will be described in section 22.

Third Special Funding Programme for Higher Education and Research (HSP III) and follow-up measures

The Third Special Funding Programme for Higher Education and Research, which entered into force in 1996 and will expire on 31

December 2000, aims at improving structures in the higher education sector, enhancing the Fachhochschulen, intensifying European and international co-operation, promoting young scientists, and women in particular. In 1998, HSP III was supplemented by a new funding scheme for university libraries aimed at improving their information services by purchasing new literature and making more extensive use of existing stocks. The total volume of funds to be provided by the Federal and *Länder* governments by the end of 2000 will be DM 3.68 billion, of which DM 2.1 billion will come from the Federal Government.

HSP III represents an important financial contribution towards achieving goals in science and higher education policy. The priorities set by the individual *Länder* governments vary according to the differences in the infrastructure and level of development of the higher education sector.

As well as achieving higher education policy objectives, HSP III also has considerable beneficial effects on employment. In 1998, funds provided under HSP III were used to finance 5,000 jobs or work contracts, more than 2,000 (41 per cent) of which were held by women. This is in addition to almost 30,000 other recipients of funding (contract work, teaching appointments, scholarships and tutorials), of which almost 13,000 were women (44 per cent).

The Federal Government and the *Länder* will continue their joint efforts to enhance higher education and scientific research and to achieve equal opportunities for women in research and teaching beyond the end of HSP III at the end of 2000. From 2001, part of the measures under HSP III will be continued on a permanent basis by the Federal Government and/or the *Länder* governments, depending on who is responsible in the individual case. However, the Federal Government and the *Länder* agree that, in addition, joint initiatives will continue to be necessary for a limited period of time. Consequently, the Federal Chancellor and the *Länder* premiers signed a **Federal/*Länder* Agreement on Developing Higher Education and Research and Achieving Equal Opportunities for Women in Research and Teaching (WHF)** on 16 December 1999.

INFO-BOX

THIRD SPECIAL FUNDING PROGRAMME FOR HIGHER EDUCATION AND RESEARCH – THE FOLLOW-UP

The Federal and *Länder* governments will continue their joint efforts to advance higher education and scientific research and achieve equal opportunities for women in research and teaching beyond the end of HSP III at the end of 2000.

Since development of the higher education sector is not a special task, but a permanent one, part of the measures under HSP III will be continued after 2001 on a permanent basis by the Federal Government and/or the *Länder* governments, depending on who is responsible in the individual case. However, the Federal Government and the *Länder* agree that, in addition, joint initiatives will continue to be necessary for a limited period of time.

Consequently, on 16 December 1999 the Federal Chancellor and the *Länder* premiers signed a Federal/*Länder* Agreement on Developing Higher Education and Research and Achieving Equal Opportunities for Women in Research and Teaching (WHF).

The Agreement comprises six new specialised programmes to promote

- equal opportunities for women in research and teaching
- the development of Fachhochschulen (Universities of Applied Sciences)
- innovative research structures in the new *Länder* and in Berlin
- structural innovation in the higher education sector
- the development of new media for application in university teaching
- the development of postgraduate courses.

To fulfil the guiding principle of equal opportunities for women in research and teaching, a target of 40 per cent has been set for the proportion of women in the personnel-related parts of all programmes, in addition to the specifically gender-oriented programme.

The Federal Government and the *Länder* intend the programmes to run until 2006. The Agreement will first cover the period from 1 January 2001 to 31 December 2003 for which the Federal and *Länder* governments will provide funding worth DM 972 million. In 2002, funding objectives and the funding volume will be agreed upon for the remaining period on the basis of a review carried out by the Federal/*Länder* Commission for Educational Planning and Research Promotion.

The text of the Agreement is available at www.bmbf.de.

Immediate Action Programme for the Innovative Development of Computer Science Courses

At the meeting of the Federal/*Länder* Commission for Educational Planning and Research Promotion held on 19 June 2000, the Federal and *Länder* governments, pursuant to Article 91 b of the Basic Law, adopted the Immediate Action Programme for the further development of informatics study courses (WIS) at German higher education institutions. Owing to this rapid implementation of the Federal Chancellor's initiative of 4 May 2000, the first measures taken under this programme will already become effective in the 2000/2001 winter semester.

The objectives of the programme are

– to create additional training capacities,
– to shorten study periods, and
– to facilitate the development and testing of new Bachelor's and Master's courses as well as of study courses offered by higher education institutions in the field of continuing education.

The cost of the planned DM 100 million programme, which covers a period of five years, will be shared on an equal basis between the Federal Government and the *Länder*.

Together with the Federal Government's Green Card initiative and the multitude of activities launched by the *Länder*, the Federal/*Länder* Immediate Action Programme will help meet the urgent demand of industry for more computer scientists and above all enable higher education institutions to cope with the soaring demand for training.

Special programmes of the DFG

Based on the Skeleton Agreement on research promotion, the DFG is running four special programmes funded by the Federal and *Länder* governments (see Part VI, section 1.1). The primary goal of these measures is to promote young scientists and top-level research work.

The programmes and their characteristics are:

– Promotion of highly qualified young post-doctoral researchers
– Post-doctoral programme: fellowships for further qualification through a limited period of work in basic research. In 2000, DM 11.5 million were earmarked for this programme, which is exclusively financed using federal funds. The programme in its present form will expire in 2000 and be continued through the Emmy Noether Programme.
– Emmy Noether Programme
– The DFG's Emmy Noether Programme, a structurally new – and exemplary – form of promoting excellence, was created in 1999 (see Infobox). It aims at qualifying young post-doctoral university teachers within a period of approximately five years, replacing the traditional *Habilitation* procedure (doing independent research and writing a pertinent thesis to obtain a professorship). Due to its unprecedented nature, the programme will receive funding worth DM 41 million from HSP III in 2000, of which approx. DM 20.5 million will be provided by the Federal Government.
– Promotion of selected researchers and research groups
– Promotion of top-level research: distinguishing individual researchers; creating improved working opportunities and enhancing flexibility; reducing administrative duties; encouraging co-operation with other researchers; in the 2000 federal budget, DM 20 million were earmarked for these activities.
– Promotion of research and young scientists in postgraduate research groups
– Postgraduate research groups are long-term, though not permanent (maximum duration: nine years) options provided by higher education institutions with a view to promoting young scientists, enabling them to obtain their Ph.D. within a systematic interdisciplinary study and research programme and encouraging mobility and internationality. There is currently a total of approx. 300 postgraduate research groups in both western and eastern Germany. The costs for these programmes are shared on an equal basis between the Federal Government and the *Länder* hosting them. In its 2000 budget, the Federal Government earmarked DM 22 million to finance its share; another DM 50 million in federal funding will come from HSP III. Thus the Federal and *Länder* governments altogether provide funds totalling DM 144 million.

Literature

– DFG year books;
– BLK, Informationen zum Gemeinsamen Hochschulsonderprogramm III (HSP III) des Bundes und der Länder;
– Federal Gazette (Bundesanzeiger) No. 2 of 2 February 2000, Bund-Länder-Vereinbarung zur "Förderung der Weiterentwicklung von Hochschule und Wissenschaft sowie Realisierung der Chancengleichheit für Frauen in Forschung und Lehre" (Federal/Länder Agreement on Developing Higher Education and Research and Achieving Equal Opportunities for Women in Research and Teaching).

Info-Box

Promotion of young scientists at research institutions outside of the higher education sector

Within the system of government funding for young scientists, research institutions outside of the higher education sector occupy a prominent position. These include notably

- the Hermann von Helmholtz Association of German Research Centres,
- the Max Planck Society,
- the Fraunhofer Society and
- research institutions of the Blue List which have joined forces to form the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz.

The special importance of these institutions is due to the fact that they are particularly characterised by the element of research in connection with development as well as by interdisciplinary co-operation. At the same time, they are open to co-operation with industry. In addition to their function proper, these research institutions contribute considerably to promoting young scientists.

This assessment is confirmed by the following global observation:

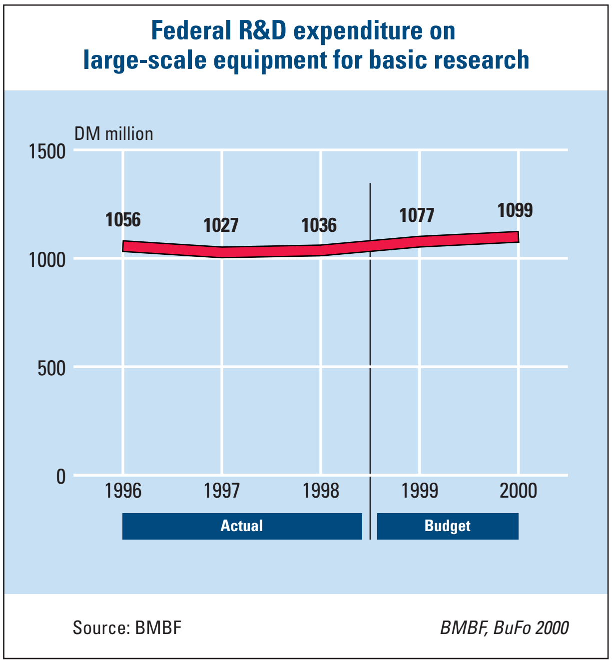
Almost 30 per cent of the total staff of 52,000 working for the research institutions are employed in connection with schemes to promote younger scientists. Besides visiting scientists, this group includes notably post-doctoral researchers, doctoral candidates, undergraduates, grant recipients, assistant lecturers and student assistants.

These employment contracts and scholarships are funded from various sources. Firstly, funds are earmarked for this purpose in most budgets. These are complemented by DFG grants as well as funding from public and private sector institutions. In most cases, young researchers are paid by the institutions they work for. The mode of payment varies from case to case, ranging from salaries for full-time jobs to salaries for part-time jobs to scholarships.

2. Large-scale equipment for basic research (Funding area B)

Acquiring knowledge about the inner structure of the world and the basic workings of nature is a key characteristic of our research and education culture. Basic research in the natural sciences holds the key to Germany's future. It is both the point of departure for, and the driving force of, technological innovation and the sustainable development of our national economy and society. New successes in the search for answers to fundamental questions concerning the structure and development of matter depend to an ever increasing extent on the availability of expensive large-scale equipment. Science in Germany has a sound basis to build upon which recently was further improved by the commissioning of the BESSY II synchrotron radiation source in Berlin and the Very Large Telescope (VLT) in Chile and will be strengthened even more by the construction of the Large Hadron Collider (LHC) in Geneva.

Chart 34



Source: BMBF

BMBF, BuFo 2000

Research policy objectives

Basic research in the natural sciences is taking on ever more extreme dimensions and pushing towards systems of higher complexity which can be investigated only with the help of highly sophisticated large-scale equipment and adequate instrumentation. This type of infrastructure is very expensive and supra-regional in scope; often large-scale equipment is available only at one particular international research centre in the world. The construction, operation and use of such equipment are important elements of a coherent research policy reflecting the national interest. The primary task is to ensure the effective use of existing large-scale equipment and its adjustment to new uses, securing in particular inputs from university research groups and young scientists. At the international level, preliminary work on large-scale equipment is aimed at producing a new generation of particle accelerators and neutron sources.

Thematic priorities

Project funding as well as basic funding schemes for research institutions cover research work ranging from fundamental questions concerning the structure and properties of matter and its smallest components to galaxies and the development of the cosmos (particle accelerators, telescopes), as well as studies of the structure and dynamics of condensed matter (neutron, ion and synchrotron radiation sources).

Another major task consists in the generation of knowledge needed as a basis for technical innovations to be applied in practice and to future large-scale equipment and instruments. Another priority is interdisciplinary research, in particular building bridges between physics and chemistry, the life sciences, environmental research and the engineering sciences.

Funding structures

The funding schemes with a total volume of DM 1.102 billion in 2000 can be subdivided into

- contributions to European research institutions (DM 374 million – 34 per cent),
- basic (statutory) funding for institutions (DM 575 million – 52 per cent) and
- project funding (DM 153 million – 14 per cent).

Research institutions concerned include the Deutsches Elektronensynchrotron (DESY – German Electron Synchrotron), the Gesellschaft für Schwerionenforschung (GSI – Heavy Ion Research Centre), the Hahn Meitner-Institut (HMI – Hahn Meitner Institute), the Jülich, Karlsruhe and Geesthacht research centres (FZJ, FZK and GKSS) as well as a number of Blue List institutes such as the Forschungszentrum Rossendorf (FZR – Rossendorf Research Centre), the Berliner Elektronen-Speicherring-Gesellschaft für Synchrotronstrahlung (BESSY) and the Astrophysikalisches Institut Potsdam (AIP – Potsdam Astrophysical Institute). Germany's international co-operation activities include the European Organization for Nuclear Research (CERN), the European Southern Observatory (ESO), the European Synchrotron Radiation Facility (ESRF) and the Laue-Langevin Institute (ILL) (see Part V). Project funds are mostly allocated to university research groups engaged in international research co-operation projects involving large-scale equipment.

Results / Developments

The HERA accelerator system at DESY has achieved its design base values and even surpassed them considerably for proton energy. HERA's capacity is currently being upgraded to four-fold luminosity to enable it better to explore interesting but rare events. This will allow a deeper insight into the internal structure of nucleons (proton, neutron) as main components of the matter surrounding us.

First results on the origin of the nucleon spin and striking asymmetries in the quark sea of the proton have attracted a great deal of international interest. The objective of the last major experiment called HERA-B is to explore the causes of the imbalance between matter and antimatter in the cosmos.

At DESY, preliminary work has been conducted under the TESLA project for a new generation of accelerators, at the same time serving as a basis for so-called Free Electron Lasers in the X-ray range. DESY recently succeeded – for the first time worldwide – in demonstrating the functional principle of the Free Electron Laser for wave lengths below 100 nanometres.

At GSI, a programme designed to increase the ion beam intensity by a factor of up to 1,000 has substantially improved the possibilities for research with heavy ions. This opens up perspectives that are unique in the world, notably for nuclear and atomic physics. The novel dilepton spectrometer called HADES will be available from 2000 as another internationally unique instrument, which scientists hope will provide new insights into the origin of the mass of particles.

In the clinical studies on cancer therapy using ion radiation, conducted at GSI's medical irradiation facility since 1998 in co-operation with the Radiology Department of Heidelberg University Hospital, the Deutsches Krebsforschungszentrum (DKFZ – German Cancer Research Centre) and the FZR, some 60 patients have been given treatment so far. The results available to date are very promising with regard to rapid tumour regression and low adverse effects.

The construction of the Berlin synchrotron radiation source BESSY II in Berlin-Adlershof has been largely completed. The storage ring went into operation before schedule in 1998. The further development of instrumentation systems will be funded by the Federal Government and from the *Land* (state) of Berlin. After HASYLAB at DESY, BESSY II is the second powerful synchrotron radiation source for the scientific community and industry in Germany, to be used for various basic and applied research activities. Fields of application range from basic research in physics, chemistry, biology and medicine to analytics, materials research and industrial use.

The Large Electron Positron Collider (LEP) at CERN has reached its best performance to date in 2000 and will be used primarily to explore the origin of particle mass. It will be followed, in the period after 2000, by the Large Hadron Collider (LHC), the construction of which is on schedule and within the budget and will be completed by 2005. Work on LHC experiments, which were also prepared in global co-operation, and the accompanying detectors is also progressing according to plan.

The first eight-meter telescopes of the ESO's Very Large Telescope (VLT) in Chile have been put into operation. By the end of 2000, all four telescopes will be available to science for studying deep space.

The ESRF went into full operation with 30 public beamlines in 1998. This capacity is complemented by more beamlines from co-operating research groups. The radiation brilliance now achieved is up to more than 100 times the design value.

The Laue-Langevin Institute (ILL), which operates a neutron high-flux reactor financed by Germany, France and the United Kingdom in Grenoble, has launched a programme for the further development of instrumentation by 2005, which will secure the ILL's leading international position in neutron research. In co-operation with the United States, the ILL will investigate the question of whether the ILL reactor can be converted in the medium term to operation with low-enriched uranium.

Munich Technical University is building a new high-flux neutron source (FRM II) to replace the Munich Research Reactor I (FRM I), in operation since 1957; FRM II will be used for research in physics, chemistry, materials science as well as engineering and life sciences. An expert commission has investigated the possibility of converting this reactor to low-enriched uranium fuel elements – with positive results.

Literature / Cross-references

- Support for research using large-scale equipment also comes under the funding areas of space research and thermonuclear fusion research.
- BMBF project funding schemes are supported by project managing agencies:
- High-energy physics, astrophysics and research using synchrotron radiation: Deutsches Elektronensynchrotron (DESY – German Electron Synchrotron), project management: HS;
- hadron and nuclear physics: Gesellschaft für Schwerionenforschung (GSI – Heavy Ion Research Centre), project management: KKS;
- exploration of condensed matter, use of new technologies in the humanities, selected fields of mathematics: Forschungszentrum Jülich (FZJ – Jülich Research Centre), project management: BEO.
- More detailed information on funding measures for basic research in the natural sciences that involves large-scale equipment can be obtained from the BMBF's project managing agencies (see Part VI, section 7) and on the Internet under http://www.verbundforschung.de.

3. Marine research and polar research; marine technology (Funding area C)

The Federal Government has laid the foundation for the funding of research and development under this funding priority with its programmes on *Marine research* (1993) and *Polar research* (1996) as well as the BMBF marine technology research concept. The objective of this funding policy is not only to gain further knowledge about the oceans and the polar zones and their role in determining the world's climate, but also to translate existing knowledge into political decisions for ecosystem and resource protection.

In the field of marine technology, the focus is on support for research and global development in both nautical and coastal engineering.

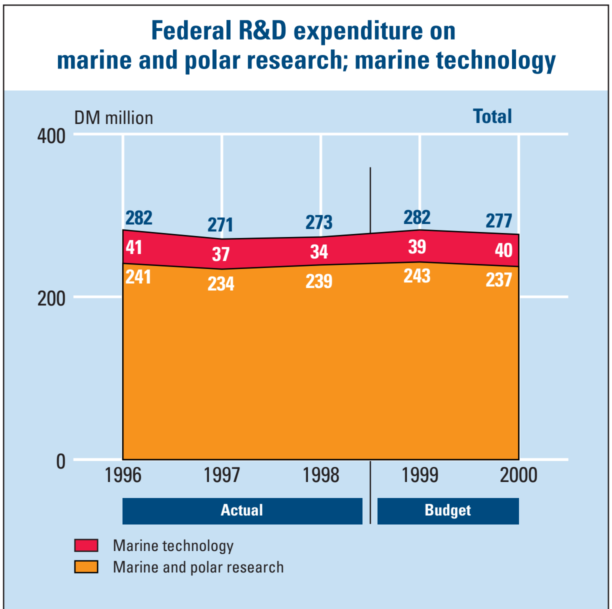
3.1 Marine research and polar research

The oceans and the polar regions combined account for approximately 80 per cent of the Earth's surface, which makes them the most important sub-systems on our planet. They are of central importance to the global climate and constitute an important source of mineral and living resources, in other words, for human food supply and the extraction of raw materials of any kind.

With its programmes on marine research and polar research, the Federal Government is helping to deepen knowledge about these two compartments of the Earth system, with the objective of ensuring their sustainable protection and using them for the benefit of humanity. Furthermore, the research results will be used to reach political decisions.

In addition, Germany is an important partner in international co-operation in marine and polar research through its involvement in the major international R&D programmes as well as through a host of bilateral agreements with countries all over the world.

Chart 35



Source: BMBF BMBF, BuFo 2000

Research policy objectives

The oceans and the polar regions are important compartments of the Earth system. They represent vital resources for human food supply and for the extraction of natural substances. They are also key factors in determining the global climate. Moreover, marine sediments and polar ice sheets hold climate archives which can provide clues about climate change in the more recent history of our planet. Despite considerable efforts, both compartments have so far been insufficiently explored.

The Federal Government's programmes on marine and polar research are expected to help to further reduce existing deficits in order to improve global climate modelling and concepts for sustainable resource use, thus creating a reliable basis for political decision-making.

Implementation of the programmes and practical application of R&D results are considered to provide good opportunities for German industry to increase its competitiveness.

Funding structures

Marine research cannot be confined to the national level. Being an element of research into the Earth system, it is bound to be international in character. Many nations are engaged in the large-scale activities conducted under the Ocean Drilling Programme (ODP), the International Geosphere-Biosphere Programmes (IGBP) or the World Climate Research Programmes (WCRP). In addition, there are a number of projects carried out under the umbrella of agreements on scientific and technical co-operation.

In Germany, marine and polar research is mostly conducted by research institutions based in northern Germany, such as various Helmholtz Centres, Max Planck Institutes, WGL institutes as well as universities and federal authorities. In addition to basic funding, specific project funds are provided by the BMBF, the Federal Environment Ministry (BMU) and the DFG.

Worldwide and regional research activities are undertaken with the help of modern research vessels. Three such vessels, FS METEOR, FS POLARSTERN and FS SONNE, operate on the oceans, while another four medium-sized research vessels are used for regional investigations.

Thematic priorities / Results / Developments

Marine research

As a result of technological progress in the last few years, monitoring of the seas has attained a new quality. Nowadays, with the help of independently operating measuring systems, marine processes can be continuously recorded even deep within the waters, and the data obtained can be transmitted via satellite; likewise, new instructions can be sent back to the measuring systems. There is at present an international debate about building a globally co-ordinated, autonomous network (Global Ocean Observing System – GOOS). The MERMAID marine monitoring system developed under the leadership of the Geesthacht Research Centre in co-operation with partners from industry is already making use of this technology. MERMAID is currently being tested by the Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency).

These new technological possibilities are expected to produce good opportunities for small and medium-sized companies to develop new, innovative measuring systems in co-operation with the scientific community, thus gaining access to new markets. The EUROMAR project run under the EUREKA programme is likely to have a similar impact.

German geoscientists are successfully working to explore the Earth system by investigating the continuous interactions across the Earth's layers between ocean, seabed, the Earth's interior, biosphere, atmosphere, cryosphere and the astronomical forces. They are also examining the products of these interactions (such as raw materials, biosphere in the seabed) or their effects (e.g. earthquakes). Only an all-encompassing approach that also looks at the Earth's history will allow us to understand substance flow processes and climate variability and make meaningful forecasts.

Marine research into natural materials

There is an enormous worldwide demand for new active substances and materials in the fields of pharmaceutics, plant protection, food engineering and cosmetics. In spite of combinatorial chemistry, nature continues to be an important supplier of raw materials, and the oceans have not yet been extensively explored. Consequently, *Marine natural compound research* was introduced as a new funding priority in 1997. Its aim is to establish close co-operation with industry to use research results for developing new products as quickly as possible. In this process, it is important to develop cultivation methods and strategies of synthesis to make the most efficient use possible of natural resources.

In the field of *marine ecosystem research*, the objective is firstly to identify key ecosystem processes to be integrated into forecasting models, and secondly to predict the effects of climate change on marine and polar ecosystems. The IGBP's core project GLOBEC investigates the impact of climate change on marine ecosystems, especially on species that can be commercially exploited. The BMBF is funding studies on the sustainable use of Antarctic ecosystems. Other contributions to GLOBEC, which focus on the North Sea and the Baltic Sea, are currently under preparation.

The collaborative projects funded by the BMBF within the IGBP's JGOFS Programme (Joint Global Ocean Flux Study) for the North Atlantic and the Arabian Sea since 1992 and 1994, respectively, are now at the stage of synthesis. The results that are now on the horizon include improved forecasts concerning the CO_2 absorption capacity of the seas as well as more profound knowledge of how biological and chemical processes in the ocean react to climate change. This new knowledge will enable scientists to include the oceans in mathematical models of the greenhouse effect in a more realistic way. On the basis of the WOCE (World Ocean Circulation Experiment) programme completed in 1999, the new CLIVAR (Climate Variability and Predictability) programme studies the role of the oceans in weather variability over several years as well as their response to instances of dramatic climate change resulting from instabilities in thermohaline circulation patterns (i.e. circulation caused by differences in temperature and salinity, usually through vertical marine currents). Germany's contribution to CLIVAR focuses on *Climate fluctuations over decades and longer periods and their predictability*.

Ecosystem research

One of the purposes of the Mangrove Dynamics and Management (MADAM) project, carried out in co-operation with Brazil, is to extend the scope of activities of the Zentrum für Marine Tropenökologie (ZMT – Centre for Tropical Marine Ecology) based in Bremen. After the first phase, which centred on a survey of the state of mangrove forests, the primary aim is now to record the processes preserving the ecosystem and establish management plans for sustainable land use.

Building the necessary foundation for concepts of sustainable use was also one of the key elements of the BMBF's Red Sea project. From the point of view of research policy, co-operation between Israeli, Egyptian, Palestinian, Jordanian and German scientists was a special objective here.

Co-operation with Indonesia is to be intensified with regard to the Pacific and Indian oceans. A special fellowship programme was launched together with the German Academic Exchange Service (DAAD) to prepare bilateral scientific projects. Its purpose is to give Indonesian marine scientists the opportunity to study in Germany, thus enabling them to ensure a high standard of education for Indonesian marine researchers in the future. The first grant recipients are already pursuing their studies in Bremen, Hamburg and Kiel where special Master's degree courses were introduced.

Point of contact

To fully exploit the innovative potential of German marine research and monitoring technology, but also of other areas of marine sciences, the BMBF has set up a point of contact at the Geesthacht Research Centre (see Part VI); its functions include

- defining marketable marine research services;
- providing advice for start-ups and for capital raising;
- preparing studies on the market potential of marine research findings;
- patent consulting.

Polar research

The Federal Government's polar research programme (1996) for the first time covers both polar regions. Besides research into global warming and ecosystems, technology development and the search for marine natural substances have also been taken on board. The funding organisations of German polar research include various federal ministries, in particular the Federal Ministry of Education and Research (BMBF), the Federal Ministry of Agriculture (BML), the Federal Environment Ministry (BMU) and the Federal Ministry of Economics (BMWi) with its Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources) as well as the DFG. The Alfred Wegener Institute (AWI) in Bremerhaven is Germany's central polar research institution. For the mostly international research projects, Germany has provided the FS POLARSTERN research vessel and several research stations in the Antarctic. German Arctic researchers are allowed to make use the Koldewey research station located in Ny Alesund on Spitzbergen which is manned all year round.

Priorities of German polar research:
– Importance of polar regions for climate events, thermal and dynamic interactions between atmosphere, ocean and cryosphere
– Analysis of trace substances in the atmosphere, hydrosphere and biosphere of the Antarctic
– Structure, dynamics and functional principles of polar ecosystems
– Mass balance and dynamics of land and shelf ice
– Structure of the Earth's crust and mantle in Antarctica.

In October 1996, the international Cape Roberts Drilling Project was started in the Antarctic on the western bank of the Ross Sea. Carried out with German participation (AWI, BGR), this exercise aims at obtaining new findings about the last 100 million years of the history of the Antarctic. It is ultimately expected to produce information on climate development and on the cause and development of sea level fluctuations.

German-Russian co-operation
The Russo-German agreement on co-operation in marine and polar research concluded in February 1995 between the BMBF and the Russian Ministry of Science and Technology Policy has resulted in the successful implementation of several joint projects in the Arctic. Joint activities currently focus on the Lena Delta and the Laptev Sea into which it flows – an important region for the climate in Europe. The subjects of investigation are seasonal variability in substance flows in permafrost regions and the adjacent sea as well as interactions between land and sea and their impact on the Arctic climate. In addition, an ice drilling operation was carried out on Severnaya Zemlya in 1999 which is expected to provide new insights into the climate development in the Arctic region since the last glacial period.

In October 1999, the AWI and the Russian Institute for Arctic and Antarctic Research signed an agreement on setting up a jointly operated scientific laboratory in St. Petersburg, the Otto Schmidt Laboratory. The first joint laboratory on Russian territory, it will primarily be used for training young scientists and could set an example for other scientific disciplines to follow. Another federal institution, the BGR, is conducting independent research in both polar regions.

3.2 Marine technology

The projects funded under the *Marine technology 1994–1998* research concept have been instrumental in promoting technological and scientific progress and in boosting competitiveness in the areas of nautical engineering, marine technology and coastal engineering. The research programme on *Shipping and marine technology for the 21st century* which covers the period from 2000 to 2004 will continue along the same lines. It complements the funding area of nautical engineering by opening up new funding opportunities for marine technology projects outside nautical engineering. Likewise, great importance is attached to R&D projects that contribute to shifting both freight and passenger transport from the road to coastal waters and inland waterways.

Research policy objectives
The marine technology research concept is divided into the areas of nautical engineering and coastal engineering. The objectives of research and development in the field of nautical engineering include boosting the competitiveness of the maritime industry, improving the transport situation in Germany and Europe by making greater use of waterways, and reducing environmental pollution through waterway transport. Coastal engineering, on the other hand, focuses on building and maintenance measures along the coasts; it also involves keeping records of natural conditions and the forces of nature and investigating their impact on coastal areas and structures.

The new research programme on *Shipping and marine technology for the 21st century* covers the period from 2000 to 2004 and comprises the following R&D funding priorities:
– Nautical engineering (upgrading shipping as a mode of transport; boosting the competitiveness of shipyards);
– shifting transport to coastal waters and inland waterways;
– marine engineering (offshore engineering; maritime environmental engineering, polar engineering).

Funding structures
Funding in the field of nautical engineering goes to projects which are often conceived as collaborative projects between industry, ship model basins, universities and other research institutions. Between January 1998 and October 1999, 73 per cent of the funds were allocated to industry, 18 per cent to higher education institutions and 9 per cent to other institutions. Out of the funds provided for industry, 57 per cent went to shipyards and suppliers, while 43 per cent went to service providers such as ship model basins and the Germanischer Lloyd. 23 per cent of funds were allocated to projects in eastern Germany. The area of nautical engineering also comprises research activities carried out in the field of maritime and inland waterway transport, which is within the competence of the Federal Ministry of Transport, Building and Housing.

Research work in the field of coastal engineering is a joint responsibility of the Federal and *Länder* governments. Projects in the past have been run by federal agencies as well as the coastal *Länder*, with the participation of universities; the priorities of this research work are agreed with the Kuratorium für Küsteningenieurswesen (KFKI – Coastal Engineering Board). In a first stage, a number of specifically selected projects will help to determine the German maritime industry's market potential in the field of offshore engineering.

Thematic priorities / Results / Developments
The thematic priorities in this funding area can be directly derived from the research policy objectives, i.e. research and development in nautical engineering and basic research in coastal engineering.

Research and development activities in the field of nautical engineering focus on the following three major areas:

- Improving production engineering;
- improving the product, i.e. increasing cost effectiveness, safety and environmental compatibility, and
- developing system-based new products / perspectives for shipping transport in Europe, i.e. increasing the importance of shipping as a mode of transport.

To increase the international competitiveness of small and medium-sized enterprises (SMEs) in the field of marine technology, the BMBF has presented a concept for *Marine research and monitoring technologies, technologies for the 21st century*. There are niches in the international markets, in particular for in-situ sensor systems and analytical systems, that German companies could occupy. A liaison office for marine research and monitoring technologies was set up at Geesthacht Research Centre, which defines development projects in co-operation with users, research institutions and industry.

Exemplary results in nautical engineering:

- Bench-scale specimens of an electronically controlled radar system; replacement of rotating antennae whose response times are inadequate for fast ships and dense traffic.
- Low-emission heavy fuel ship's engines whose NO_X emissions have been reduced by 50 per cent compared with 1992 engines due to a different engine design, and by 95 per cent where catalytic converters are used.
- Container ships with a load capacity of 8,000 standard containers, taking into account the door-to-door transport chain. Rationalisation of maritime freight transport and development of solutions to avoid bottlenecks in hinterland transport.
- Research on the chances of survival for ro-ro ferry boats in the event of a leakage has led to new findings and criteria. These have become the subject of international debate and will be incorporated into the Stockholm Agreement which applies to both the North Sea and the Baltic Sea.
- The development results and on-board tests of an integrated navigation system for inland shipping have paved the way towards what will eventually become an industrial product. The automatic track control system facilitates the captain's work, thus increasing the level of safety on inland waterways.
- The Life Cycle Design collaborative project provides the mathematical basis for directly designing and dimensioning ships according to physical principles (First Principles Design). The element of progress lies in the analytical recording of all relevant factors influencing the ship's life cycle, opening up new potential for shipyards to optimise product development and quality as well as production costs.
- The development of ground effect machines as an innovative transport system in the speed range between rapid ferry ships and aircraft has attracted international attention. Now that the functionality of the system has been proved and confirmed by positive test results, research and development activities on two different approaches have advanced to a stage where the construction of a demonstration vehicle for eight to twelve persons has become a realistic goal.

Activities in the funding area of *coastal engineering* also include mission-oriented research, in line with the joint responsibility of the Federal and *Länder* governments for the "improvement of agricultural structure and coastal preservation" pursuant to Article 91a of the Basic Law. Natural conditions in coastal areas and interactions between the sea and engineered coastal structures are recorded scientifically with a view to making forecasts as accurate as possible. This will provide guidance for decision-makers in matters of coastal protection.

Literature

- Marine Research – Programme of the German Federal Government, BMBF, 1993;
- "Polarforschung – Programm der Bundesregierung", BMBF, 1996;
- BMBF brochure: "Ostseeforschungskonzept";
- BMBF brochure: "Tiefseeforschungskonzept";
- BMBF brochure: "Meeresforschungs- und Meeresüberwachungstechnik";
- BMBF brochure: "Marine Naturstofforschung";
- BMBF brochure: "Entwicklungen in der Schiffstechnik";
- The Ocean and the Poles (ed. G. Hempel), G. Fischer Verlag, 1996;
- Annual reports of the research institutes, centres and institutions involved.

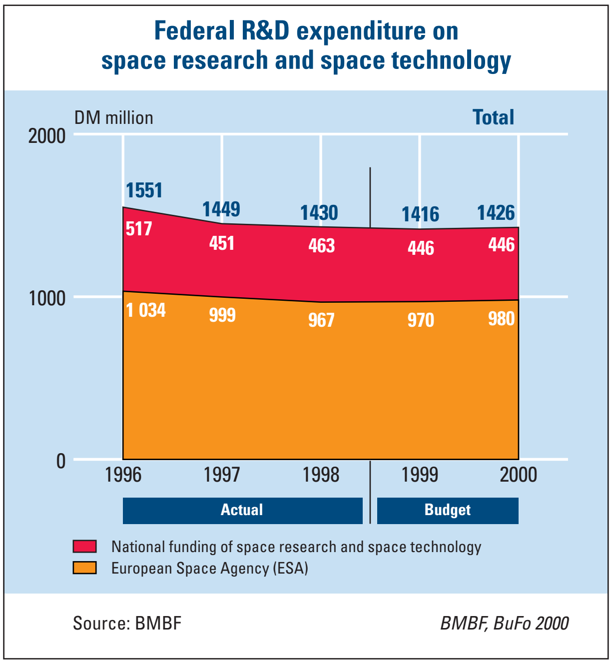
4. Space research and space technology (Funding area D)

The decisions taken by the ESA Council Meeting at ministerial level held in May 1999 are of landmark importance for German space research. Excellence in research and high economic benefits are the key objectives of funding space research at European as well as national level.

A new integrated space research programme, the content of which must reflect the core competences of German space research and industry, is under preparation. The initiatives proposed by the ESA Ministerial Conference for the development of European space activities will be put into practice.

One key principle of German space research management is to conceive and use space travel and the opportunities it affords as an important instrument for developing a sustainable policy worldwide. The insight that our planet is a closed system in ecological, economic and social terms has far-reaching consequences: We have to take advantage of all opportunities that help us to enhance our understanding of the interplay of forces in the Earth system as well as the influences to which the system is exposed. Space research activities, particularly due to their observer position and the unhindered view of any point on our planet, are predestined to provide information and arguments for a sustainable policy and identify areas where action is needed.

Chart 36



Research policy objectives

The Federal Government's space research policy is aimed at generating the technological, scientific and economic impetus that is needed to secure and consolidate Germany's standing in international research and that is indispensable to the economic and political weight of Europe as it moves towards ever greater integration. This is why – even more than in the past – the new integrated German space programme will focus on achieving scientific excellence, opening up economic potential and meeting the needs of public and private sector users.

The cornerstones of the new programme are independent access to space for Europe with the ARIANE launcher system and a leading position for Germany in the fields of Earth observation, satellite-based navigation and telecommunications. After the establishment of the International Space Station (ISS) measures will need to be taken to initiate the handing over of routine operations into private hands (scheduled for 2004), also with a view to securing current industrial capacities in the long term, and to ensure an increasing participation of public and private sector users in defining, implementing and financing multidisciplinary activities.

The key elements of space research funding are

– greater concentration on thematic priorities (core areas), with a view to securing top positions in these selected core areas;
– consistent use of space research for solving social issues;
– more effective co-operation between the government, research and business enterprise sectors (public-private partnership);
– a stronger orientation towards public and private needs;
– more direct (financial) involvement of public and private users;
– a further increase in efficiency with regard to management and technical implementation.

Thematic priorities

In order to concentrate Germany's space research activities on areas where it could occupy a leading position, German space research planners have set the following thematic priorities:

– Securing independent access to space as well as the share in the market for commercial launcher systems acquired through the ARIANE family;
– Backing up private and public-sector involvement, especially with regard to telecommunications, navigation and Earth observation applications;
– Securing continuity in funding for oriented basic research while ensuring strong (financial) involvement of scientific users;
– Industry-funded use of ISS.

Funding structures

Government funding of space research activities can be broken down into:

– The national space research programme;
– German contributions to the ESA programme;
– The space research activities of the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre) (core funding provided by the Federal and *Länder* governments, see Part VI, section 3.4).

The purpose of the national programme is to pursue independent goals, notably with a view to securing Germany's standing in international research, and to prepare active participation in the ESA programme and carry out complementary work at the national and bilateral levels.

The bulk of Germany's contributions to the ESA programme are associated with the major infrastructure programmes, the work for which is shared among the European countries. This applies in particular to European participation in the International Space Station and the development of transport systems (ARIANE). In addition, Germany plays a major role in defining the ESA space science programme and participates in the ESA satellite applications programmes (Earth observation and navigation). Under these programmes, ESA's main role consists in providing flight opportunities (satellites), while the various national programmes contribute the payloads (measuring instruments).

Approximately 80 per cent of German space research funding is spent on European programmes within ESA (2000: DM 980 million from the BMBF's budget). Under the German national programme (2000: DM 310 million, of which DM 266 million are appropriated for project funding), some 80 per cent of the projects are conducted in co-operation with international partners. About 90 per cent of federal funds for space research are provided by the BMBF. Other federal ministries, such as the Federal Ministry of Transport, Building and Housing (BMVBW) and the Federal Ministry of Defence (BMVg), are also involved in application-oriented space research projects, insofar as these projects concern their departmental functions. Of the total amount of funding allocated by way of contracts or grants under the 1999 national programme, 60 per cent was channelled to companies, while the remaining 40 per cent went to higher education and research institutions. As suitable research and industrial capacities in eastern Germany were integrated into space research activities, project funds worth DM 25.3 million (9.6 per cent of the national programme) went to the new *Länder* in 1999.

Developments, changes, key results

ESA Council Meeting at ministerial level

At the ESA Council Meeting at ministerial level held in May 1999, landmark decisions were taken for European – and thus for German
– space research. Cross-programme decisions were reached on
– a European space strategy, in co-operation and agreement with the EU;
– Redefining co-operation with industry (public-private partnership);
– Bringing together institutions and centres of excellence under the umbrella of one single network;
– Abolishing the principle of automatic adjustment to inflation.

Programme decisions

– On modernising ARIANE 5 while reducing the budget by about 10 per cent, and on ensuring a € 100 million contribution by ARIANESPACE to development costs;
– On continuing ARIANE 5 support programmes on a strongly reduced scale and for a limited period of time, thus preparing them for handover to industrial operators;
– On an Earth observation framework programme in which Germany will play a leading role;
– On fixing the funding volume for obligatory activities within a nominally constant space science programme with a one-time special payment for the Mars Express;
– On the definition phase for GalileoSat, ESA's contribution to Europe's GALILEO satellite navigation system, which will be implemented in public-private partnerships with industry, under the overall responsibility of the EU;
– On the operating programme for the International Space Station;
– On extending the EMIR-2 Microgravity Research Programme.

Important steps have been taken to secure Europe's leading position in the *market for commercial launcher systems*, notably with the first successful operational mission of ARIANE 5 carrying the XMM science satellite in December 1999 as well as with the final qualification of the launcher system for carrying double payloads to the geostationary transition orbit in March 2000 (ARIANE flight 505 with ARIASTAR and INSAT 3 B). German companies, particularly EADS/ASTRIUM, MAN-Technologie and approximately 170 small and medium-sized enterprises, contributed substantially to this success.

In the field of *extraterrestrial research*, the CASSINI/HUYGENS space probe, launched two years ago, passed the Earth according to schedule and at a safe distance on 18 August 1999, on its flight to Saturn. ESA's XMM-Newton Roentgen satellite was successfully launched in December 1999.

One priority in the field of *Earth observation* is preparation for ESA's environmental satellite ENVISAT, scheduled to be launched in June 2001 (carrying the SCIAMACHY payload instrument designed and built by a German-Dutch consortium; establishment of the national ground segment ; preparation for use). Furthermore, on the basis of the decision on establishing an *Earth Observation Envelope Programme* (EOEP), taken by the ESA conference at ministerial level in May 1999, preparations were started for scientific Earth observation missions adopted within this framework (CryoSat in 2003: thickness of the polar caps; GOCE in 2004/05: gravitational field and ocean circulation; SMOS in 2005: ocean salinity and soil moisture; AEOLUS in 2006: determination of 3D wind fields to improve weather forecasting). The signature to EOEP marks a decisive step towards securing the leading position of German research in the field of Earth observation in the long term.

National funding schemes

Within the TETRA project for future *reusable space transport systems*, both development activities and co-operation with the USA have been making good progress. The key components for the test flight of the US-made X 38 demonstrator, scheduled for June 2002, are expected to be delivered in the first quarter of 2001.

The TerraSAR lead project, which is still at the planning stage and is aimed at commercialising the X-SAR radar technology energetically developed by Germany, is nearing the end of the definition phase, and the decision on launching the development will soon be adopted.

In the field of *satellite communication* (multimedia satellite constellations), the central lead project COMED focuses on components and sub-system developments which are expected to consolidate and boost the involvement of German companies in this sector, especially SMEs. The project is carried out within the framework of a public-private partnership, with 50 per cent of the funding coming from industry.

The ABRIXAS Roentgen satellite faced technical problems related to its energy supply system shortly after being launched. In spite of comprehensive corrective measures, the problems could not be solved; as a result, the scientific goals of the project had to be abandoned, and the mission failed.

Literature

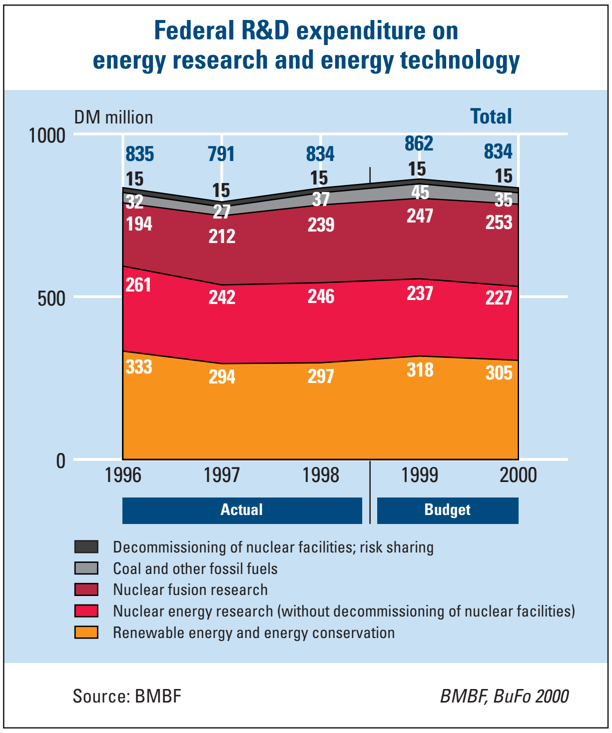
– DLR 1998/1999 annual report;
– DLR News, Sept. 1999; Federal Minister Bulmahn: „Perspektiven der deutschen und europäischen Raumfahrt“;
– BMBF/BMWi brochure „Innovationsförderung – Hilfen für FuE“.

5. Energy research and energy technology (Funding area E)

Support for energy research must be seen within the wider context of the Federal Government's overall energy policy goal of ensuring a viable and permanently subsidy-free energy supply excluding the use of nuclear power. Consequently, technology potential needs to be developed in order to ensure that new technology options are available when they are needed.

Responsibility for energy research was transferred to the Federal Ministry of Economics and Technology (BMWi) with effect from 1 December 1998. Research on the decommissioning of nuclear facilities and on nuclear fusion continues to be within the competence of the Federal Ministry of Education and Research (BMBF). Its energy research funding takes its cue from the objectives set out in the Fourth Energy Research Programme launched in 1996. The programme requires research activities to help ensure that
– emissions of climate-damaging gases are reduced;

Chart 37



– the development of high technologies in Germany is advanced, thus
– boosting the export opportunities of German industry in a growing and highly competitive world market for energy technologies.

In the light of these objectives, the funding priorities in the field of non-nuclear energy research focus on the development of technologies for
– further reducing energy consumption,
– increasing energy efficiency and
– making more efficient use of renewable energy sources.

Since it is the Federal Government's political goal to phase out the use of nuclear energy for power generation in the long term, activities in the field of nuclear energy research focus on safety aspects. Besides research accompanying the final phase of operations at German nuclear power plants and investigations concerning long-term safety with regard to the disposal of radioactive waste, these activities involve co-operation with our western partners, but above all with the countries of central and eastern Europe, with a view to improving standards of nuclear safety in that region.

Research and development activities in the field of controlled thermonuclear fusion follow a more long-term agenda and generally tend to belong to the realm of basic physical research.

5.1 Coal and other fossil energy sources

Power plant engineering and combustion research

Research policy objectives – Funding structures – Results / Developments

Fossil fuels will continue to be the backbone of power supply in Germany in the foreseeable future. At the same time, however, combustion of hard coal, lignite, oil and natural gas for the purpose of power generation is the largest source of CO_2 emissions in Germany. Therefore, improvements in combustion processes and power plant efficiency open up a particularly great potential for reducing greenhouse gas emissions. Given the prospect of a growing use of fossil energy sources worldwide, modernisation of existing technologies is highly important, creating good export opportunities and contributing to the achievement of future global climate policy goals.

Research activities in this field have always been characterised by close collaboration between users, vendors and researchers. Well-known examples of this long and successful tradition include collaborative research groups such as AG TURBO, TECFLAM and MARCKO, which have developed into globally leading centres of excellence. They have become the quality seal of successful collaborative research, securing a leading international position for German science and industry. German power plant equipment providers, for instance, have successfully defended their eminent position in the world market, in spite of fierce international competition and a dramatic drop in energy prices.

Thematic priorities

The research programme will in future focus on the following areas:

– Improving components and processes, for example high-temperature gas and steam turbines for combined-cycle power plants and more environmentally sound coal combustion processes with even higher efficiency ratings.
– Developing and testing new materials able to withstand higher pressures and temperatures in power plants and meeting the requirements of corrosion and erosion resistance. Higher process temperatures are crucial for increasing efficiency.
– Upgrading the process of pressurised pulverised coal combustion for application in the remote future, since it promises major progress in both economic and ecological terms.
– Performing associated basic research to explore and test hot gas cleaning, with a view to using this technology in pressurised combustion and combining it with gas turbines. A collaborative project to that effect carried out with partners from industry has produced significant results.

5.2 Renewable energies and energy conservation

Research policy objectives

The use of renewable energy sources makes it possible to avoid soil, air and water pollution and save what are finite resources – a particularly effective contribution to achieving the energy policy goal of environmental compatibility. However, since the cost of renewable energies is still high in most cases, their share in primary energy supply continues to be low. Consequently, it is an objective of the Federal Government's research funding policy to make the cost-effective use of renewable energy sources possible in the long term. In addition, energy conservation and higher energy productivity are two key elements for achieving a lasting reduction in greenhouse gas emissions, thus helping to preserve Germany's appeal to investors.

Thematic priorities – Funding structures – Results / Developments

Renewable energy sources

The primary goal of supporting research and development in the field of *photovoltaics* is to improve the profitability of photovoltaic installations, in other words, reduce specific costs from a present average of DM 15,000/kW and increase the specific annual energy yield, currently at approx. 800 kWh/kW. Funds are specifically provided for the development of industrial processes for reducing the manufacturing costs of solar cells and modules, as well as for efforts to increase the efficiency of solar cells and to reduce the high additional cost of inverters and installation.

In *wind power* utilisation, funding focuses on the development of wind turbines with installed capacities in the order of several megawatts, in particular for possible offshore use, as well as on early fault detection systems to minimise downtime. At the same time, the operating data of more than 1,500 wind power turbines funded under the BMBF's 250 MW Wind programme are recorded within the framework of a scientific measuring and evaluation programme. This provides both equipment manufacturers and plant operators with valuable information on investment and operating costs as well as on the annual power yields of wind power installations operating at different locations with varying suitability for wind power generation.

In the field of hydrothermal *geothermal energy*, research focuses on fundamental questions regarding the evaluation of geoscientific and economic conditions for the use of hot deep water. The European project for developing the Hot Dry Rock process at Soultz-sous-Forêts produced promising results during circulation tests conducted in 1998, making use on an industrial scale a realistic prospect.

Biomass engineering lies within the competence of the Federal Ministry of Food, Agriculture and Forestry (BML). Research funding focuses primarily on the supply of biofuel as well as on improving heat and power generation, with a view to optimising profitability and producing favourable effects on the environment.

In the field of *fuel cell research*, the bulk of the funds go to the development of basic technologies, which are expected to lead to more cost-effective manufacturing processes and reliable plant operation. The carbonate melt fuel cell has already been successfully tested in demonstration plants. As regards the solid oxide fuel cell, German scientists are working to improve both the planar concept and the tubular concept for stationary applications. The polymer electrolyte membrane (PEM) fuel cell is already being tested by the automobile industry with a view to using it in cars.

The scheme for funding research and development related to *solar thermal power plants* which had been going on for more than 20 years has now come to an end. It is now up to the companies that received the funding to start marketing this technology in the more sunny regions.

Research into renewable energies is conducted by national research centres such the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre), the Forschungszentrum Jülich (FZJ – Jülich Research Centre) and the Hahn Meitner Institute (HMI) in Berlin, as well as by several university research institutes and individual institutions of the Fraunhofer Society (FhG); cf. Part VI.

Energy conservation

Government funding for research in this field focuses above all on two areas that are highly effective and forward-looking: heat supply for buildings and energy-efficient industrial processes.

– The Solar Thermal Power 2000 Programme assesses the long-term behaviour of solar thermal facilities owned by the Federal Government and studies solar demonstration plants (primarily in the new *Länder*) and technologies for seasonal heat storage.
– The funding concept for the *Construction of new buildings with*

optimised solar technology concentrates on passive solar systems, solar energy-supported heating and ventilation systems and their demonstration in low-energy buildings using optimised solar technology.
– The funding concept for *Improved energy conservation in existing housing stock* provides funds for software and component development, trial and demonstration projects and the transfer of results to initial and further training.
– The *District heating 2000+* funding concept supports research and development in the relatively small utilities that provide district heating. This scheme is aimed at improving their technical and economic basis, thus allowing a more extensive use of district heating.
– In the area of energy-saving industrial processes, the focus was on processes for the electrolytic separation of metals, processes for draining and drying and industrial furnace processes.

Moreover, many aspects concerning renewable energy sources and energy conservation have been incorporated into the cross-disciplinary lead project entitled *Energy generation and storage for decentralised and mobile utilisation*, which represents a new funding policy approach. Six comprehensive projects were selected by a jury at the end of a competition.

5.3 Nuclear energy research (without decommissioning of nuclear facilities)

Research policy objectives

As a result of the Federal Government's decision to phase out the use of nuclear power, a new situation has emerged for research and technology funding in the field of nuclear energy research. Future research activities will primarily focus on safety aspects. This involves maintaining a minimum level of expertise for supporting and monitoring the phase-out of NPP operations, as well as closely observing and analysing, and providing advice on, other countries' safety philosophies. Precautionary, application-oriented activities to ensure long-term safety in the disposal of radioactive waste constitute another important task. The nuclear energy research activities of the Jülich (FZJ) and Karlsruhe (FZK) research centres, continuously reduced in scope over the last few years, are confined to precisely this field.

Thematic priorities – Funding structures – Results / Developments

Reactor safety research

Some the results of research activities that received funding have been widely applied in practice, reducing the risk of accidents. This pragmatic policy will be continued focusing on the following elements:
– Improving the models for the quantitative and qualitative description of material behaviour and failure modes of reactor components under complex load cycles as well as the models for operation under extreme loading conditions;
– Evolving assessment methods in reactor physics;
– Improving the methodological basis and computer programmes required for assessing safety conditions at nuclear facilities.

Disposal

Research on long-term safety for the final disposal of radioactive waste has been successfully performed by various research institutions for over 30 years. The leading research institutions involved in this process are the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources), Jülich Research Centre (FZJ), Karlsruhe Research Centre (FZK) and the Gesellschaft für Anlagen- und Reaktorsicherheit (GRS – Plant and Reactor Safety Ltd.). Other major research institutions as well as a number of Blue List institutes, universities, engineering firms and smaller businesses have contributed to these activities to a lesser extent.

Application-oriented basic research centres on methods and processes for ensuring and assessing the long-term safety of repositories. As a result of the increasing internationalisation of research in this field, the bulk of research has now shifted from salt domes to other geological formations. Particularly noteworthy activities include the work on granite formations carried out by the underground laboratories at Grimsel, Switzerland, and Äspö, Sweden. Research into clay formations is conducted at Mt. Terri, Switzerland, and Hades, Belgium, and under preparation at Bure, France. Possible co-operation with the Yucca Mountain research laboratory will shortly be discussed with the US DoE.

In spite of numerous research successes, the following priorities will remain on the agenda in the long term:
– Conceptual work to update the criteria for assessing the stability and integrity of repositories, as well as criteria for scenario analysis;
– Improving mathematical methods for assessing long-term safety;
– Improving the reliability of computing programmes for long-term safety by means of partial validation of the models used in computer codes, using natural analogues and conducting field tests;
– Deepening the understanding of the properties of potential non-saliniferous host rock formations;
– Implementing and testing laboratory results regarding the sealing properties of isolating materials such as clay, clay mixtures and crushed salt in technical long-term safety concepts for engineered components;
– Extending the studies of contaminant transport in granite to include fracture systems and areas with higher fluid flow;
– Developing the nuclear material surveillance concept for direct disposal.

International nuclear material safeguards

The purpose of international nuclear material safeguards is to ensure compliance with the Treaty on the Non-Proliferation of Nuclear Weapons by the parties to the treaty. Research in this field is designed to develop the necessary concepts, instruments and processes for the inspectorates of the International Atomic Energy Agency (IAEA) and the European Atomic Energy Community (EURATOM) that have been entrusted with surveillance. Current activities focus on the digital networking of measuring and surveillance systems. Future tasks will be guided by the need to integrate existing and new surveillance activities, the latter being laid down in the INFCIRC/540 Additional Protocol adopted by the IAEA in 1997. The goal is to create a new surveillance concept that takes better account of qualitative aspects in the individual countries.

Radiation protection
In this field, the primary purpose of *research funding provided by the BMU* is to protect personnel as well as the public at large against the detrimental effects of ionising radiation from medical and technical applications; activities are also more and more concentrating on assessing the biological impact of non-ionising radiation. The wide range of issues includes the analysis of natural and anthropogenic radiation exposure and its effects on man, the improvement of monitoring technologies and the prevention of, and provisions for, accidents.

Research in the field of radiation protection is conducted by the Bundesamt für Strahlenschutz (BfS – Federal Office for Radiation Protection) and by various federal institutes such as the GSF-Forschungszentrum für Umwelt und Gesundheit (GSF – National Research Centre for Environment and Health), the FZJ and the FZK as well as a number of other research institutes and universities.

5.4 Decommissioning of nuclear facilities; risk sharing

At present, 20 nuclear power plant units and various nuclear fuel cycle facilities are undergoing the process of decommissioning in Germany; some of them are being immediately dismantled and removed completely. In the BMBF's sphere of responsibility, there are approximately ten such projects primarily involving test and demonstration facilities stemming from the early years of nuclear engineering which have either served their purpose or whose technology is discontinued (e.g. high-temperature reactors, fast breeders).

For the period after 2000, a total of approximately DM 1.5 billion has been earmarked in the BMBF's budgetary planning for decommissioning and dismantling projects. Funds are provided only for those plants for which the Federal Government has entered into contractual undertakings or assumed any obligations under company law; this applies to the following facilities:

– Karlsruhe Reprocessing Plant (WAK): The WAK was built in the 1960s as a pilot plant for a commercial-scale German reprocessing plant. It was decommissioned in late 1991 and is currently being dismantled. At the same time, preparations are underway for the vitrification and disposal of the high-level liquid waste stored in this facility.
– Test facilities at the Jülich and Karlsruhe research centres: The decommissioning projects handled by the Jülich Research Centre include the AVR high-temperature test reactor, the Merlin research reactor (FRJ-1) and the fuel cell laboratory. The decommissioning projects at the Karlsruhe Research Centre comprise the multi-purpose research reactor (MZFR) and the compact sodium-cooled nuclear reactor (KNK). The FR-2 research reactor has been under safe enclosure since November 1996.
– Kalkar Nuclear Power Plant (SNR-300): The so-called fast breeder project was discontinued in the spring of 1991. In late 1995, the plant was sold to a Dutch investor who is converting it into a leisure park. The liquidation of the project has not been completed yet, since disposal of the fuel assemblies is still pending.
– Hamm-Uentrop High-Temperature Reactor (THTR-300): The reactor was shut down in 1989 and has been under safe enclosure since February 1997; a contractual agreement concerning the necessary funding has been signed between the Federal Government, the state government of North Rhine-Westphalia and the energy industry covering the period until 2009.
– Asse Salt Mine: Since the 1960s, the Asse salt mine has been used to gather essential knowledge on the underground disposal of radioactive waste in salt domes. For safety reasons, approximately 130 chambers in the area of the southern flank are currently being backfilled with salt. In the long term, the mine is to be shut down altogether, and preparations are already underway, taking due account of existing statutory safety requirements.

5.5 Thermonuclear fusion research

Research policy objectives

The purpose of thermonuclear fusion research is to prove that large-scale power generation based on controlled thermonuclear fusion in a fusion reactor is technically feasible in principle. The aim is to tap a new energy source that does not emit CO_2. This ambitious aim can only be attained through long-term international co-operation and the pooling of resources. In Germany, thermonuclear fusion research is concentrated on three institutions: the Max-Planck-Institut für Plasmaphysik (IPP – Max Planck Institute for Plasma Physics), the FZJ and the FZK.

Thematic priorities – Funding structures – Results / Developments

The goals of thermonuclear fusion research are pursued in experiments carried out at various test facilities and through the systematic development of a theoretical foundation. These research activities focus on investigating the physical properties of burning fusion plasmas and developing the necessary technologies to allow the fusion energy of the plasmas to be utilised.

German fusion research activities are part of the European thermonuclear fusion programme which, within EURATOM, provides part of the funding for the work of associated laboratories such as IPP, FZK and FZJ. The Science Council, in its statement on energy research published in January 1999, came out with a strong endorsement of the work of German thermonuclear fusion researchers, recommending its continuation within the framework of international co-operation.

Germany's largest thermonuclear research project is the new Wendelstein 7-X stellarator project which is currently being set up by a department of the IPP in Greifswald; completion is scheduled for 2006. The experiment is receiving substantial co-funding under the EU thermonuclear fusion programme and from the government of Mecklenburg-Western Pomerania. It is expected to produce important results concerning the purity and stability of the plasma and, ultimately, the suitability of stellarators for power generation. Moreover, the work at Greifswald complements the main line of development, the tokamak reactor, over which the stellarator has an edge with regard to stationary operation.

Literature

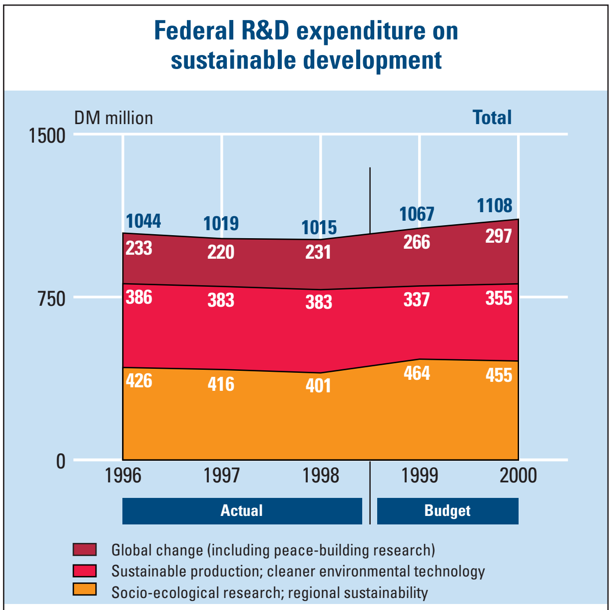
– BMBF brochure: „4. Programm Energieforschung und Energietechnologien", 1997;
– „Nachwachsende Rohstoffe, Konzept der Bundesregierung zur Förderung von Forschungs-, Entwicklungs- und Demonstrationsvorhaben 1996 – 2000", published by the BML, 1996;
– „Kohlekraftwerke der Zukunft – sauber und wirtschaftlich", published by the BMWi, 1999.

6. Environmental research for sustainable development (Funding area F)

In 1998, the Federal Ministry of Education and Research established global sustainable growth as a guiding principle governing research funding. Environmental research is a funding priority particularly well suited to demonstrate ways of putting this principle into practice.

As early as 1997, the Federal Government's Research for the Environment Programme set new priorities for environmental research. More emphasis was placed on application-oriented research for the sustainable development of landscapes and environmental systems at the regional and global levels, on the integration of environmental protection aspects into production processes and products as well as on measures to reduce the cost of environmental compliance. The newly adopted principle of global sustainable development constitutes a policy approach to research funding that – even more than in the past – takes on board the economic as well as the global perspective of sustainability. The Research for the Environment Programme comprises the activities of all federal ministries involved, with general research funding being the responsibility of the Federal Ministry of Education and Research (BMBF), while the purpose of research commissioned by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and other government ministries is to help them fulfil their specific departmental functions. The BMU's departmental research projects are listed and published annually in its Environmental Research Plan (UFOPLAN).

Chart 38



Source: BMBF

BMBF, BuFo 2000

Under the first aspect, i.e. improving the environment at the regional and global levels, the research community is to develop proposals as to how landscapes and environmental systems can be shaped and used by man in order to limit the use of natural sources and sinks (deposits and their transformation potential) to a level that does not threaten the livelihood of future generations. This requires, first of all, a better understanding of the functionality and carrying capacity of natural systems, ranging from individual ecosystems to the global climate system.

Sustainable management, the second aspect of research funding, concerns economic activity. Here the aim is to design production and consumption patterns in such a way that they are integrated into natural substance cycles, in other words, become as environmentally sound as possible. This applies, on the one hand, to the integration of environmental aspects into production processes and products. On the other hand, remedial environmental technologies will remain necessary to protect soil, water and air; however, more than in the past, the further development of these technologies must be geared to the requirement of cost reduction. Research is also being conducted on non-technical elements of innovation such as new consumption patterns or new forms of use, and on an innovative framework for sustainable management.

The concept of sustainability is fleshed out step by step in the various parts of the programme. Sustainability is defined as a viable development that maintains a balance between ecological, economic and social needs. Focusing on sustainability marks another logical step forward since, long before the United Nations Conference on Environment and Development was held in Rio in 1992, the Federal Republic of Germany had already been leading in implementing – on a statutory basis – end-of-pipe environmental technologies such as exhaust gas filters or sewage plants. This is also true for the management of waste at controlled landfill sites and waste incinerators. Similarly, the problems posed by noise emissions and hard radiation were addressed by legislation at a very early stage. Environmentally compatible products, too, have been supported by government policy for more than two decades.

Attempts to establish a general system of closed substance cycles for production wastes and promote the recycling of used materials are more recent. The latest links in this chain are efforts to avoid possible pollution even at the early stages of the manufacturing process and to design products from the perspectives of resource efficiency, reusability and recyclability, as well as the promotion of natural regenerative processes.

More than ever before, research now takes into account the needs of those who use environmental knowledge in business, local government, public authorities and private households. Measures to promote environmental education and the transfer of environmental knowledge are directly integrated into the research projects. But this new approach pursued in research also forces scientists to co-operate across the boundaries of their individual disciplines. Natural, engineering and social scientists are called upon jointly to develop socially and economically viable concepts for sustainable development within the EU, thus contributing to global sustainability.

Research for sustainable development can be divided into three funding priorities.

6.1 Socio-ecological research; regional sustainability

Research policy objectives / funding structures

While considerable successes have been achieved in reducing the pressure on environmental systems, particularly through the protection of water bodies and air quality control, the increase in the use of environmental resources continues. As a consequence, future research will have to focus more than before on economic and social factors, which should be either promoted as drivers of sustainable growth or eliminated as impediments.

This shift of emphasis in the funding of environmental science is characterised by the following three elements:

– Technologies that use and boost the regenerative capacity of natural systems at the interfaces between production systems and nature;
– Regionally focused priorities that specifically reflect the conditions and possibilities of the people involved at the regional level;
– New funding activities for research on the relationship between environment and society.

Thematic priorities – Funding structures – Results and developments

Technologies to support regenerative processes

In former years, research on environmental technologies was confined to responding to pollution and developing successful end-of-pipe technologies. And although a substantial part of funding is now poured into integrated solutions, treatment and disposal technologies need to be further improved. It will be virtually impossible to design manufacturing processes in all sectors of industry that are fully environmentally sound, socially and ecologically compatible and at the same time economical. In other words, there will always be waste that has to be retained by means of suitable technologies.

In the field of water management, the focus is above all on cost-optimised technologies for water supply and waste water disposal that do not involve any major side effects or maintenance work. As regards waste and contaminated site management, more emphasis is now placed on measures to explore the effects of natural purification and support them through suitable technologies such as biomechanical waste treatment.

Furthermore, it will remain a necessity to find technological solutions to problematic areas of water use and to develop and demonstrate technologies adapted in particular to the needs of developing countries and newly industrialised countries, as well as to devise new water management concepts.

The BMBF has played a co-ordinating role in a two-year debate between water companies, water researchers and various federal ministries. The results were published in autumn 1999 by the associations of the water management sector in the form of recommendations for an action concept for sustainable and competitive water management in Germany.

The BMBF recently published a brochure featuring the reports of the three working groups of the water industry. The implementation of those recommendations that have a bearing on the BMBF's responsibilities – such as support for German pilot plants abroad, international technology transfer via personnel exchange and operator models in the world market under German leadership – will account for a substantial part of the resources provided for this funding area.

The priority scheme *Cost reduction in water supply, waste water disposal and in waste management*, covering over 20 ongoing projects, is aimed at systematically tapping technical and organisational potential to improve efficiency and cost-effectiveness in drinking water supply and waste water disposal as well as in waste management at the municipal level.

Regional elements in environmental research

Since ecological research has for some time been oriented towards various types of landscape, the new funding priorities place more emphasis on the social players at the regional level, and thus on the socio-economic conditions of sustainable development. Research in this field has to take due account of agriculture and business, consumers and residents as well as local authorities and initiatives. Research projects focused on the regional level are particularly well suited for this purpose as they can make use of existing networks.

The new *Regional pilot projects for sustainable management* funding priority comprises 15 collaborative projects funded with an overall volume of approximately DM 15 million since 1999. Issues include social innovation, for example concepts for food supply from regional production, regional material flow management or boosting the regional development potential.

In addition to the pilot projects, a new funding measure entitled *Sustainable consumption at the regional level* has been launched. Intensive forms of product use – e.g. systematic recycling chains, multiple use or groups of users – can help increase the output produced from a given resource input and improve ecological efficiency. At the same time, new forms of use often entail supplementary services (e.g. repair, maintenance, retrofitting) that generate employment and thus economic potential.

In the area of water body research, with its strong emphasis on the regional level, the focus of attention has in recent years been shifted from small watercourses (1991–1995) to research on the management of a major river basin, that of the river Elbe. 28 projects have received funds totalling about DM 40 million.

The example of the river Elbe has helped create the basis for the sustainable management of aquatic landscapes. Another funding priority, *Research for river basin management* (FEM), was created to close gaps in the knowledge about ecological and socio-economic interactions in German river basins. In so doing, the BMBF acted on the new requirements concerning water resource and water body management under the EU Framework Water Directive.

The research results from the priority scheme for the *Rehabilitation and ecological recultivation of landscapes in eastern Germany formerly used for opencast lignite mining*, launched in 1994, are increasingly being put to use in rehabilitation projects. To date, more than 55 collaborative and individual research projects have received funds worth about DM 80 million. This funding priority can now be brought to a conclusion by completing a number of ongoing projects, mostly covering water engineering measures at the closed-down former opencast mines in eastern Germany, especially in the Lusatian region.

Research on the relationship between man and the environment

The new *Socio-ecological environmental research* funding priority covers scientific research on the question of how to put the relationship between humans and their natural and social environment on a sustainable footing. This initiative echoes the Science Council's call, in 1994, for increasing capacities in socio-ecological research. The aim is to strengthen existing elements as well as to improve the participation of young researchers in, and the infrastructure for, socio-ecological research. Research themes, collaborative research projects and working groups to be funded are selected by way of tender on a step-by-step basis.

As regards funding for environmental health research, the intention is to build on experience with previous substance-based funding projects and to focus, more than in the past, on the aspect of designing sets of tools for the assessment of environmental risks.

6.2 Economic sustainability; integrated environmental technology

Research policy objectives / Funding structures

Research for integrated environmental protection, unlike remedial environmental engineering, puts the emphasis production processes, product design and utilisation and – as cross-cutting issues – on corporate instruments for sustainable management, as well as on overall conditions for innovation. The aim is to make responsible use of resources (raw materials, energy, land) a criterion as early as in the planning stage, thus avoiding the generation of waste. Intelligent solutions are needed for innovative processes in industry, agriculture and forestry, in the craft trades and the service sector, on the one hand, and for private households and consumers, on the other, and, of course, also for policymakers, who have to provide incentives for the necessary innovations.

This programme objective is implemented using a largely sector-based approach. Since the problems encountered within individual sectors resemble each other to a significant extent, research and development activities can be easily pooled, which particularly benefits small and medium-sized enterprises.

Thematic priorities – Funding structures – Results and developments

The priorities in the BMBF's funding schemes for integrated environmental management were redefined in 1998, with the focus now on the following areas:
– Agriculture and food processing
– Chemicals and plastics („sustainable chemistry")
– Textile and leather industry
– Forestry and wood processing / wood technology
– Metal production and metal processing
– Electrical and electronics industry
– Concrete, glass and ceramics

as well as on the generic issues:
– Opportunities and limitations of new product utilisation strategies
– Corporate instruments for sustainable management
– General setting needed to foster innovation for sustainable management.

Depending on their potential for pollution abatement and resource efficiency, these funding schemes target either
– the production process (environmental protection integrated into production),
– the product itself (ecological design, sustainable use) or
– overall conditions and instruments.

Since 1998, new funding measures in addition to ongoing projects in the areas indicated above have been publicly announced to promote integrated environmental protection in the following fields: food processing; the textile industry; sustainable forestry; wood processing/ engineering; the ceramics industry; the plastics and rubber industry; the foundry industry; metal production; agro-technology; and the packaging industry; funding is also provided for research on the possibilities and limitations of new product utilisation strategies, corporate instruments to promote sustainable management, and a framework for innovation in the field of sustainable management. Further funding measures are under preparation for paints and lacquers/varnishes, the printing industry and the electrical and electronics industry.

6.3 Global change

Research policy objectives / Funding structures

Research on global change is aimed at analysing the causes and effects of global changes in the environment and in society, with a view to improving the predictability of short-term changes, preparing reliable scenarios for long-term developments, and identifying options for bringing about sustainable development.

The review of national and international research activities on global change that was started in 1997 has now been brought to a conclusion, leading to a partial reorientation of research topics and methods. As a result, research on global change is no longer confined to classic disciplines such as climate and ecosystem research, but increasingly includes interdisciplinary elements. These elements increasingly take into account the complex interactions between natural and social systems. At the same time, they allow global phenomena to be classified, albeit often still in rather vague terms; nevertheless, such prioritisation is required by the user side, in other words policymakers and industry.

Another important aspect of this substantive reorientation are plans for putting German research activities on a more international footing. One way of doing this is by improving the links between national funding programmes and the major international research programmes, i.e. World Climate Research Programme (WCRP), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions of Global Change (IHDP) and the DIVERSITAS international biodiversity programme, and by advancing the networking between national and international research institutions.

Within a research policy that aims at fostering sustainable development, peace research also plays an important role. Its purpose in the political process of coexistence of individuals and peoples is to preserve the livelihood and basis of existence of people by identifying ways to prevent or eliminate war, violence, exploitation, poverty, famine and oppression, on the one hand, and ways to preserve or establish freedom, justice, prosperity, democracy and human rights, on the other.

Thematic priorities – Funding structures – Results and developments

– The programmes still underway in atmospheric research (troposphere, ozone, aerosols) will expire in 2000. The new AFO 2000 Atmospheric Research Programme which was put out to tender in September 1999 will pool existing German research capacities and concentrate them on the priority themes of vertical transport in the troposphere, physical and chemical processes of the upper troposphere and the middle atmosphere as well as multi-stage processes in the troposphere and the stratosphere.
– In biosphere research, funding goes to projects in the areas of biotope and wildlife protection as well as tropical ecology. Particularly noteworthy is a German-Brazilian research project named SHIFT (Studies on Human Impact on Forests and Floodplains in the Tropics), which has been running successfully for ten years. In addition, the BMBF invited tenders for a new research programme named Biodiversity and Global Change (BIOLOG) in April 1999 which will focus on terrestrial biodiversity. The emphasis will initially be on integrative and interdisciplinary research activities to improve systemic understanding with regard to the functionality of biodiversity, with special attention being given to global abiotic environmental changes. Account will also be taken of socio-cultural and economic aspects.
– In the field of climate research, the Applied Climate and Atmospheric Research Programme will expire in 2000. A new climate research programme called Climate Development – From Understanding Variability to Forecasting is under preparation. Its purpose is to explore climate variability and predictability, conduct regional process studies and investigate the consequences of climate fluctuations.
– For several years, the BMBF has supported environmental impact research, for example case studies such as *Climate change and the coast*, projects to explore the effects of global environmental change on forests, or the German-Brazilian WAVES project (Water Availability and Vulnerability of Ecosystems and Society in north-eastern Brazil). New projects will be run under the recently launched GLOWA programme, which deals with the global change of the water cycle. GLOWA's goal consists in designing strategies for sustainable and far-sighted water management, taking due account of global environmental change and socio-economic constraints. Further projects are being prepared under the umbrella of the new climate research programme.
– The BMBF is helping continuously to extend the research infrastructure. Particularly noteworthy is the crucial support provided for the preparatory phase of the ESA's ENVISAT mission as well as for the work of the Deutsches Klimarechenzentrum (DKRZ – German Climate Computer Centre).
– Funding of research for the benefit of a policy of peaceful development is to be provided by a foundation to be established with the Bundesstiftung Umwelt (DBU – German Environment Foundation) in Osnabrück; its purpose is to give lasting impetus to peace research, especially in Germany, and to make it financially and politically independent. Funding will be provided for the following research areas: constructive conflict management, conflict management strategies, optimising the instruments for peace keeping, crisis prevention and conflict settlement, civilisation and juridification of international relations, environmental conflict research (environment and security); analysis of the future role of the armed forces as well as of arms control and disarmament; scientific inputs into efforts to design strategies for conflict prevention and crisis management in politics and business; development of „intelligent agents (i.e. information pilots)" for electronic aggregation and processing of knowledge in peace and conflict research; innovative search processes for more sustainability.

Literature

– BMBF brochure: „Forschung für die Umwelt";
– „Forschung für den Wald – Berichte aus der ökologischen Forschung", BMBF, Bonn 1999;
– „Integrated environmental protection for a sustainable economy", BMBF, Bonn 1999;
– „Innovative Ansätze zur Stärkung der regionalen Ökonomie", BMBF, Bonn 1999.

7. Research and development for the health sector (Funding area G)

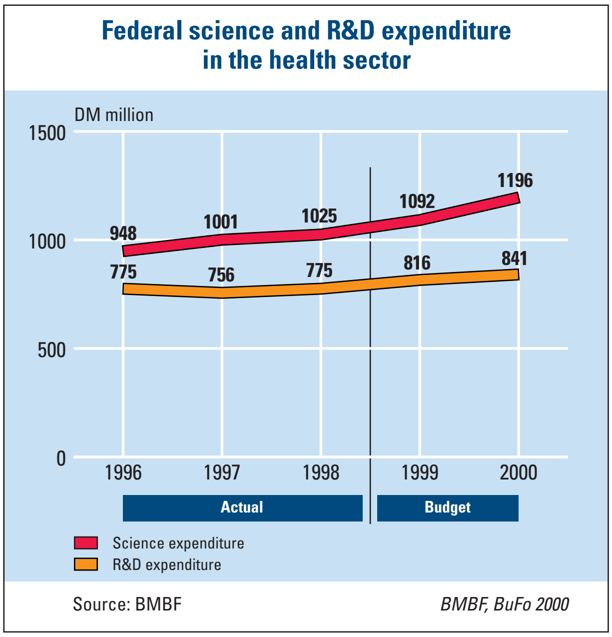
The key objectives of the Federal Government's health research policy are to enable people to lead healthier, longer and more active lives, and to create living conditions that are conducive to public health in a highly industrialised society, while ensuring efficient and cost-effective medical services for all groups in society. The Health Research Programme jointly sponsored by the BMBF and the Federal Ministry of Health (BMG) meets these requirements and, accordingly, pursues specific research and health policy goals. Particular emphasis is placed on promoting health and combating disease, on the one hand, and on improving the structures of health research, on the other. Above all, the programme is designed to contribute to an efficient and affordable health care system and to communicate this effort to the citizens.

Research policy objectives

Depending on their respective approaches to funding, the BMBF and the BMG pursue different, but complementary goals under their jointly funded programme.

BMBF funding has a dual thrust:
– In terms of content, the objective is to obtain research results that meet top international standards and to take advantage of opportunities for innovation in the hospital sector, in industry and in the health care system;
– in structural terms, the objective is to create, maintain, improve and network research potential that are attractive for international science and industry, in particular the pharmaceutical industry.

Chart 39



The BMG's departmental research activities are application-oriented and intended to generate knowledge pertaining to its departmental functions, prepare the concepts underlying political and administrative decisions and evaluate BMG schemes aimed at properly fulfilling its departmental tasks. The objectives of this departmental research are:
– To promote public health and to prevent and combat disease;
– To ensure the efficiency, quality and cost-effectiveness of the health care system, and to ensure the stability of the long-term care insurance system;
– To make environmental health protection efficient and effective.

Funding structures

The substantive and structural objectives of BMBF funding are attained through various funding instruments, i.e.
– Project funding to support activities with a clear-cut thematic definition and timeframe and to take up and establish new research ideas by way of providing start-up funding, to boost competition, and to improve the structures of university and non-university science systems;
– Basic funding for non-university research institutions to tackle long-term supraregional research tasks, create a permanent basis for important research activities and develop internationally attractive research competence.

In its departmental research, the BMG mainly uses the following instruments:
– Pilot projects and project funding;
– Research activities by subordinate institutions and basic funding for non-university research institutions (e.g. Paul Ehrlich Institute, Robert Koch Institute, Forschungszentrum Borstel, cf. Part VI).

Thematic priorities / Results / Developments

BMBF funding focuses on the following areas:

Biomedical research

Biomedical research is receiving increased funding in the fields of
– Cancer research
  • The greatest contribution to cancer research comes from the medical departments of universities, which, in the clinical sector, are supported by tumour centres. In the non-university research sector, the most important contributors are the Stiftung Deutsches Krebsforschungszentrum (DKFZ – German Cancer Research Centre) and the Stiftung Max-Delbrück-Zentrum für Molekulare Medizin (MDC – Max Delbrück Centre for Molecular Medicine) which are both foundations. In project funding for the competence networks in medicine which took up their activities in 1999, three of the nine networks deal with cancers.

– Cardiovascular research
  • Activities in this field focus on preventive and risk factor research, which received its initial impulse from project funding (e.g. German Cardiovascular Prevention Study), but has now become established in the higher education sector and associated institutions, such as the Institut für Arterioskleroseforschung (IFA – Institute for Arteriosclerosis Research), as well as in non-university institutions, especially the HGF centres, the Max-Delbrück-Zentrum für Molekulare Medizin (MDC – Max Delbrück Centre for Molecular Medicine) and the GSF-Forschungszentrum für Umwelt und Gesundheit (GSF – Environmental and Health Research Centre). This area of research is receiving additional project funding through a host of individual projects targeting the structural priorities, such as the interdisciplinary clinical research centres, or through reconstruction measures in eastern Germany.

– Molecular medicine
  • The new molecular biology approach has become established in the entire field of biomedical research, with the MDC serving as a hub for the rapid transfer of research results to clinical research. This approach is supported by BMBF project funds for the *Gene therapy I and II* research priorities. Since 1998, five selected projects have received funding under the lead project on *Diagnosis and therapy supported by molecular medicine*. This area of research is receiving additional project funding through a host of individual projects targeting the structural priorities such as the interdisciplinary clinical research centres, or through reconstruction measures in eastern Germany.

Clinical research

In clinical research, BMBF funding is mainly intended to achieve structural goals related to co-operation, networking and competition:

– Interdisciplinary clinical research centres
  • These centres pool and co-ordinate the research activities and resources of medical universities in all relevant fields which makes them an instrument for the structural improvement of medical schools. As a result of the centres' activities in the last few years, a strictly performance-based distribution of research funds, clinical orientation of research projects, transparent financing modalities and more efficient management structures have been introduced and now form an integral part of the centres' performance.

– Co-ordination centres for clinical studies at universities
  • This scheme will provide start-up funding for medical departments to set up co-ordination centres to prepare, conduct and evaluate clinical studies across universities. The purpose is to overcome the present deficit in clinical research.

– Competence networks for medicine (MedNet)
  • Disease-related competence networks will transfer the results of leading-edge research as quickly as possible to patient care centres and – in reverse – return questions from patient care centres to research. The intention is to set up horizontal links between working groups of different disciplines and vertical links with highly qualified patient care institutions. This approach covers the following priorities: leukaemia, malign lymphomas, child cancers, Parkinson's disease, depression, schizophrenia, apoplexy and chronic intestinal disorders.

– Infectious diseases
  • In this area, funding is provided for twelve collaborative research projects aimed at exploring the pathogenesis of bacterial and viral diseases, in connection with the emergence of new pathogens (e.g. BSE) and the control of infectious diseases such as AIDS and hepatitis, which are of particular importance to the national health care policy.
  • Furthermore, tenders were invited for projects intended to strengthen clinical studies of infectious diseases as well as research into their epidemiology. Special support is provided for research in the fields of tropical medicine and parasitology.

Public health research

This type of research comprises all those issues that transcend the medical aspect of health and disease of the individual and relate to measures to prevent disease and maintain the health of entire cohorts and large groups of the population. Public health research takes an interdisciplinary approach; in other words, the findings of central medical disciplines such as biomedical research and epidemiology as well as those of psychology and economic and social sciences, are taken up and evolved so as to close knowledge gaps between biomedical and social basic research. The BMBF supports five collaborative research projects in conjunction with the establishment of postgraduate study courses at universities. Other central components of public health research that receive funding include

– Health care systems research and health economics
  • Health care systems research looks into the structures of health care systems, their control incentives and the impact of these incentives on health care services for the population at the microlevel, the mesolevel and the macrolevel. It thus aims at improving the efficiency and cost-effectiveness of the entire system and of health care delivery.

– Rehabilitation sciences
  • The BMBF and the Deutsche Rentenversicherung (VdR – Association of Pension Insurance Agencies) as the biggest provider of funds for rehabilitation established rehabilitation sciences as a funding priority in 1996, with a view to building up and developing structures of rehabilitation research in Germany. At the same time, funding for high-quality, internationally competitive research projects will point the way towards more patient-centred and successful rehabilitative care. To this end, support has been provided since 1998 for eight regional co-operative projects covering a total of about 70 individual projects bringing together universities, non-university research institutions, rehabilitation clinics as well as representatives of regional pension insurance institutions. Funding is provided by the BMBF and the insurers on a 50 : 50 basis.

– Co-operation on research into health care delivery
  • An agreement has been concluded on financing research into health care delivery. In addition to the project funding provid-

Part III

ed by the BMBF and the umbrella organisations to improve service processes in the health care sector, an advisory platform will be established to prepare recommendations on the funding of projects, including those carried out on behalf of other research funding organisations. This platform will be composed of representatives of the scientific community, the umbrella organisations of the statutory health insurance companies as well as the BMBF and the BMG.

Medical technology
The BMBF's funding schemes are co-ordinated under the Health Research Programme, but implemented and financed under the specific programmes on information technology, laser research, materials research, microsystems and biotechnology. Currently, the priorities of cross-programme funding are the centres of excellence for medical technology as well as innovation competition. Institutions receiving basic funding in this field include the Institut für biomedizinische Technik (Institute of Biomedical Technology) of the FhG and five HGF centres, in particular the Karlsruhe Research Centre and the DKFZ. A specific problem encountered with this type of funding is the implementation of innovative medical technology products in a regulated health care market, under general cost cutting pressures.

Telematics in the health care system and in medical research
Developments in information and communications technologies in the last few years have created new opportunities for improved communication also in the health care sector and in medical research and will in future lead to substantial changes in these fields. A framework for the use of telematics will be defined by the Action Forum for Telematics in the Health Care Sector initiated by BMBF and BMG.

The BMBF is establishing a telematics platform for research networks with a view to defining binding standards and conditions for the use of telematics in medical research. The BMG's activities focus on surveys and assessments concerning the use of telematics in the German health care system as well as on support measures for the development of new fields of use (e.g. electronic prescription, use of health professional and insurance cards).

The priorities of the BMG's departmental research are currently in the following areas:

Disease-related departmental research
The main focus is on addiction as well as on AIDS and other new infectious diseases and on diseases of the allergic type. The narcotic drugs and addiction prevention policy centres on information campaigns, preventive measures and help for addicts. As a new approach introduced through a pilot project, heroin-based treatment will be tested for opiate addicts who could not be helped successfully – or not at all – using the „conventional" aid measures offered. Tenders for a study design for the scientific pilot project were invited in September 1999. Furthermore, several new expert studies were commissioned to investigate the addiction-related problems of migrants living in Germany. Another priority in applied research is *neuropsychiatric disorders*. As one of the results achieved within the health care model for hard-to-treat epilepsy (1992 – 1999) that was brought about by technical and personnel support from the Federal Government in consultation with the *Länder*, a new health care delivery network for epileptic patients was established which led to improved diagnosis and therapy. The nine centres for preoperative diagnosis and four centres for epileptic surgery that received funding have become places of scientific training and research.

Based on morbidity-based and age-specific selection criteria, prospective priorities will be structural networking models for crisis intervention and prevention, as well as for co-operation and liaison services between specialist clinics and general practitioners in the fields of psychiatry and neurology.

Evaluation of medical diagnostic and therapeutic methods
Under this priority, a database information system for assessing the benefits and costs of medical methods and technologies was set up at the Deutsches Institut für Medizinische Dokumentation und Information (DIMDI – German Institute for Medical Documentation and Information). This information system provides access to relevant databases and contains studies and other documentation on the state of national and international knowledge in the field of technology assessment in medicine (cf. Part VI). This helps to ensure that decisions on any medical services to be covered by statutory health insurance schemes are taken on the basis of a systematic evaluation of the benefits and costs of the services in question.

Quality assurance
While during the first phase of the quality assurance pilot scheme funding focused mainly on projects conducted in individual areas of health care, it is now for the most part aimed at supporting research on quality management methods.

Measures to improve the safety of blood and blood products
In the area of blood and blood products, the Federal Government's funding goes to various projects designed to improve the safety of blood and blood products. The priority goal of these research activities is to identify serious pathogens that may occur among the blood donor population. Funding is also provided for studies on the safety and quality of blood products.

Health reporting
Although health reporting at the federal level has left the research phase and now become routine, some fields need continuous research support for further development, particularly in terms of data collection and methodology. Responsibility for co-ordinating and fleshing out these research activities lies with the Robert Koch Institute.

Preventive consumer protection in the health care sector
The objectives of a wide variety of projects funded in this field include recording the release of dyes and auxiliary agents from textiles with the help of a model system that should be as simple as possible as well as examining the levels of certain azo dyes in recyclate fibres to be used in textiles that come into contact with human skin (recyclate fibres are extracted from old clothes to produce new ones).

Research under the long-term care insurance

The BMG is conducting the following three research projects in connection with long-term care insurance: *Impacts of long-term care insurance*, *Study evaluating the benchmarks for the assessment of the duration of long-term care as stipulated in the guidelines according to section 17 of the Social Code Book XI* and *Pilot programme for improving the services rendered to persons in need of long-term care*. The latter project, which has accompanied, and will continue to support, the introduction and implementation of long-term care insurance, is expected to help close remaining gaps in the existing infrastructure, introduce future-oriented elements to health care and modernise existing nursing care services.

Literature

– Health Research 2000 – Programme of the German Federal Government, Bonn, 1993;
– „Außeruniversitäre Einrichtungen der Gesundheitsforschung in Deutschland“, Bonn, 1997;
– „Herz-Kreislaufforschung in Deutschland“, Stuttgart, Berlin, Köln, 1997;
– „Krebsforschung in Deutschland“, Stuttgart, Berlin, Köln, 1994;
– Forschungsprogramm „Gesundheitsforschung 2000 – Vorhabensübersicht ‘99“, Bonn, 1999;
– „Gesundheitsbericht für Deutschland 1998“;
– Executive summaries of research reports can be found on the BMG’s website (http://www.bmgesundheit.de).

8. Research and development to improve working conditions (Funding area H)

Germany’s economic and social structure is currently undergoing a process of fundamental change. The challenges of the future are posed by changes in forms of work and employment, by new corporate, operating and working structures as well as by changes in job/employment orientation. Federal research funding in this area is aimed at ensuring a humane working environment, safeguarding existing jobs and creating new ones.

Research policy objectives

The Work and Technology Programme jointly sponsored by BMBF and BMA was further developed and subdivided into two major activities in November 1998, *Innovative work design* and *Innovative services*. Under the former, the goal is to contribute to the creation of new jobs by introducing future-oriented approaches to humane work and technology design, with a particular focus on learning on the job.

The primary goal of research funding for the *Innovative services* initiative is to boost knowledge-based services and provide incentives for the scientific community and the service sector to intensify what to date has been rather underdeveloped co-operation.

Thematic priorities – Funding structures – Results / Developments

The *Innovative work design* initiative comprises the current funding priorities of *Occupational Safety 2000* and *Demographic change*:

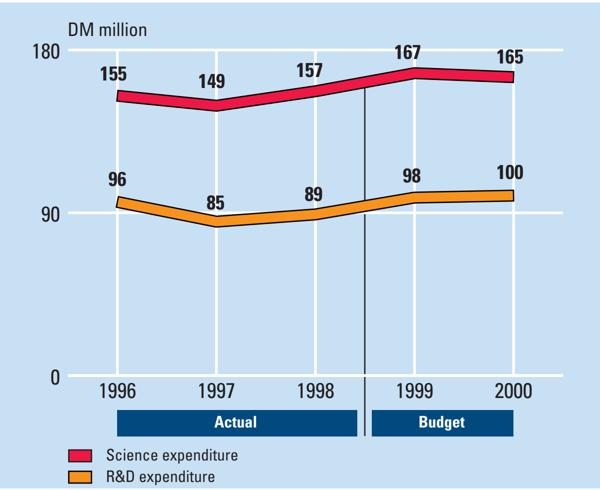
Occupational Safety 2000

The R&D measures for this funding priority are intended to support the reorientation of preventive occupational safety and health protection, which is necessitated by the transformation of the working world and required under the Occupational Safety Act. Current R&D activities therefore focus on organisation of in-company occupational safety and health protection, innovative approaches to occupational safety education, with special emphasis on the needs of small and medium-sized enterprises, and prevention consulting services that are specifically geared to customer requirements. In these fields of research, funding is provided for the following collaborative projects (see under Literature):

– Health and safety in new forms of work and organisation;
– Strengthening the role of occupational safety and health protection in corporate development and planning processes;

Chart 40

Federal science and R&D expenditure to improve working conditions



Source: BMBF

BMBF, BuFo 2000

– Development of a web-based electronic marketplace for occupational safety called Prävention online (see Infobox);
– Occupational safety research – a stocktaking exercise.

Implementation and dissemination activities are supported by close co-operation with the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Federal Institute for Occupational Safety and Health).

Impact of demographic change on work and innovation

To assess the consequences of demographic change – particularly the ageing of the working population – on the working capacities and innovative strength of the private sector and the economy as a whole, and to develop response measures where necessary, five collaborative research projects have received funding since 1996.

The results of the *Demographic change* funding priority were documented in a report on the future, which is expected to provide both industrial managers and political decision-makers with specific guidance on preventive action options. The report will serve as an early warning system and roadmap for coping with the consequences of demographic change. At the expert conference on Ageing and Employment held in Berlin from 29 to 30 November 1999, the participating researchers put their findings up for discussion. The consultations and exchange of experience that ensued pointed the way for future development.

In this context, the BMBF has provided funding for a public relations and marketing strategy for awareness raising, consulting and active involvement with regard to the consequences of demographic change and the resulting options for action (www.demographie-transfer.iao.fhg.de).

Innovative work design – The future of work

Based on individual and corporate conditions for innovation processes, a framework concept is being devised to support R&D projects for developing and implementing innovative concepts for work, plant and corporate organisation which gives special attention to on-the-job learning. Important aspects of this concept include developing and maintaining the individual's fitness to work, designing flexible organisational structures and inter-company relations as well as new forms of co-operation between businesses, the scientific community, educational institutions, public authorities and intermediary organisations (e.g. labour and management, chambers of industry and commerce).

In late 1999, a project was announced which was to take stock of successful changes achieved in work and company organisation.

The development of the framework concept will continue to incorporate occupational safety and health protection as well as demographic issues.

In the years to come, the BMBF will appropriate up to DM 30 million a year for R&D activities aimed at developing viable concepts for a humane organisation of work.

Innovative services

As a consequence of the new information and communications technologies, and given the fact that the process of globalisation has now reached the service sector, modern services have to meet the same standards of cost-effectiveness, efficiency and quality that have long since been applied to material goods. This is the only way in which to exploit the new market and employment potential of the service sector and protect the industry's existing jobs in the long term.

In the area of innovative services, first allocations have been made to R&D projects for the development of new services. The choice of the projects to be financed was based on the recommendations made by the advisory committee on the Services 2000 Plus Report as well as on the results of the so-called preliminary priority measures presented at the 3rd Services Conference organised by the BMBF in late August 1998.

More than 600 project proposals were submitted following the public announcements. Now that they have been reviewed and the necessary applications filed, work on more than 200 projects has begun or is about to begin shortly. The aim is to develop particularly innovative services both in the sector of classical services, such as retail, tourism and the trades, and in new services such as call centres, facility management or virtual companies. The emphasis in the various projects is on issues of economic development and use of technology as well as on work organisation, humane working conditions and skills and qualifications.

As more and more specific R&D projects have been financed, public perception of the importance of new services has increased considerably. This fact is reflected by the number of publications and trade fair participations as well as by activities organised by regional bodies and chambers of industry and commerce. Other BMBF funding programmes, too, now take greater account of service-related issuers.

As announced in September 1999 in the Action Programme for Innovation and Jobs in the Information Society of the 21st Century (see section 9), the BMBF presented a new research concept called *Knowledge-intensive services* in January 2000. Over the next few years, the ministry will appropriate up to DM 30 million a year for the development of knowledge-intensive services based on information and communications technologies, as well as for the modernisation of the classical service sector through these technologies.

INFO-BOX

MARKETPLACE FOR OCCUPATIONAL SAFETY

Prävention online

- permits quick access to the worldwide body of knowledge,
- offers guidance and assistance in the
- search for information,
- provides the latest news,
- networks existing knowledge on prevention,
- promotes the exchange of experience and
- develops prevention services.

www.praevention-online.de

Literature

- Occupational Safety 2000 collaborative projects;
- „Gesundheit und Sicherheit in neuen Arbeits- und Organisationsformen" (http://www.fb14.uni-dortmund.de/~gesina);
- „Ausbau des Arbeits- und Gesundheitsschutzes bei betrieblichen Entwicklungs- und Planungsprozessen" (http://www.argeplan.org);
- „Entwicklung eines elektronischen Marktplatzes auf Internetbasis für den Arbeitsschutz: *Prävention online*"(see Infobox);
- „Bilanzierung zur Arbeitssschutzforschung" (http://www.forum-as.de);
- DLR – project managing agency of the BMBF (Ed.): „Forschung und Entwicklung für innovative Arbeitsgestaltung und Dienstleistungen – Jahresbericht 1998-1999", Bonn 1999;
- Information on ongoing projects, references to literature and events on the subject of innovative services: Internet server of the BMBF's Services Initiative (http://www.dl2000.de);
- Pack, J. et al: „Zukunftsreport demographischer Wandel – Innovationsfähigkeit in einer alternden Gesellschaft", Bonn 1999;
- BMBF-Forschungskonzept „Wissensintensive Dienstleistungen", Bun-desanzeiger (Federal Gazette) of 27 January 2000, as well as under http://www.bmbf.de.

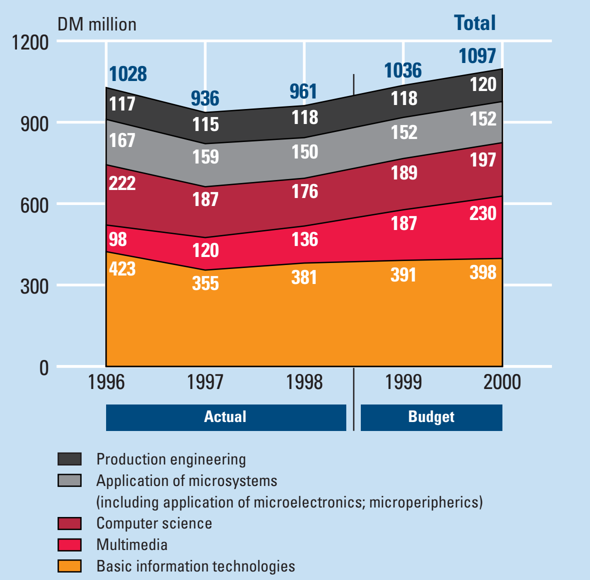
9. Information technology (including multimedia and production engineering) (Funding area I)

The triumphant advance of modern information and communications technologies is one of the key developments of our time. No other technology has such a profound impact on our lives at the beginning of the new century. This applies not only to professional life, to teaching and learning processes in initial and continuing education and participation in legal and economic activities, but also to most aspects of everyday life and even to recreational activities.

And no other technology is changing economic structures so fundamentally and opening up such growth and employment potential as modern information and communications technologies. The multimedia network of industry allows worldwide communication within seconds, optimisation of manufacturing and production processes as well as a marked increase in productivity. New markets, and hence new employment opportunities are emerging. Annual growth rates of roughly 10 per cent as currently boasted by the German IT industry, which surpass overall economic growth many times over, give an indication of the dimensions of growth that have now become possible. Experts estimate that approximately 370,000 additional jobs could be created in the IT sector by 2002, if policy-makers provide the necessary framework and if substantial progress can be achieved in relevant fields of action.

Chart 41

Federal R&D expenditure on information technology (including multimedia and production engineering)



Source: BMBF *BMBF, BuFo 2000*

Against this backdrop, it is one of the central tasks of today's education, research, technology and economics policies to tap the growth and employment potential offered by the new information and communications technologies. On 22 September 1999, the Federal Government adopted the Action Programme for Innovation and Jobs in the Information Society of the 21st Century (see essay) in order to give a strong impetus to efforts to accelerate the use and dissemination of modern information and communications technologies in industry and society. In this contexts, research, education and technology policies are of decisive importance which support the opening up of new applications through the use of modern information and communications technologies and consolidate Germany's leading position in information technology development and infrastructure. The main purpose of the action programme is to pool and focus activities ranging from creating best-practice examples for the broad-based introduction of multimedia and the Internet into industry and society, to specific funding activities designed to teach media skills, to research and development projects aimed at establishing and testing faster and more powerful communication networks, to creating the technological setting for new network generations, to developing specific web technologies to facilitate information search on the Internet and support new multimedia applications.

9.1 Computer science / IT systems

Research policy objectives

The Federal Government's research funding in the field of IT systems is aimed at devising innovative methods of information processing as well as at developing novel software and testing it in IT applications. This approach is intended to enhance the scientific and technological basis of German computer science research and accelerate the transfer to industry of new scientific findings.

Funding structures

Funding primarily goes to collaborative projects involving universities, research institutions and the business enterprise sector. Their work covers research and development topics derived from specific application-related issues. The transfer of knowledge from scientific research to industry is ensured by the participation of software companies and industrial users.

Thematic priorities / Results

Software technology

In order to be technologically competitive, it is important for German industry to acquire and improve skills and competence in developing software. Research activities funded centre on methods and tools for the efficient development of manageable, safe and reliable software, methods for maintaining and reusing existing application software as well as design tools for software in technical products. Encouraging results were obtained in terms of software safety and reliability as well as modelling technical and organisational systems and processes. In 1999, new collaborative projects were launched to provide additional support for efforts to design realistic methods and tools for developing high-quality product software (embedded systems).

Supercomputing

Complex, time-consuming and costly scientific and technical experiments are being increasingly replaced by computer simulation using supercomputers. This particular application of supercomputers requires powerful and application-specific simulation models as well as improved basic mathematical procedures. Other funding objectives include nationwide access to existing supercomputers and their networking as well as developing software tools for tapping the full potential of parallel *supercomputers*. This funding scheme has helped boost the use of supercomputers in scientific research and in industry. Computer simulations are now increasingly used in practical development, design and testing processes in the automotive industry and in mechanical engineering.

Virtual and augmented reality

Still at the beginning of what could be a promising technological trend, the technology of *virtual and augmented reality* can be used to describe in virtual 3D worlds complex processes in science, technology and education as well as in everyday life, thus making them more comprehensible for users. The spectrum of applications of virtual and augmented reality in industry ranges from product development and manufacturing to complex process control to mobile maintenance. Likewise, there are numerous non-industrial applications, for example in the education sector and in medicine, architecture, the arts or in the media. A i competition of ideas was held to initiate R&D projects in Germany.

Intelligent systems

The purpose of this funding priority is to harness methods and technologies of artificial intelligence and neuroinformatics for planning and optimisation processes. The intention is to provide technological systems with intelligent skills such as autonomy, the ability to learn, adaptivity, robustness and co-operativeness. Information processing systems are to learn automatic document content identification and intelligent information retrieval. In many sectors of industry and in most areas of transport and environmental engineering as well as in the service sector, such intelligent systems may lead to new innovative products and substantial quality improvements. A number of collaborative projects have now produced research and development results for a wide scope and great variety of applications which are being successfully tested and implemented.

Speech technology

In future, the use of natural speech will make it much easier for non-experts to handle technical equipment. Automatic speech translation is another field covered by the speech technology funding priority. The VERBMOBIL collaborative project has made it possible to recognise and translate spontaneous speech in dialogue situations for the language combinations German-English and German-Japanese. There is now a prototype capable of translating approximately 3,000 words that is considered to be leading worldwide with regard to identifying and translating spontaneous speech. The VERBMOBIL II collaborative project which will be financed during the period from 1997 to 2000 is expected to allow robust and direct translation of spontaneous dialogue between more than two partners and involving several language combinations. The use of modern telecommunications media will ensure a high level of availability of the translation system.

Man-machine interaction

The efficient use and integration of human senses in computer systems is the subject of the *Man-Machine Interaction* lead project launched in 1999. It centres on natural-language information input and output, incorporation of gestures and haptic features into the communication between man and machine, sensomotor manipulation of technical equipment as well as the realistic visual representation of complex interrelationships through IT systems.

Information processing according to biological principles
Under this funding priority, support is provided for interdisciplinary research projects designed to develop mechanisms for receiving, processing and storing information. This involves the use of biological approaches such as methods of evolution. IT applications used in this context include the optimisation of telecommunications and transport networks, technical control systems and production processes. Another priority covers nanotechnology and neuroprosthetics, which will allow the development of technical solutions capable of compensating for a loss of function of the human nervous system.

Safety in information technology
The Bundesamt für Sicherheit in der Informationstechnik (BSI – Federal Information Security Agency) investigates safety risks involved in the application of information technology and develops appropriate safety measures, especially IT procedures and equipment ensuring the safe use of information technology, as far as this is needed for the work of the Federal Government. The BSI also develops criteria, procedures and tools which it uses primarily to fulfil its mission of testing and assessing the safety of information technology systems and components and ensuring their type approval at the federal level.

9.2 Basic technologies for IT systems

Research policy objectives
As a result of the strong growth of data traffic in networks and the constantly rising demand of users for a faster, more efficient and better transfer of information, established technologies and standards usually soon come up against their own limits. This is why electronic and photonic systems need to be continuously improved as they are vital to competitiveness and employment in numerous sectors of the old as well as the new economy. The goal of funding basic technologies for IT systems is to consolidate Germany's position in the key technologies of our knowledge-based society, i.e. microelectronics and the information and communications technologies.

Funding structures
Funding mostly goes to industry-led collaborative projects involving partners from the business and scientific communities who are well-placed to work successfully on the research issues in question.

Thematic priorities – Results
Silicon-based microelectronics
Sub-100 nm technologies
– Technological processes and equipment for sub-100 nm structures and 300 mm wafers;
– Functionally optimised back-end technologies;
– Virtual technology design.

The production of 300 mm wafers was the first leading microelectronics technology developed in Germany. The first 300 mm plant is currently being built in Dresden which has acquired worldwide renown as a location for front-end microelectronics. In addition, small and medium-sized equipment companies have been able to gain a foothold in the microelectronics market and create many new jobs.

Novel microelectronic components for new systems
– Component structures for extremely high storage densities;
– Mixed-signal components for maximum frequency applications;
– Microelectronic systems for high currents, voltages and outputs;
– Functional nanostructures.

As a result of more stringent requirements concerning electronic systems and the possibilities of sub-100 nm technologies, new component structures are needed with situation-specific characteristics (e.g. more output, higher frequencies, lower internal power consumption).

With the silicon-germanium (SiGe) technology, the German silicon microelectronics sector has found cost-effective access to the mobile telephony market.

Systems integration and design methods for sub-100 nm technologies
Design methods for complex systems and circuits
Exemplary chip systems as drivers of technology and CAD development

New approaches to implementing system-oriented design processes and methods are needed to overcome bottlenecks in designing capacity and in circuit and system know-how. The *Smart systems engineering* research priority scheme has produced not only excellent technical results, but also a number of spin-off companies which are now marketing their products on an international scale.

MEDEA+ (Microelectronics Development for European Applications)
In its initial phase, the EUREKA programme MEDEA concentrated on areas in which European industry holds a leading position worldwide, i.e. communications, automotive/transport, production engineering for semiconductors, multimedia, production equipment and circuit design. At present, German firms are involved in more than 20 projects.

The success of European co-operation has led industry to continue the project. The EUREKA Ministerial Conference held on 23 June 2000 assigned to the project the label with the number E!2365, under the name of MEDEA+. The focus of MEDEA+ is twofold: In the field of production engineering, research will centre on lithographic processes, whereas in the area of applications, the aim is to develop chip systems including the necessary design technology to enable Europe to play a leading role in tapping the potential of Internet technologies (the so-called e-economy).

Telecommunications and its basic technologies
Systems technology for future communication networks
In response to increased communication demands user-friendly concepts need to be developed for mobile systems, transmission and terminals. This is why the BMBF – under the *Mobile communications* (*MOBIKOM*) priority activity – has focused its funding on the development of systems solutions providing access to multi-

media services at any time and in any place and leading to proposals for European standards, thus opening up mass markets.

The central funding areas are *UMTSplus* (Universal Mobile Telecommunications System plus) and *ATMmobil* (Asynchronous Transfer Mode mobil) as well as the components needed for their implementation. *UMTSplus* supports the development and testing of technologies to implement a platform for a flexible, software-configurable, multi-standard mobile system (base station and mobile station). The results of this work are used to develop a mobile network that can be used to provide nationwide telematics and multimedia services specifically in moving vehicles. Under *ATMmobil*, the goal is to develop a concept for an integrated broadband mobile communication system encompassing the entire spectrum from narrow-band applications to mobile broadband multimedia communication in one closed overall system at a high level of service quality. Such a system would cover the entire range from the fixed network to wireless subscriber access and from local networks inside and outside buildings to the universal multimedia terminal. What is more, the results of *ATMmobil* provide the most important basis for the development of the new HiperLAN2 standard. HiperLAN2 is a local radio networking technology with transmission rates of up to 54 Mbit/s that allows wireless data throughput at levels comparable to those of similar fixed networks.

Optical networks

The worldwide growth in data traffic places high demands on the network infrastructure up to user access. Efficient communication networks are vital to the functioning of future interactive multimedia applications. The *KOMNET* funding priority centres on developing the technologies needed for the next network generations, as well as testing them under realistic network conditions. Operation and management of a fast, large-capacity photonic network are being tested in the Berlin area as well as on long-distance links to Darmstadt and Stuttgart. The objective is to reach a transmission speed in the Terabit range (i.e. 1,000 Gbit/s). In this context, new technical approaches developed and tested by industrial enterprises together with partner institutes are of particular importance, as are network management and contributions to the standardisation of broadband access systems.

Display technology

Without visual presentation of information supported under the VISION (visualisation of knowledge) funding priority, progress in information and communications technologies is inconceivable. Display technology is facing a fundamental technological shake-up. The cathode ray tube (CRT), which is still dominating the market, is getting more and more competition from flat-square screens which are based on different physical principles. Given the economic importance of flat-square screens, it is imperative to promote further activities in display technology research in Germany in the next few years. For this purpose, in addition to ongoing activities, there are plans to finance projects designed to strengthen and enhance the R&D infrastructure, improve innovative materials, glasses, equipment and processes and test and optimise screens using organic illuminants. Small-panel microscreens and current-free, flexible displays which seem to be a promising alternative are receiving support, in particular with an eye to mobile communications. Furthermore, research and development activities aiming to achieve realistic 3D vision without the need for any additional aids have created a new dimension for innovative applications and improved user-friendliness. Industry and the research community are developing the laser projection process as another possibility for the large-screen presentation of colour images.

Quantum structure systems

Reductions in layer thickness and lateral dimensions within and on semiconductors can produce quantum-physical effects that are still largely unknown. The question of how these effects can be explained and whether they can be used for specific components is at the centre of the basic research work conducted under this priority funding scheme. These activities are very much forward-looking and are at the cutting edge of physical semiconductor research worldwide.

9.3 Microsystems applications

Research policy objectives

Microsystems are a key technology for the 21st century. Worldwide competition in this field is in full swing. To ensure that German industry can maintain and strengthen its internationally leading position, new development results in this technology need to be turned into products and marketed without delay.

The Federal Government is supporting German industry with the *Microsystems 2000+* funding concept, the aim being the industrial use of microsystems across the board. This is why funding concentrates on applications that are vital for the national economy. One particular focus of the programme is on small and medium-sized enterprises, for which the various technical and organisational problems and the requirements of the market which result from the combination of different microtechnologies pose an enormous challenge.

Funding structures

Microsystems combine electronic, optical and mechanical structures whose function-critical dimensions are in the range of a thousandth of a millimetre. Because of its integrating character, this technology requires a high degree of interdisciplinary co-operation. As a result, funding mostly goes to collaborative projects that allow the scientific potential of R&D centres to be fully utilised and inter-company networks to be built.

During the first year of the new *Microsystems 2000+* funding concept, funds have been earmarked for 43 projects in which industrial companies and research institutions collaborate. The bulk of the cost will be defrayed by industry, which therefore will also have a substantial say in defining the projects. Another important aspect is the involvement of small and medium-sized enterprises.

To ensure the scientific basis of microsystems engineering, the BMBF also uses the instrument of basic funding for institutions, supporting the microsystems activities conducted by the Karlsruhe Research Centre.

Thematic priorities / Results

Microsystems, like microelectronics, pave the way towards an unprecedented variety of products. The range of applications extends from automotive engineering to environmental protection to housing equipment/facility management to medical technology and mechanical and plant engineering. This makes microsystems a key technology for many other technologies as well as for applications and products.

For the manufacturing industry it has become an important economic factor. A survey conducted among companies involved in microsystems engineering and receiving funds under the programme, i.e. mostly small and medium-sized enterprises, showed that, by using these technologies, these companies had been able to increase their turnover by 250 per cent on average in the period from 1990 to 1998. During the same period, they created a disproportionate amount of new jobs, increasing their headcount by an average 20 per cent.

Some products spawned by this technology have been part of our everyday lives for a number of years now, for example the mobile telephone or the RPM sensor, which controls the driving dynamics of automobiles. Another success story on the mass markets is a new generation of extremely small and precise electric sensors. In automotive engineering, for instance, it will be possible in the future to save considerable amounts of fuel if power consumption is minimised by using these sensors in new start-stop systems.

In medicine, microsystems can help replace failing bodily functions. Intelligent neuro-implants produce a technical contact with the nerve and thus, for example, are able to control the bladder function of paraplegics. However, the enormous potential of microsystems are still far from being fully exploited.

The wide range of applications offered by this key technology was impressively demonstrated at a conference and exhibition entitled Microsystems technology – Innovation for the 21st century, organised by the Federal Ministry of Education and Research in June 1999, where more than 530 experts from industry, science and politics discussed the opportunities and challenges of microsystems. The results of this discussion were used as a basis for defining priorities in the *Microsystems 2000+* funding concept, which specifically promotes the development of microsystems for economically attractive applications and aims to create efficient microsystems manufacturing processes. To ensure that companies that do not have their own research and development departments and manufacturing facilities can nevertheless fully benefit from the wide variety of applications offered by microsystems, the funding programme promotes the development of technological multi-purpose components, i.e. modular microsystems. These modular micro-components will in future allow the production of small and medium numbers of pieces.

Parallel to project funding, specific measures are being taken to remove existing barriers to innovation. Selected pilot projects will help to build up an infrastructure for the broad dissemination of microsystems technology. At the same time, education and training in this field will be improved as required. For industry to be able to make full use of the opportunities afforded by this growth market, funds are provided for testing new means of information about microsystems developments and their applications. Furthermore, international co-operation in this field will be boosted, and German participation in transnational co-operative ventures and projects intensified.

9.4 Production engineering

Research policy objectives

The purpose of pro-active measures to influence technological, social and ecological change with a view to offering products and services with high customer benefit, is to enable companies to acquire technology and market leadership and to secure long-term success. This is an essential prerequisite for employment and prosperity in Germany. Against this backdrop, the funding schemes of the Federal Ministry of Education and Research are especially aimed at:

– Intensifying research and development in the field of industrial production, making use of new developments in areas such as information and communications technologies, surface machining and coating technology, laser technology and new materials;
– Exploring integrated and sustainable – i.e. ecological, social and economic – solutions for production systems, and in the process at intensifying co-operation between industry and research institutions as well as between different scientific disciplines;
– Supporting the broad-based application of research results by small and medium-sized enterprises, especially in the new *Länder*, and boosting their capacity for co-operation in inter-company networks.

Funding structures

The bulk of the funding goes to collaborative projects, with industrial partners defraying at least 50 per cent of the overall cost. It is in particular Fraunhofer institutes working in the area of production engineering/manufacturing technologies and members of the Wissenschaftliche Gesellschaft für Produktionstechnik (Scientific Society for Production Engineering) that make fundamental contributions to research in this field.

Since small and medium-sized enterprises account for a very large proportion of businesses in the manufacturing sector, they are being increasingly involved in research projects. Multipliers of R&D results such as industrial associations, chambers of industry and commerce and similar institutions are also included in the process to support the dissemination and implementation of the knowledge gained.

Thematic priorities / Results

Given the challenges resulting from globalisation and rapidly changing markets, the overall strategy of a manufacturing company must build on several cornerstones. A host of different goals, such as rapid product and process innovation, inter-company co-operation, technology leadership, sustainable management, development of an independent corporate culture and „lifelong learning", all have to be pursued together with the workforce.

Guidance on research needed for this process from a present perspective is provided by a survey entitled Produktion 2000 plus – Visionen und Handlungsfelder für die Produktion in Deutschland (Production 2000 plus – Visions and fields of action for the German manufacturing sector) which was sponsored jointly by industry and science institutions.

The new BMBF framework concept for *Research for the manufacturing sector of the future*, launched in October 1999, is based on this survey.

Its fields of activity are:

Part III

– Market orientation and strategic product planning: e.g. methods for strategic business segment planning for small and medium-sized enterprises; tools for the efficient translation of ideas into products; speedy development of operational prototypes; new prospects for product innovations through miniaturisation, integration of software and services, sustainable management;
– Technologies and production equipment: innovative manufacturing technologies; flexibly configurable machines and production systems; integration and shortening of process chains; designing processes to meet criteria such as „no waste, no thermal loss, no waiting time, no errors“, etc.;
– New forms of co-operation among manufacturing enterprises, such as partnerships to generate value-added; application of the latest management methods in corporate networks; obtaining access to the benefits of regional inter-company networks; utilisation of new information and communication networks for business processes;
– Man and the flexible company: new approaches in industrial personnel management to create decentralised, open and flexible production structures; creating an organisational, personnel and technical framework for systematically preserving and passing on empirical knowledge and linking it up with state-of-the-art technical knowledge in largely self-controlled learning processes, especially in small and medium-sized enterprises.

Funding provided for collaborative projects is based on a system of ideas competitions on individual subject areas announced in the Federal Gazette.

The R&D work carried out under the lead projects on *Innovative technologies and systems for virtual product design (iViP)* and *Accuracy-controlled machine (ACCOMAT)* creates the basis for substantial improvements for companies in the manufacturing sector.

The results of 130 collaborative projects conducted under the BMBF's *Production 2000* programme between 1995 and 1999 are being used by the companies involved and made available to other interested companies through the project management agency as well as other channels.

9.5 Multimedia[1]

Research policy objectives

In the last few months, Germany has made substantial progress on its way towards becoming an information society on a number of counts such as Internet penetration, teleworking or multimedia start-ups. But in spite of this spirit of optimism, the German IT sector is lagging behind the leading nations in the international arena. The latest report on international technological performance has again shown that other countries occupy the top positions in the global trade in IT goods as well as with regard to patents and publications. In addition, the penetration rate of modern information and communications technologies remains insufficient in small and medium-sized enterprises, in the public sector and at all levels of education. Therefore, the Federal Government is intensifying its funding activities in this area. The key objectives are to extend the information infrastructure, exploit the full application potential of multimedia in small and medium-sized enterprises, encourage even more start-ups and teach the necessary level of media literacy.

Funding structures

The Federal Government's funding activities in the field of multimedia are manifold. They include collaborative projects involving universities, research institutions and companies; calls for tenders in competitions for which the private sector sometimes provides substantial funding; pilot and demonstration projects and information material with best practice examples, intended to encourage people to follow suit and invest in viable jobs; as well as the establishment of Internet-based networks.

Thematic priorities / Results / Developments

Media skills

Teaching media skills is a central task to be accomplished on the way towards an information and knowledge-based society. In just a few years' time, information processing will be the core task for 80 per cent of our workforce. Both in professional and in private life, using the Internet and multimedia has become a key skill to be taught at schools, during initial and continuing vocational training as well as at universities.

Besides nationwide provision of information and communications technologies for all educational institutions and viable solutions concerning key criteria such as Internet access rates, the provision of high-quality software for teaching and learning is another essential task. The development of multimedia education material has been neglected in the past. The Federal Ministry of Education and Research has launched the New Media in Education Programme, in which the development and large-scale use of high-quality teaching and learning software in school, vocational education and training and the higher education sector are the key concerns.

The purpose of *LERNET– Web-based learning in SMEs and public administrations*, a competition initiated by the BMWi, is to provide support for the development and testing of Web-based learning. Funding goes to examples of best practice that boost the development and spread of new forms of continuing training as well as emulation.

The goal of the *Connecting schools to the Internet* initiative, organised jointly by the Federal Ministry of Education and Research and Deutsche Telekom, is to help ensure that all German schools have access to the Internet and that both teachers and pupils are prepared for the requirements of the knowledge-based society. This task involves providing schools with access to telecommunications networks and on-line services, developing and testing IT-based teaching materials and organising and co-ordinating not only initial and continuing training, but also possibilities for teachers to share their experience, as well as teaching schoolchildren the relevant skills for handling information and communications technologies.

The InfoSCHUL project centres on the topic-based use of electronic and multimedia-based sources of information in subject teaching at the upper secondary level. Here the aim is to identify models for the meaningful use of such sources of information in the classroom and in the pupils' self-directed work in combination with other teaching materials.

[1] Cf. section 20 (Specialised information)

Promoting the focused and demand-driven use of modern information and communications technologies in the education sector is also the objective of the lead project on *Using global knowledge for initial and continuing training and for innovation processes*, funded by the BMBF.

The increased use of multimedia in small and medium-sized enterprises is contingent upon the media skills of their staff. Identifying new ways of fostering these skills was the aim of two competitions, *Teaching media skills in the manufacturing, retail and service sectors* and *Teaching media skills in the trades*, both held at the end of 1997. The award-winning chambers of industry and commerce and chambers of crafts developed and implemented broadly applicable concepts for supporting small and medium-sized enterprises in introducing and using multimedia systems, for demonstrating possible multimedia applications, for offering appropriate training and qualification measures and for creating new platforms for electronic business transactions. Relevant results and experience were presented to the public at a final expert meeting in June 1999; they have prepared the ground for the work of the 24 centres of excellence for electronic transactions.

MEDIA@Komm

The purpose of the MEDIA@Komm *city competition* launched by the Federal Ministry of Economics and Technology in 1998 is to enable Germany to take a leap forward on the path to electronic structures in administration and business. Its key objectives are the „virtual town hall" and the „virtual marketplace". The ultimate goal is to transfer municipal information, communication and interaction processes to the electronic network. The digital signature will play a key role in this context. The concepts presented by the three winning regions will be implemented as examples of best practice in the years to come. The intention is to ensure the nationwide application of relevant experience and results by means of research support and public relations work.

Multimedia Start-up Competition

The *Multimedia Start-up Competition* organised by the BMWi is supported by numerous sponsors from industry, making it a good example of public-private partnership. It is held every year as an ideas competition to encourage young people to develop concepts for start-up businesses in the Internet and multimedia sector. The 100 best ideas for a new business are awarded a prize. Among these, the best 20 are selected and given further support. Furthermore, a Gründerleitfaden Multimedia (Guidelines for Multimedia Start-ups) which are available on the Internet were developed to summarise relevant experience and back up young entrepreneurs in planning and implementing their concepts. With the Multimedia Start-up Competition, the Federal Government intends to double the number of multimedia companies operating in Germany (currently an estimated 1,500) by 2001 and create new jobs in this sector.

Telework

To speed up the introduction of telework, the Federal Government, together with Deutsche Telekom, published „Telearbeit – Ein Leitfaden für die Praxis" (A practical guide to teleworking) in May 1998; this advisory package outlines different forms of telework with their benefits as well as important factors of success from both the employees' and the employers' perspective.

The *Teleworking in SMEs* initiative, concluded in 1999, produced a significant knock-on effect for the introduction of multimedia and Internet systems in the private sector. Under this scheme, 400 small and medium-sized enterprises set up 1,700 teleworking positions, of which about 500 were new ones. Fears that teleworking would ultimately lead to an isolation of employees, bring about substitution measures and create only jobs with low qualification requirements have not been confirmed.

To date, telework and teleco-operation schemes have been implemented in only 3 per cent of all German municipalities and are planned for another 28 per cent. Concerns about data privacy and security pose a serious problem in this regard. To give a lasting impetus to this process, the *DATEL – Teleworking and data security at municipal authorities* funding activity was launched in 1999. In the next few months, up to 50 local governments will receive funding for their schemes introducing telework. The selection will be made through a competition. The main criteria for funding are the number of teleworking jobs to be created and a sound and consistent security concept.

In May 1999, the *Internet telework exchange* project was launched, whose pilot phase is scheduled to end in December 2000. It focuses on introducing and testing an electronic platform for offers and enquiries concerning work capacities and telework stations as well as on establishing contact between employers and employees. If successful, the project will be taken over and continued by the Bundesanstalt für Arbeit (BfA – Federal Employment Service) or another sponsor.

POLIKOM

Multimedia teleco-operation opens up new possibilities of communication and co-operation for public administrations, industry and private households. However, this requires the development of universal solutions that meet security needs and are accepted by users. To this end, the BMBF established the *Teleco-operation POLIKOM* funding priority which covered the period from 1994 to 1998 and initiated and subsequently intensified the development, testing and evaluation of multimedia systems solutions for cross-site co-operation projects in various fields of application. The experience and research results gained in this process were presented to the public at a final conference in November 1998 and summarised in a brochure entitled „Telekooperation in der öffentlichen Verwaltung" which provides guidelines for teleco-operation in public administrations.

German Research Network

In June 2000, the sector of science, research and education was provided with the so-called Gigabit Science Network (GWIN), the most modern Internet worldwide. This net is synonymous with superfast data transfer, new multimedia applications and worldwide connectivity, in short, Internet 2 in Germany.

Based on state-of-the-art optical fibre technology, GWIN has superseded the so-called Broadband Science Network (BWIN). During the initial phase, subscribers to GWIN will be provided with access with capacities of up to 2.5 Gbit/s, to be followed later by a large number of 2.5 Gigabit/sec channels.

The establishment of the Gigabit network was preceded by two Gigabit test-beds, in which it was demonstrated that new applications in science and research require transmission rates in the Gigabit range and in which the technological basis for the Gigabit network was developed.

An R&D programme was started to develop the applications in the GWIN. It has thus become possible, on the basis of a high-performance network infrastructure, to develop and give a lasting impetus to applications in science which will generate knowledge and experience about new network technologies and services. The Federal Ministry of Education and Research is spending DM 160 million on work to develop and install the German Research Network.

Intelligent Internet technologies

On the occasion of the CeBIT 2000 trade fair, the Federal Ministry of Education and Research introduced a new funding priority for developing *intelligent Internet technologies*, as a technological basis for future and new Internet applications. The scheme focuses on

– Ad-hoc networks and middleware
– Computer networks as well as the Internet consist of a multitude of individual networks which normally have certain tasks and functions assigned to them. In addition to these fixed network structures, performance of short-term tasks will in future increasingly require so-called ad-hoc networks and the incorporation of equipment, vehicles, machines and robots into existing networks or the Internet.
– Mobile agents
– The growing amount of information and services available on the Internet requires new search engines capable of compiling and independently processing information according to the specific needs of users in a time-independent manner. Such mobile agents will make using the Internet more simple and thus more effective.
– Internet protocols and service platforms
– In the foreseeable future, transfer, transport and processing of data on the Internet will require IP protocols with supplementary features which will have to meet different criteria depending on the intended type of use. The primary goal under this priority is to find new ways for simplified service integration into the Internet by enhancing, adapting or redesigning protocols and platforms.

Digital library[1]

The leading idea in the area of scientific and technical information / libraries is gradually to *build up a digital library* permitting fast and extensive access to the scientific information available worldwide. Funding focuses on the development of the Internet-based information infrastructure and involves improvement of overall conditions (standards) as well as start-up funding for a limited period of time in the following areas:

– Improvement of the scientific and technical information structure for the Global Digital Library (GLOBAL INFO)
– Development of the electronic publishing chain and creation of the necessary technical tools
– Electronic and multimedia publishing – upgrading and transforming scientific and technical books into multimedia knowledge representations (MULTIMEDIA-BUCH)
– Extension of the electronic information and document supply services of scientific libraries, especially upgrading of the German libraries' co-operative electronic document supply service (SUBITO), and expansion of the electronic library for natural science and technology at the Technische Informationsbibliothek Hannover (TIB QUICK 2000)
– Gradual development of interdisciplinary information networks offering knowledge from specialised information centres, libraries and other service providers, and, in particular, networking of the electronic information and full-text supply services of the Fachinformationszentrum Karlsruhe and the Technische Informationsbibliothek Hannover.

Basic funding for institutions forming part of the information infrastructure goes to the Fachinformationszentrum Karlsruhe (FIZ-Ka), the Fachinformationszentrum Chemie and the Technische Informationsbibliothek (TIB) Hannover.

Literature

– Annual reports 1994 to 1999 on the „Mikrosystemtechnik 1994 – 1999" Programme of the Federal Ministry of Education, Science, Research and Technology within the future-oriented information technology concept, VDI/VDE-Technologiezentrum Informationstechnik GmbH, Teltow;
– Botthof, W. Claußen, A. Schütze, H. Sturm: „Innovation durch Mikrointegration. Industrielle Anwendungen durch Systemintegration von Mikro-, Bio- und Nanotechniken", Teltow 1998;
– „Mikrosystemtechnik – Innovationen für das 21. Jahrhundert" (Microsystems technology – Innovation for the 21st century). Conference documents and exhibition catalogue, Bonn, 28 and 29 June 1999;
– Collaborative projects within the "Production 2000" framework concept (summary of results); project managing agency commissioned by the BMBF for production and manufacturing technologies: Karlsruhe Research Centre;
– "Produktion 2000 plus – Visionen und Handlungsfelder für die Produktion in Deutschland", (study report sponsored by the BMBF), published by Freundeskreis des WZL, Aachen, 1998, ISBN 3–000-003074-3;
– "Gestalten und gewinnen – im 21. Jahrhundert erfolgreich produzieren" (summary of the "Production 2000 plus" survey report); project managing agency commissioned by the BMBF for production and manufacturing technologies: Karlsruhe Research Centre, 1999;
– Programme brochure for the new BMBF framework concept for *Research for tomorrow's production processes*; announcements of ideas competitions run under this programme and other information can be found on the Internet under: www.bmbf.de-Förderung–Forschung– Neue Technologien–Produktionstechnologien or www.fzk.de/pft);
– LERNET competition: www.Lernet-info.de;
– Multimedia start-up competition: www.gruenderwettbewerb.de;
– MEDIA@Komm: www.dlr.de/it/mm/media@komm;
– Teleworking: "Telekooperation in der öffentlichen Verwaltung": www.bmwi.de/projekte/telearbeit/telekoop.html;
– POLIKOM guidelines: (www.iid.de/telekooperation/leitfaden);

[1] Cf. section 20

– final report on "Telearbeit im Mittelstand – Erfahrungen aus der Praxis": BMWi documentation No. 667;
– BMWi conference documentation "Medienkompetenz in Industrie, Handel, Handwerk und Dienstleistung", October 1999;
– Online Forum Telearbeit: www.onforte.de; legal framework: www.iukdg.de;
– Digital library: *Information as a raw material for innovation* programme: http://www.darmstadt.gmd.de/PTF; http://www.GLOBAL-INFO.org; http://www.subito-doc.de; http://www.tu-clausthal.de/idw/;
– Intelligent Internet technologies: http://www.der-grosse-sprung.de.

Info-Box

Lead project on *Man-machine interaction in the knowledge-based society*

Tomorrow's knowledge-based society will be characterised by systems of modern information and communications technologies permeating the professional and private lives of each and everyone of us. Consequently, more than in the past, it will be of decisive importance for each individual to be perfectly at ease with the multitude of new products and methods. However, everybody knows from personal experience that today's information technologies, which were originally developed by specialists for specialists, are often difficult for the non-expert to handle and require a great deal of detailed technical knowledge. If information technologies are to be used in society on a broad everyday basis, they need to be designed to meet human needs and reflect human patterns of thinking and working; in short, technology must be adapted to man, not the opposite.

Within their lead project on *Man-machine interaction in the knowledge-based society,* BMBF and BMWi are providing funding for research and development projects to design cross-sectoral, interdisciplinary systems solutions that lead to easy-to-operate, user-friendly equipment and services. In a two-stage selection process, six collaborative projects involving around 100 partners from universities, research institutions and industry were selected from 89 project ideas that had been submitted originally. Total funds for these six projects amount to over DM 320 million, of which just under DM 160 million in federal funds have been earmarked for a period of three to four years.

Research work focuses on issues relating to natural-language information input and output, visual representation of information, image processing, recognition of gestures and lines of vision as well as incorporation of the sense of touch and of motor sensibility to operate machines. Just as important as this work at the very interface between man and machine is the development of intelligent, networked assistance systems to which users can delegate routine tasks of information search and processing. Here it is important to take into account aspects of ergonomics, user acceptance and operating safety, as well as the impact of the use of the new technology on organisational structures and work processes both in business and in private households.

In the collaborative projects mentioned above, the research findings are tested in realistic application scenarios in various disciplines of engineering, such as mechanical engineering and facilities engineering, but also in the service sector and in private households, with each project having its own specific priorities in terms of methods and applications:

The goal of **SmartKom** – Dialogue-based Man-Machine Interaction, co-ordinated by the Deutsches Forschungszentrum für Künstliche Intelligenz GmbH, Saarbrücken (German Research Centre for Artificial Intelligence), is to develop intelligent communication assistants capable of interpreting and handling different natural input modalities. The most important application scenarios are
- a multimodal communication cell (SmartKom-Public) as an upgrade to today's public telephone booths;
- a mobile communication assistant (SmartKom-Mobil) as a user's permanent personal companion that enables him to access information at any time and in any place; and
- a personal computer workstation (SmartKom-Home/Office) that can also be used as a control centre for an networked residential environment.

MORPHA – Intelligent Anthropomorphic Assistance Systems, co-ordinated by EAI-DELTA GmbH based in Fellbach, is aimed at developing components and processes for communication, interaction and co-operation with intelligent mechatronic assistance systems. The practicability of the processes is evaluated and optimised in two application scenarios, the Mobile Manufacturing Assistant and the Housekeeping and Home Care Assistant, as well as in other areas.

INVITE – Intuitive Man-Machine Interaction for the Networked Information World of the Future, co-ordinated by ISA GmbH based in Stuttgart, aims at an intuitive, effective and flexible use of complex information worlds in two areas:
- intelligent product consulting agents and tools for intelligent information and product brokers in electronic commerce and online customer assistance (INVITE-Contact);
- Intranet tools for collaborative knowledge management, interactive creativity rooms („room ware") and software tools for intuitive 3D design of products with complex shapes (INVITE-Innovation).

The **ARVIKA** project – Augmented Reality for Development, Production and Servicing, co-ordinated by Siemens AG, Nürnberg, is pursuing the following aims:
- User-centred and application-oriented development and use of augmented reality technologies;
- product development in mixed real/virtual environments;
- flexible production (assembly) by means of information displayed on mobile visualisation units for workers on the line; and
- support for servicing tasks relating to the remote diagnosis, maintenance and repair of distributed machines and equipment (even on a global scale).

EMBASSI – Elektronic Multimedia Operation and Service Assistance; co-ordinated by Grundig Fernseh-Video Produkte und Systeme GmbH, Fürth; this project is intended to respond to the growing complexity of electronic appliances in private households by ensuring user-friendly, intuitive operability with the help of intelligent assistance systems. The technologies developed are implemented in representative pilot applications:

- Operating assistance for household chores, for example for programming and controlling the functionalities of domestic appliances or for use of the Internet;
- safe operation of information, communication and control systems in vehicles; and
- public terminal systems for easy operation by the disabled.

The purpose of the **MAP** project – Multimedia Workplace of the Future – co-ordinated by Alcatel SEL AG, Stuttgart, is to develop intelligent help and delegation systems that enable a user to delegate the collection, processing and evaluation of data to a multimedia workstation at the office, at a location away from the office or at home by using natural forms of communication. Time-consuming routine tasks are to be performed by software agents without any further intervention by the user, and the results are to be reported back and presented in a multimedia format.

Further information on this lead project can be obtained on the Internet under www.dlr.de/IT/IV/MTI

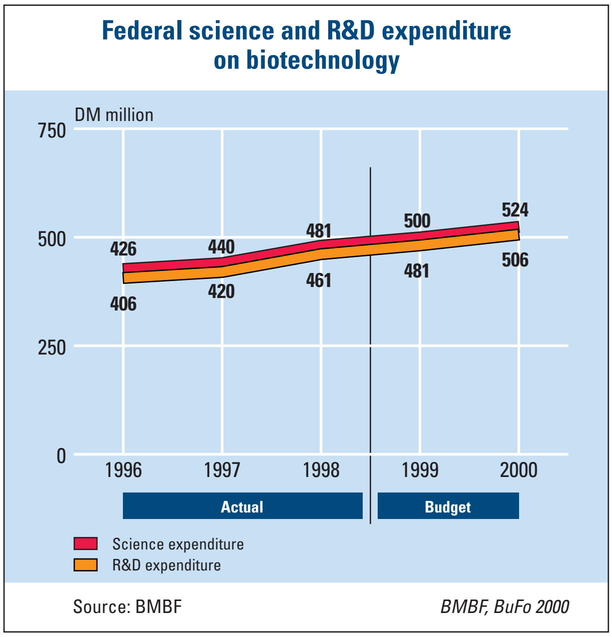
10. Biotechnology (Funding area K[1])

Biosciences will leave their mark on the 21st century. The authors of the DELPHI study on technological development, published in 1998, concluded that by 2020, biotechnology methods will be involved in approximately half of the 30 most important innovations worldwide. Therefore, funding biotechnology research is one of the central priorities in the Federal Government's research policy. The purpose of the Biological Research and Technology Framework Programme is to consolidate Germany's high level of performance in the biosciences and maintain it also for the new millennium, as well as to open up new potential for innovation. The programme centres on supporting innovation in biotechnology and genetic engineering, especially in areas overlapping with other disciplines, as well as on funding genome research and the reorganisation – with the help of biotechnology methods – of industrial production processes to make them sustainable.

Research policy objectives

The Federal Government's biotechnology research policy is aimed at maintaining and improving public health, ensuring responsible use of environmental resources and at safeguarding existing jobs and creating new ones. However, these goals can only be achieved if high standards in basic research are secured as a foundation for innovation, if efficient mechanisms are guaranteed for the transfer of technology from the research sector to specific applications and if an appropriate legal framework fostering innovation is put in place. The Federal Government attaches great importance to the acceptance of this approach by the general public. Structural measures in the field of biotechnology, which are expected to generate more employment, especially in small and medium-sized enterprises, have high priority. The promotion of young scientists through national and international programmes (for example groups of young researchers under the BioFuture programme) is an important contribution to maintaining high standards in the biosciences. All programme activities are designed to encourage the building of

Chart 42



[1] Partial overlap with other funding areas (see text).

networks between industry, universities and non-university research institutions in order to make better use of synergies.

Thematic priorities
BioFuture, BioProfile and BioChance Programmes.

Info-Box

BioFuture
The BioFuture funding programme provides younger national and international scientists experienced in research with the opportunity to break new ground in basic research in the life sciences by participating in independent working groups in Germany. The purpose of funding is to pave the way for grant winners towards a top career in scientific research or a promising start-up business. Up to now, 32 groups of young researchers have been selected from a large number of applications received in the previous three selection rounds. The average financial volume per group is DM 3 million over a period of five years.

BioProfile
The new BioProfile competition targets regions that match specific profiles in certain areas of modern biotechnology with particularly good future potential, with a view to focusing on their development. It is a deliberate policy of BioProfile also to give smaller regions the opportunity to compete successfully for available funds. After a process of preselection, the three best concepts will be awarded a prize in mid-2001. The intention is to provide this new funding scheme with DM 100 million over a five-year period.

BioChance
The new BioChance funding programme was launched in June 1999. Its purpose is to turn Germany's biotechnology sector into an internationally competitive industry. The provision of funds for young biotechnology firms conducting research activities that carry a high economic risk contributes towards the sustainable development of the German biotechnology industry and thus towards the creation and/or safeguarding of additional highly qualified jobs. DM 100 million have been earmarked for BioChance for a period of five years.

Proteome research
Based on the results of genome research, the focus of bioscientific research activities has been shifted towards the strategic exploration of the biological functions of all proteins present in a cell, an organ or an organism. This is the only way to gain an understanding of the complex processes that are vital to the development and treatment of diseases affecting plants, animals and humans, and that are indispensable if the synthesis potential of biological systems is to be exploited. Aspects of glycobiotechnology and modern natural substance research can play a crucial role in achieving this aim. Techniques and methods for the highly innovative field of proteome research are only available to a limited extent, even on an international scale. New interdisciplinary approaches are the only way to improve the technical and methodological conditions for protein analysis and develop them further with a view to automation and miniaturisation. The priority funding programme on *New efficient methods for functional proteome analysis* complements and supports the activities of genome research (DHGP, GABI, etc.), especially with regard to functional analysis, which, without investigation of the protein functions, would only advance at a slow pace. In the long term, it will be possible to decode large protein networks as well as signal and regulatory cascades and to make use of the results both for systematic studies in basic research and for the development of new therapeutic methods to treat diseases resulting from genetic transformations (e.g. new targets for polygenic diseases). This priority funding programme also strongly complements research and development activities in the health care sector (e.g. development of vaccines, gene therapy, Molecular Medicine lead project), which in future will have a solid basis to build upon.

Bioinformatics
The dynamic growth of the bioinformatics sector is a consequence of the rapid development of certain modern disciplines of the life sciences. Wherever large quantities of data arise that have to be correlated and placed in their proper context, it is indispensable to use methods of bioinformatics. Besides brain research and research into biological diversity, one of the current main fields of application is genome research. Even if sequencing of the human genome has almost been completed in 2000 and the sequencing of the most important model organisms (e.g. rat, mouse, zebrafish, puffer, rice) will be concluded in just a few years' time, a great deal of additional expertise in bioinformatics is needed for the work on the functional analysis (structure, function and interaction of cellular proteins), which is already starting now. There is reason to assume that due to the complexity of feedback systems in cells and organisms, all new issues of molecular biology will make it necessary to develop new methods of bioinformatics. The requisite high-performance bioinformatics tools will have to be developed by life scientists and computer scientists in interdisciplinary working groups. Other central goals include the creation of common bioinformatics standards, without which the integration and use of the knowledge gained would be problematic, and the implementation of infrastructural measures, such as establishment of new bioinformatics study courses to boost the number of young scientists in Germany.

Nanobiotechnology
Nanobiotechnology is an emerging field of scientific and technological opportunity which establishes links between nanofabrication and biosystems for the benefit of both disciplines. It is characterised by its high degree of interdisciplinarity and will boost co-operation between life sciences, physical sciences and engineering sciences. This enables researchers to gain new substantive insights into the functioning of biological systems. At the same time, nanobiology will lead to a completely new class of machines and systems produced by means of microtechnology and nanotechnology. Co-operation between industry and the research community in collaborative interdisciplinary projects is expected to create the basis for the application of this new technology. The possibilities opened up by nanobiotechnology should be used to bring about

innovations that improve the competitiveness of German industry and ensure a more responsible use of the environment and its resources.

Tissue engineering

The current state of knowledge in disciplines such as cell biology and cell culture engineering, molecular biology and biophysics makes it possible to venture into the field of biologically oriented tissue regeneration. A new field of research and application with enormous market potential is emerging from areas of overlap between traditional disciplines. Skin cell replacement alone is expected to offer a high market volume. In the innovative field of biological regeneration and tissue engineering, technological competence is generally and to an increasing extent generated by networked interdisciplinary research and development activities. The driving force behind the research discipline of organ regeneration and tissue engineering is the steadily growing demand for substitute tissue and organs. Industrial research and pre-competitive development projects are funded in order to translate existing biotechnology knowledge into specific applications. In the case of high-risk research projects, funds may be granted for technical feasibility studies. The intention is to develop and use biological matter for tissue reconstruction and hybrid tissue substitution at each of the three different levels of molecules, cells and tissue/organs. The funding is provided in a joint initiative with the Health Research Programme.

Sustainable BioProduction

As one of the key technologies for the 21st century, biotechnology has enormous potential for pointing the way towards environmentally sound, resource-saving economic management. Biological systems can make an important contribution to sustainability, since usually they preserve resources, save energy and avoid waste. In future, funding will primarily go to efforts to develop innovative and ecologically sound biotechnology production processes and products that, from the outset, prevent or minimise environmental pollution and thus make an important contribution to production- and product-integrated environmental protection.

German Human Genome Project (DHGP)

- Exploring the structure and function of the human genome;
- Creating the scientific basis for the diagnosis, prevention and causal cure of severe human diseases (e.g. cancer, dementia);
- Patenting and translating research results into innovative applications.

Plant Genome Analysis Programme – GABI

- Identifying the functions of the genomes of Arabidopsis, barley as well as selected genome sections of important crops;
- Using genomic information for applied research and breeding projects.

Food and Nutrition lead project

- Meeting quality requirements for foodstuffs right at the start of plant breeding;
- Preserving and/or reinforcing nutritionally relevant plant constituents.

Alternatives to animal experiments

- Development and validation of biotechnological alternative and supplementary methods with a focus on legally required animal experiments.

Biological safety research

- Scientific biological evaluation of open-air tests with transgenic plants and of
- Developing methods for crop monitoring;
- Research support for the release of genetically modified micro-organisms.

Results / Developments / Perspectives

German Human Genome Project (DHGP)

The second phase of funding (1999–2001) started in September 1999, focusing on the functional analysis of the human genome and the genomes of model organisms. Since the establishment of the patenting and licensing agency within DHGP in 1997, 30 projects have been registered. One of the encouraging results of this patenting campaign was that so far ten new companies have emerged from the DHGP process. To date, more than DM 100 million have been earmarked for the second phase of the DHGP.

Plant Genome Analysis Programme – GABI

The GABI programme was launched in October 1999. An industrial consortium for plant genome research, which to date comprises 25 firms, provides support for this research programme and finances the technology transfer, including the activities of a patenting and licensing agency. Approximately DM 50 million have been earmarked for the first funding phase (1999 - 2001) of the eight-year research programme.

Food and Nutrition lead project

With its Food and Nutrition lead project, the BMBF is providing funds for research on modern food production methods. An expert jury selected three pilot projects for funding from originally 45 proposals. The purpose of these projects is to find ways of removing harmful plant constituents (e.g. allergens) from vegetable raw materials and of optimising plant constituents for human consumption. The BMBF will provide a total of about DM 40 million for the three pilot projects over a five-year period starting in autumn 1999.

Legal framework

The amendment to Directive 90/219/EEC, adopted in late 1998 and to be transposed into German law through the Genetic Engineering Act, allows a more practicable approach to issuing permissions for laboratory work and permits exemption of safe applications. By contrast, the Common Position reached in June 1999 on Amending Council Directive 90/220/EEC on the deliberate release into the environment of genetically modified organisms places greater emphasis on safety aspects. In January 2000, the signatories to the United Nations Convention on Biological Safety adopted the so-called Biosafety Protocol for the protection of biological diversity in the case of cross-border movements of living modified organisms. Together with the DFG, the BMBF has started the Bioethics initiative in order to promote a constructive dialogue between scientists, politicians and the general public and to strengthen interdisciplinary research co-operation.

Funding structures

Every year, the Federal Government allocates approximately DM 1.5 billion to the promotion of research and technology in the life sciences. About DM 1 billion is spent by the BMBF and its subordinate agencies; this includes not only the resources appropriated for funding areas K and G (i.e. Biotechnology and Health), but also statutory funding for the Max Planck Society (MPG) and the Deutsche Forschungsgemeinschaft (DFG) (see section 1). At present, funds worth more than DM 350 million are provided every year for the Biotechnology 2000 Programme alone (including basic funding for the institutions of the Helmholtz Association and the Blue List which perform research in this field; see Part VI). This is complemented by activities in other funding areas which in some cases also deal with biotechnology issues. The BML spends about DM 100 million to fund research projects covered by funding area K. These include biotechnological research activities conducted at eight federal research institutes within the sphere of the BML as well as research into renewable raw materials.

In addition, it is important to mention ongoing international co-operation activities. The EU's Fifth RTD Framework Programme provides particular opportunities for biotechnological research. Other noteworthy activities include the work of the European Molecular Biology Laboratory (EMBL) based in Heidelberg, for which Germany provides funds of more than DM 20 million a year on a pro-rata basis (see Part V). Furthermore, there are numerous co-operative research projects with non-EU countries (e.g. Brazil, China, Indonesia, Israel, Russia), some of which come under the umbrella of post-doctoral programmes.

Literature

– Annual Report 1999; project managing agency for biology, energy and the environment of the BMBF and the BMWi (PT-BEO);
– Biological Safety; Proceedings of the BMBF Workshop held in May 1998; ISBN 3-89336-234-7;
– Informationsblätter Biotechnologieförderung; October 1999; PT-BEO;
– Funding of Biotechnology in Germany, May 2000, PT-BEO;
– Biotechnology for Clean Industrial Products and Processes; OECD Paris 1998; ISBN 92-64-16102-3;
– "Biotechnologie für umweltverträgliche industrielle Produkte und Verfahren"; November 1999; PT-BEO;
– "Science live – Wissenschaft im Dialog, Perspektiven moderner Biotechnologie und Gentechnik", April 2000, BMBF;
– "Biotechnologie – Basis für Innovationen", May 2000, BMBF.

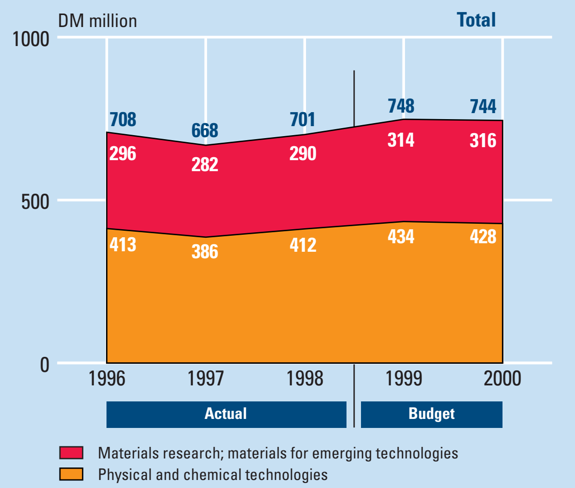
11. Materials research; physical and chemical technologies (Funding area L)

Innovative products and services are vital for further boosting the performance of German industry in global markets. Key technologies play a central role in this process. Research and development in fields such as physics, chemistry and the materials sciences – together with intelligent production processes – form the basis for the new technological developments of tomorrow. Success hinges on the rapid and efficient implementation of research results to stimulate the innovative drive of industry and especially of dynamic small and medium-sized enterprises.

This reorientation in research policy complements and enhances the classical instruments of basic funding of institutions and project funding. In addition to the greater fusion of individual topics into lead projects, more emphasis is now being placed on building competence networks between industry and the scientific community.

Chart 43

Federal R&D expenditure on material research; physical and chemical technologies



Source: BMBF *BMBF, BuFo 2000*

11.1 Materials research; materials for forward-looking technologies

The performance, competitiveness and acceptance of products and systems hinge on the type of materials used. Improved „traditional“ or completely novel materials are the basis for systemic innovation; they are the key to, and the driving force of, technological and economic progress. The BMBF has provided funding for materials research through its New Materials for Key Technologies of the 21st Century – MaTech Programme since 1994.

Research policy objectives

- To boost the competitiveness of German industry through innovative applications of new materials in key technology fields; to secure innovative capacity;
- To lend fresh impetus to co-operation between the various disciplines of natural and engineering sciences as well as between industrial and university or non-university research institutions;
- To support cross-sectoral co-operation through specific industry-led projects, with greater involvement of small and medium-sized enterprises (SMEs).

Thematic priorities

Production and processing of new high-performance materials for innovative applications in the following technology areas:

- Information technology (e.g. substrate and layer materials able to withstand high ambient temperatures; innovative storage systems); transport technology (e.g. innovative light-weight structures, adaptronics [„intelligent materials“]);
- Energy technology (e.g. high-temperature materials, heat insulators);
- Medical technology (e.g. biomaterials with improved tolerability);
- Production engineering (e.g. dry machining, ultra-lightweight engineering).

The aim is to demonstrate the technical suitability of new materials by providing support for collaborative research projects (co-operation between R&D partners from industry and research institutes/higher education institutions) as well as for user and demonstration centres and centres of excellence to ensure technology transfer to industrial.

Funding structures

The principal funding model is collaborative research, i.e. R&D partners from industry (project leaders) and from research institutes and universities sharing the burden of work in co-operative ventures. The programme is certainly also open to other models of funding, for example institutes involved in collaborative research under basic research projects or specialised projects, such as user and demonstration centres to support technology transfer to practical industrial applications. Institutions working in this area that receive basic funding include in particular the Jülich (FZJ) and Karlsruhe (FZK) research centres, the GKSS Geesthacht Research Centre and other Helmholtz centres and Blue List institutions (see Part VI, sections 2 and 4). The activities of the Bundesanstalt für Materialforschung und -prüfung (BAM – Federal Institute of Materials Research and Testing), which conducts research into the safety and reliability of materials and chemical technologies, and of the Physikalisch-Technische Bundesanstalt (PTB – Federal Institute of Physics and Metrology), which is responsible for ensuring standardised measurements and measuring methods and conducts research aimed at developing high-precision measuring technologies, are financed from the BMWi budget.

Results / Developments

Funding for materials research focuses on (interdisciplinary and cross-sectoral) applications in key technology fields. One outstanding example is the 3D-MID (Moulded Interconnected Devices) project financed under the *Information technology* and *Production engineering* funding areas: The results obtained from this collaborative project (18 partners) – the development of new, cheaper high-performance plastics and of new bonding agents (both conductive adhesives and low-melting solders) and of complete production engineering processes – have made it possible to integrate electronic components directly into plastic casings. These spatial injection-moulded circuit boards can be used for a multitude of shapes and can be instrumental in advancing product miniaturisation. They also help to save components, shorten the production process and ensure a greater degree of reliability (http://www.lpkf.de).

The collaborative projects are application-oriented and pursue medium- to long-term R&D objectives; they link the most important stages in the value chain and pool material resources.

Basic research and industrial development have become more interlinked, with a considerable increase in the number of small and medium-sized enterprises participating in the process of innovation (currently, 21 per cent of grant recipients are SMEs, while 47 per cent are research institutions, and 32 per cent large companies). (http://www.fz-juelich.de/nmt/nmt).

It has been shown that the use of new materials leads to greater resource efficiency, thus promoting environmental protection.

A special measure under the MaTech Programme is the establishment of user and demonstration centres that are dedicated to clear-cut thematic issues and tailored to industrial needs; this scheme is designed to eliminate obstacles to innovation and speed up the translation of research results into practical applications, while at the same time involving a greater number of SMEs in the innovation process. These centres cover the following subject areas (http://www.kfa-juelich.de/nmt/zus-zentren.htm):

- Machining new materials (Aachen, Jena, Zwickau);
- Innovative methods of polymer characterisation (Darmstadt, Dresden, Mainz);
- Surface treatment using inorganic and wet-chemical methods (Aachen, Saarbrücken, Würzburg);
- Biomaterials for medical technology (Aachen, Stuttgart/Tübingen, Ulm, Rostock);
- Nanotechnology (Tübingen/Saarbrücken; Dresden).

Other centres are currently taking up work or are scheduled to do so in future:

- Recyclability of new materials (Karlsruhe, Halle);
- Process simulation, materials modelling, component simulation (Freiburg, Aachen, Mainz);
- Materials for microtechnology (Ulm, Berlin, Karlsruhe);
- Medical technology (Hanover).

11.2 Physical and chemical technologies

In the field of physical and chemical technologies, new findings from basic research are processed and evaluated; promising approaches receive specific funding so that the results obtained can be prepared for innovative implementation in business and industry.

Research policy objectives

– To pool interdisciplinary R&D resources with a view to tackling selected technological problems in a comprehensive manner;
– To contribute to attaining sustainable development goals: waste avoidance, inherent safety in chemical processes and products, improved resource efficiency and energy productivity;
– To speed up the translation of new findings of basic research into broad-based technological and industrial applications;
– To integrate nanotechnologies strategically into an overall interdisciplinary concept;
– To develop strategies to take advantage of the wide range of applications and the innovative potential of optical technologies.

Thematic priorities

Chemical research

– Catalysis;
– Combinatorial catalysis and materials research;
– Microreactor systems in chemical engineering;
– Chemistry of nanoscale systems;
– Molecular surfaces;
– Innovative materials conversion.

Physical research

– Superconductivity;
– Nanotechnology;
– Plasma technology;
– Electronic correlation and magnetism;
– Non-linear dynamics.

Laser research and laser engineering

– Diode lasers: more efficient laser methods through direct application of high-power diode lasers;
– New applications through ultra-short pulse lasers , VUV lasers.

Funding structures

The principal funding model is collaborative research, i.e. R&D partners from industry (project leaders) and from research institutes and universities sharing the burden of work in co-operative ventures. The programme is certainly also open to other models of funding, for example institutes involved in collaborative research under basic research projects or specialised projects, such as user and demonstration centres to support technology transfer to practical industrial applications. Institutions working in this area that receive basic funding include the Jülich (FZJ) and Karlsruhe (FZK) research centres and other Helmholtz centres and Blue List institutions as well as some Max Planck and Fraunhofer institutes. The Physikalisch-Technische Bundesanstalt (PTB – Federal Institute of Physics and Metrology), which is responsible for ensuring standardised measurements and measuring methods and conducts research aimed at developing high-precision measuring technologies, is financed from the BMWi budget (see Part VI).

Results / Developments

Chemical research

Within the Chemistry Dialogue, particular emphasis was placed on the theme of sustainable chemistry, for which an expert body was constituted in 1999 to take stock of the situation and prepare specific recommendations directed both at the BMBF (covering the areas of education and teaching as well as research and development) and at the organisations participating in the Chemistry Dialogue.

Two funding priorities, the Microsystems Technology 1994–1999 Programme and in particular the *Microreactor systems in chemical engineering* funding scheme, were instrumental in giving German research institutions a leading international position in the field of chemical production with the help of microstructured reactors. A similar thrust is likely to be provided by the recently launched scheme for competence networks in combinatorial catalysis and materials research (http://www.dechema.de/englisch/fue/microrea/pages/f_micror.htm).

Structural measures that support the building of networks have proved to be valuable particularly in the case of newly emerging scientific issues. Internet forums and project and partner finding workshops have not only produced numerous contacts between research institutions interested in the same subjects, but have also helped to elaborate the subject matter of new research co-operation projects, for example in the fields of sonochemistry, microreactor engineering, combinatorial chemistry and supramolecular systems (http://www.dechema.de).

Physical research

The *Knowledge transfer in surface machining* project was launched in 1999 to give German industry better access to existing and expected potential of modern surface machining. The project goals are to speed up innovation, transfer knowledge and improve effectiveness in order to boost competitiveness and technological performance. The project targets in particular innovation-oriented small and medium-sized enterprises.

The area of *plasma technology* comprises research into the basics and applications of low-temperature plasma technology. Here, research activities cover novel approaches to plasma generation and analytics, such as new atmospheric pressure plasma sources or pulsed plasmas. Funding is also provided for the development of new plasma technology applications, such as plasma applications in the textile industry, purification of combustion engine exhaust gases and plasma ignition systems, sterilisation of food packaging using plasma, novel plasma chemical processes or gas discharge lamps.

In the field of *high-temperature superconductivity*, most technically relevant fundamental issues have been adequately resolved. Funding now focuses on demonstrations of industrial applications in the fields of power engineering, sensor systems, and high frequency engineering, taking into account the necessary cooling systems technology. Within the general framework of the lead project competition designed to generate *Innovative products on the basis of new technologies*, funds have been allocated to a project on *Superconductors for the communication technologies of the future*.

The purpose of the project is to design far smaller, lighter and more powerful components for communication systems in satellites. In mobile telephony, superconductors represent a superior technology that allows a higher channel loading density or a reduction in transmitter power.

Funding in the area of *Electronic correlations and magnetism* increasingly targets application-oriented problems of magnetism. The *Magnetoelectronics* lead project also comes under this category. Other projects in this field are also based on the giant magnetoresistance discovered by German and French scientists and patented in Germany. Planned applications range from non-volatile, high-density computer memories (MRAM) to novel active electronics systems that use the magnetic moment of electrons as an additional degree of freedom. Far from being confined to information technology, magnetoelectronics also offers potential for innovation in the sectors of mechanical engineering, automotive engineering and sensor systems, all of which are thriving in Germany.

As a result of the newly discovered access to individual components of matter and the growing understanding of the self-organisation of matter, *nanotechnology* has attained a fast pace of innovation worldwide. The first product groups have been launched onto the world market. As well as for collaborative projects, BMBF funding is also being used for the establishment of six centres of excellence focusing on ultrathin functional layers, application of nanostructures in optoelectronics, development and use of lateral nanostructures, chemical functionalisation of nanostructures, ultraprecise measurements and nanostructure analysis, with a view to ensuring optimum translation of nanotechnology knowledge into products, manufacturing processes and services.

Due to their inherent non-linearities, many natural and technical systems have highly complex properties. Over the last few years, *non-linear dynamics* has developed from what used to be a special discipline of mathematical physics into a discipline which increasingly influences technological research, with beneficial effects on areas such as process control, early fault detection, image processing and traffic control, to name but a few (see also under: http://www.vdi.de/tz-pt/tz-pt.htm).

Laser research and laser technology

The LASER 2000 funding concept and all its priorities are consistently being implemented. The results of the co-operative project on the *Qualification of laser processes* provide the basis for using standardised process controls for laser weld seams to tap the huge innovative potential of laser welding for a wide range of industrial applications, also in the field of state-regulated reviews of weld joints (e.g. in shipbuilding, structural steel engineering and pressure vessel construction).

A new generation of highly effective lasers based on high-power diode lasers is being explored in the *Modular diode laser systems (MDS)* lead project. MDS is an efficient network of 15 firms and six institutes (laser manufacturers and users) that use prototype applications (separation, joining, surface machining) to open up the full potential of direct application of high-power diode lasers in materials machining. First success: demonstration of deep welding using high-power diode lasers.

This lead project is complemented by the *NOVALAS* co-operative network designed to bridge the gap between basic research into high-power diode lasers (Phase I) and their application in industry. Here, research work centres on new concepts for high-power diode laser structures, diode-pumped solid-state lasers and microoptics (http://novalas.fhg.de).

Based on the results of a contest, the field of *femtosecond technology (FTS)* is receiving large-scale funding to prepare the practical application of ultra-short pulse lasers. FST is being applied in ultra-precision materials machining (e.g. microjets), in medicine (odontology, audiology and ophthalmology) and metrology (e.g. coherence radar) in five networks each consisting of a number of research institutes and companies.

In the area of *Laser biodynamics*, four collaborative projects are aimed at creating laser-based (nano)tools for representing biological processes or the interrelation of functions at the cellular level. This opens up entirely new possibilities for research (e.g. repair of cellular dysregulation), diagnosis (e.g. early cancer detection) and therapy (e.g. patient-specific medication).

The *Laser-based ultra-precision systems – 157 nm-lithography* collaborative industrial project, which is funded on a cross-programme basis, marks the building of a European network, which gives Germany the opportunity to secure a substantial share in the highly competitive international electronics market.

The purpose of the collaborative industrial project on *Innovative light-weight engineering based on reduced-energy joining technology using the latest generation of laser systems (LEICHTER)* is to exploit the potential of diode-pumped solid-state lasers for joining innovative light metal structures for resource-saving ground transportation.

The nationwide network of *Testing and consulting centres (EBZ)* for promoting the spread of laser applications in SMEs and craft business has been successfully established (about 2,500 tests/consultations between 1996 and 1999) and is currently being turned into a self-supporting organisation operating independently of federal funding (http://www.lasernetze.de).

More information on laser research can be obtained under http://www.vdi.de/technologiezentrum

Literature

– BMBF paper „The Chemical Sector in Germany“, Progress Report 1999;
– BMBF-brochure „Plasmatechnik – Prozessvielfalt + Nachhaltigkeit“, 2000;
– BMBF brochure „Supraleitung, Bilanz und Perspektiven“, 1998;
– BMBF brochure „Nanotechnology 1998“;
– BMBF brochure „Laser – ein Schlüssel aus Licht“, 1998“.

INFO-BOX
OPTICAL TECHNOLOGIES FOR THE 21ST CENTURY

In the coming century, optical technologies will become enabling technologies sparking innovative technological developments in virtually all relevant areas of social life, thus contributing to the solution of important problems. In the USA, this subject has already been dealt with in depth and documented in the COSE Report on Harnessing Light published in 1998. In Germany, too, associations and organisations from industry and the scientific community have arrived at the same conclusion:

In the next century, the photon will complement, and in some areas supersede, the electron as the driving force of technological progress.

To enable Germany to respond appropriately to the implications of this prediction, a strategy process controlled by an industry-led co-ordination body and co-funded by the BMBF looks into the role of optical technologies in the context of conditions and requirements prevailing in Germany. The aim is to develop strategies for the full future use of the wide range of applications and the innovative potential of optical technologies.

Based on the results of two successive series of workshops, a German Agenda on Optical Technologies for the 21st Century was drawn up and subsequently presented to the expert community at a conference held in May 2000. Subdivided into eight priorities, the Agenda contains recommendations for action by industry, the scientific community and politicians, which are at present being evaluated by these groups (http://www.optischetechnologien.de).

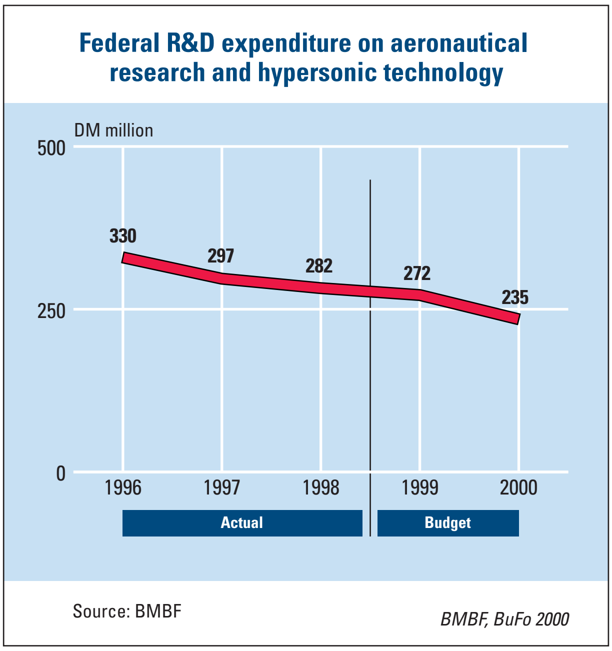
Optical technologies have a bearing on several of the BMBF's funding priorities, and necessary funding activities are being identified, taking due account of the principle of subsidiarity. Four urgent funding measures, including the establishment of *Competence networks for optical technologies*, will be launched as early as 2000 (http://www.OptecNet.de).

12. Aeronautical research (Funding area M)

In an age of globalisation, mobility is unthinkable without aviation. Air traffic will continue to grow, at a rate of 5 to 7 per cent a year according to current forecasts. However, the rise in air traffic must not result in a rising burden on people and nature. For this reason, the strategic tasks of funded technology projects in the field of aircraft construction target not only economic aspects, but also aim to break the link between growth in air traffic and growth in pollution, and to cut noise levels near airports.

Major mergers in the world's aeronautical industry and new products will further intensify competitive pressures in the coming years. In addition to the integration of aviation into European structures, the objectives for the next few years include innovations and new technological developments, such as the planned megaliner. The Federal Government is continuing the programme of civil aeronautical R&D with targeted lead concepts until 2002. Further Federal Government measures in the field of aeronautical research are supplemented by the basic funding from the BMBF for the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre) and by specialised programmes funded by the Federal Ministry of Transport (BMVBW).

Chart 44



Research policy objectives / funding structures

The overall Federal Government programme in the field of aeronautical research comprises the following elements:

- Civil aeronautical research programme of the BMWi;
- International co-operation on wind tunnels;
- Basic funding for the DLR provided by the BMBF and the Federal Ministry of Defence (BMVg);

– Specialised programmes of the BMVg and the BMVBW.

Federal funding totalling DM 600 million was allocated to the civil programme on Aeronautical Research and Technology 1995-1998; in addition, the aeronautical industry shouldered at least 50 per cent of the costs it incurred. This resulted in a programme budget of around DM 1.2 billion, enabling the German aeronautical industry to build on the competitive technological position it had established through more than 20 years of European and international co-operation. The specialised programme of the BMVBW provided roughly DM 7.5 million in the same period for studies and developments in air traffic safety. Further to this, the specialised programme of the BMVg amounted to around DM 420 million from 1995 to 1998 and formed part of the Defence Research and Technology funding area (cf. section 23). In 1999, the BMWi allocated DM 98.7 million and the BMVBW DM 1.9 million to aeronautical research. The BMVg earmarked DM 221 million for its aerospace research in 1999.

The Federal Government's integrated overall programme aims

– to enhance the technological competence of the German aeronautical industry and of the relevant research establishments and institutes and to strengthen their position in European co-operation with a view to helping to maintain Germany's competitiveness as a high-tech country,
– to support corporate co-operation within Europe and thus improve the competitiveness of European firms on world markets, and
– to maintain the industrial base to help to meet the needs of the air force within a framework of international co-operation and division of labour.

Thematic priorities / results / developments

Results of the Federal Government's civil aeronautical research programme 1995–1998

The aeronautical research programme from 1995 to 1998 was adopted and successfully implemented in a difficult economic phase for Germany's aeronautical and component supplier industry. Firstly, the research system was structurally improved with more targeted support involving closer co-operation between the system providers, the equipment suppliers of the aeronautical industry and the scientific world. Secondly, the support given to the companies produced a boost to technology. Successful examples in the case of the megaliner are the development projects for the fibre-carbon wing, for electronic flight control, for fuselage technology and for on-board systems. In the helicopter and propulsion field, the research work on cutting noise and on low-pollution combustion chambers has made an impressive contribution towards reducing damage to the environment. As a result, the German companies have gained a substantial competitive edge which can be utilised in the course of the European integration of the aeronautical industry to develop opportunities to obtain new packages of work in the future.

The BMWi's civil aviation research programme 1999–2002

Following the formation of the new government in autumn 1998, responsibility for civil aviation research shifted from the BMBF to the BMWi on 1 December 1998. A resolution by the Bundestag in June 1999 stipulated the following federal priorities for aeronautical technology:

– Megaliner and next-generation aircraft: in particular, technologies for a long-range subsonic aircraft larger than the Airbus A340 and the upgrading of 70-200 seater aircraft, via studies and developments in the fields of aerodynamics and control systems for the wings, the deployment of new materials (e.g. CFCs, weldable aluminium alloys), joining processes in the fuselage, new on-board systems and design methods, etc.
– Low-noise all-weather helicopter: studies and developments for a low-noise rescue helicopter with all-weather flight capability, as well as the research priorities of new rotor and avionics systems, etc.
– Efficient and environmentally friendly propulsion: further development and study of the main components of the compressor, combustion chamber and turbine: the aim is to reduce NO_x, CO_2 and noise emissions by deploying new materials, calculation methods, component and process design, by linking and monitoring systems, and by using economic manufacturing processes, etc.

Federal funding totalling DM 240 million has been earmarked for the 1999–2002 period.

In order to assist the European aeronautical industry's efforts at integration, the Federal Government has worked hard to ensure that greater priority is given to aeronautical research in the Fifth Framework Programme for Research of the European Union. The key action entitled New perspectives for Aeronautics has been allocated € 700 million (DM 1.37 billion). The German aeronautical and component supplier industry, along with the scientific institutions, have made intensive use of this (1st and 2nd call).

Wind tunnels

Following the completion of the commissioning and calibration work in 1999, the initial operational phase of the European Transonic Wind Tunnel in Cologne-Porz, Germany (cf. Part V, section 1.3.13) will take place in international co-operation on a cost-sharing basis up to 2003.

Specialised BMVBW projects

In the context of the further development of rules on the construction and testing of aeronautical equipment, the BMVBW funds measures to improve air traffic safety and environmental compatibility. Research is also commissioned to support policy decisions on aviation. Here, key issues include safety aspects of aeronautical equipment (e.g. for new airship developments), flight operation procedures, new flight control and navigation systems (e.g. Galileo), a reduction of noise and exhaust emissions and questions relating to global alliances in air transport.

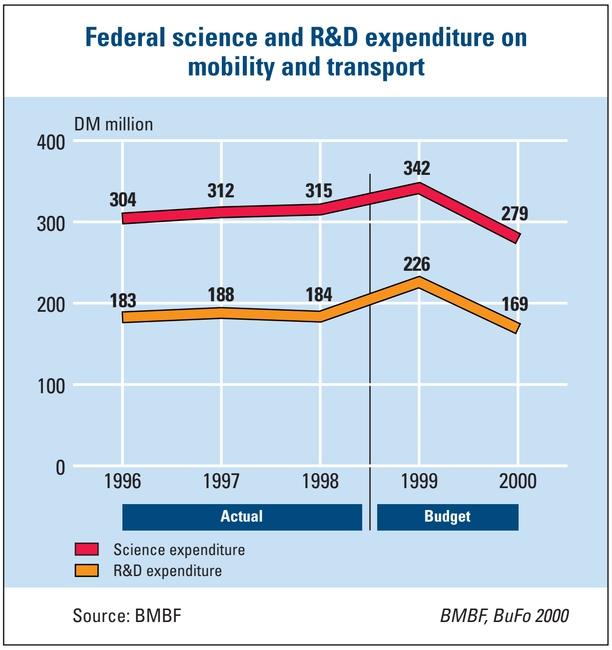
Literature

– BMWi/BMBF brochure: STEIGFLUG–Bericht zum Luftfahrtforschungsprogramm, 1998;
– BMBF brochure: Umweltschonende Antriebe (Engine 3E – 2010);
– BMBF leaflet: Atmosphären- und Triebwerksforschung zum Schutz der Umwelt;
– BMBF leaflet: Fluglärmminderung;
– Summary of results of the Federal Government's aeronautical research programme 1995 – 1998.

13. Research and technology for mobility and transport (including transport safety) (Funding area N)

In March 2000, the Federal Cabinet adopted the new *Mobility and transport* research concept for a future-oriented policy on mobility research. In expanding the existing concept of 1996, it is also setting new priorities in research into mobility and transport. This research initiative is intended to support transport policy as it endeavours to resolve those problems caused by a level of traffic which is increasingly meeting its economic, ecological and social limits. The problems are no longer merely the limited capacities of the current transport infrastructure, or the ecological and health aspects, but also include the ability to finance ever more costly transport projects. Whilst the new *Mobility and transport* research concept is more fundamental and long-term in nature, the departmental research of the Federal Ministry of Transport, Building and Housing (BMVBW) covers the many needs for short-term and medium-term information.

Chart 45



The increasingly complex challenges in the transport sector have shown that support for research must not be restricted solely to technological developments and improvements in rail and road traffic. Rather, the policy objective of linking the modes of transport necessitates an integrated approach and co-operation between different policy fields and areas of expertise, as well as early involvement of the future users. If the mobility and transport needs are to be realised in an optimal way in a seamless transport system, it is therefore also necessary to give consideration to organisational, structural and social innovations.

Research policy objectives

Ensuring ecologically and economically sustainable and socially acceptable mobility in the context of a modern, viable transport system involves more than the mere continuation of existing transport structures. In the interplay of the various modes of transport, mobility must be ensured, but at the same time the volume of traffic and particularly the overall burden from traffic must be appreciably reduced, and environmentally friendly resource-saving modes of transport must be used to a greater extent. In view of the limited scope to expand the existing transport systems, on the other hand, the existing transport infrastructure must be used better and designed in a safer and more efficient manner in order to cope with the transport problems. Here, a key role will be played by the comprehensive and intelligent use of new information, communications and guidance technology. The utilisation of the emerging potential of information and communications technologies will in future enable transport users to select the optimal mode of transport in each situation – not least in view of environmental compatibility. Here, greater attention must be paid in particular to the transport needs of elderly people, children and the disabled.

This sort of sustainability-oriented concept is intended to boost Germany's international competitiveness on a lasting basis, to safeguard existing employment and to create new, future-oriented jobs in the transport sector.

Thematic priorities / developments / results

Departmental research by the BMVBW in the field of transport

The content and scope of the departmental research done by the BMVBW is largely determined by topical questions and problems and by ongoing departmental work. The BMVBW commissioned research projects, studies and expertises on the following transport issues during the period covered by this report:

Further development of the transport infrastructure planning instruments and studies into the implementation of the current requirement plan acts:

- Traffic forecast 2015
- Development of the North Sea area up to 2015
- Alternative development scenarios
- Assessment basis in terms of nature conservation
- Regional planning requirements
- Berlin – Warsaw, Berlin – Wroclaw railway corridors
- Urban development potential and transport infrastructure projects

Part III

– Large-scale studies of traffic and the transport sector with regard to various road-building schemes
– Feasibility studies into the private-sector funding of transport routes on a BOT basis.

Intermodal transport
– From road to sea (short-sea shipping)
– Traffic guidance systems for freight handling railway stations
– Terminal concept for integration of inland waterways
– Intermodal transport in logistical process chains.

Optimisation of use of transport routes
– Potential impact of transport telematics.

Traffic safety
– One-way streets and bicycle traffic
– Young drivers
– Children and traffic
– Fire safety in transport tunnels.

Air traffic
– Aircraft noise, helicopter noise
– Aeroengine exhaust emissions
– Aircraft emissions and the Kyoto Protocol.

Improvement of urban transport
– Quality campaign in local public transport
  • Nation-wide electronic timetable information (DELFI)
  • Enhancing attractiveness of local rail passenger transport
  • Automatic ticket price information for local transport
  • Marketing in local transport
  • Urban buses in middle order centres
  • Flexible services
– Shop opening hours and volume of transport
– Integration of cycle lanes into urban traffic
– Inline skaters in road traffic.

The following fields were also studied as additional specialised topics:
– Introduction of a distance-related autobahn use charge for heavy lorries
– Studies into the Fehmarnbelt fixed link.

Research promotion by the BMBF

New solutions are being developed and tested via a range of existing project networks, for example in the *Mobility in conurbations* lead projects:

Improving the transport situation in conurbations is a particularly urgent task. Here, highly diverse mobility requirements compete in a small area with the demands of the residents for quality of life. In spring 1998, a body of experts evaluated a contest for ideas and selected five project proposals to receive support from the BMBF. The lead projects *WAYflow* (Frankfurt/Main), *StadtInfoKöln* (Cologne), *Mobinet* (Munich), *Mobilist* (Stuttgart) and *InterMobil* (Dresden), involving funding of roughly DM 150 million, are important and practical milestones towards a sustainable design for urban mobility. Here, broadly funded solutions for the respective conurbations are developed, tested, and reviewed to ascertain the extent to which they can be transferred to other areas. They range from new intermodal traffic guidance and information systems to concepts of new privately run intermodal transport services and longer-term measures of settlement and urban development planning.

The challenging objectives of *conserving the environment and resources* can only be attained by a targeted linking of all research activities to cut emissions in transport, from materials and energy research through to information technology. Here, the aim is both to make greater use of the potential of conventional propulsion methods and to develop future vehicle and propulsion concepts.

A *contest for ideas on minimal emissions* launched by the BMBF resulted at the end of 1998 in the selection of more than 25 collaborative and individual projects to be funded with a total of more than DM 45 million. Here, the focus is not least on cutting emissions of particulates and NO_x on the engine and exhaust side, on developing viable alternative propulsion concepts with electrical and hybrid engines, and on fuel-cell and gas-driven propulsion. The selected noise-reduction projects primarily involve solutions for rail vehicle chassis, but also noise reduction concepts for roads.

New Mobility and transport research concept

In the context of the new *Mobility and transport* research concept, support is given to research and development work – oriented towards the above-mentioned programmatic objectives – which is intended to optimise intermodal interfaces and reduce interchange friction between different modes of transport, and which points to ways to facilitate and optimise the choice of mode of transport and use of the existing transport infrastructure for passenger and freight traffic.

This covers the following overarching priorities:

The intelligent transport network

The introduction of computer technology in all areas of the transport system with the aid of telematics represents the next fundamental systemic innovation in the transport sector. In an integral information and communication system covering all modes of transport, it is possible, for example, to minimise the consumption of resources and the duration of travel, and to further improve safety via support for drivers in road traffic and automatic operational guidance and monitoring systems in public transport. In addition to the use of computers in road, rail and local public transport, this aspect also involves intermodal information and communication networks and the development and testing of new information and communication-based mobility services.

Against the trend: more freight by rail

To achieve the intermodal networking of freight transport, new components are needed to establish seamless rapid links in combined transport, as well as enhanced compatibility between vehicles, loading units and handling systems. Further approaches are intermodal networking, particularly in the field of rail-borne freight, via freight logistics and fleet management with alternative forms of co-operation in urban, regional and supraregional transport. The promotion of selected projects from the field of *flexible transport chains* shows the extent to which road freight can be shifted to rail.

Rail and buses: faster and more comfortable

In addition to the current lead projects on *Mobility in conurbations*, enhanced transport and interchange technologies can be achieved by vehicles which are more energy-conserving, more environmentally friendly, more comfortable, more efficient and cheaper in both local and long-distance traffic. This includes new alternative systems for local and regional transport, and technologies to improve the interchange between different modes of public transport and between collective and individual transport.

Responsible approach to health, environment and resources

A sustainable and socially acceptable development of transport must take the form of a closed cycle which largely minimises the transport-related consumption of material and energy and the emissions. In the *Quiet transport* funding priority, the health-related problems of traffic noise across the whole spectrum are investigated in detail, building on the current activities. Similarly, the improvement of energy efficiency in all modes of transport will in future shift further to the forefront of the BMBF's funding activities, as will the development of alternative transport system components such as carbon-free or low-carbon energy chains.

Transport safety: an ongoing task

The *Safe roads* project network has introduced an initiative which particularly aims at increasing the safety of the system by broadly introducing telematics and microelectronics, not least on the railways. Also, promising ideas to reduce accidents involving serious injuries are to be implemented in future; the same goes for the development of passive and active safety systems to protect the weaker transport users.

Understanding mobility better

The better we understand the links between the causes of mobility, the creation of traffic and its consequences, the sounder the transport-related decisions made by industry and government will be and the more effective the information and education measures aimed at developing responsible attitudes to traffic. The envisaged work will concentrate on surveys specific to modes of transport and target groups, and will aim at greater awareness of the factors influencing individual decisions and individual mobility. The intention is also to develop processes to cope with mobility bottlenecks and traffic problems on the spot, e.g. by testing new forms and possibilities for recreational traffic. Finally, work is planned to improve the foundations of transport science in the form of situational analyses, scenarios and models, e.g. to promote the social acceptance and sustainability of planned innovations or to analyse the causes and background of barriers to innovation.

Literature

– BMBF brochure: "Eckwerte einer zukunftsorientierten Mobilitätsforschungspolitik; Forschungsrahmen der Bundesregierung", April 1997;
– BMBF brochure; "Leitprojekte Mobilität in Ballungsräumen", April 1998;
– Federal Government *Mobility and transport* research concept, March 2000;
– Information on current and planned BMBF project networks on the home page of the project co-ordinating agency, http://www.tuev-ptmuv.com.

14. Geosciences and raw material supplies (Funding area O)

The subject of this research discipline is "System Earth", and it examines the processes occurring inside and on the surface of the planet as well as the interactions between the geosphere, hydrosphere, biosphere, cryosphere and atmosphere subsystems.

14.1 Geosciences

Research policy objectives

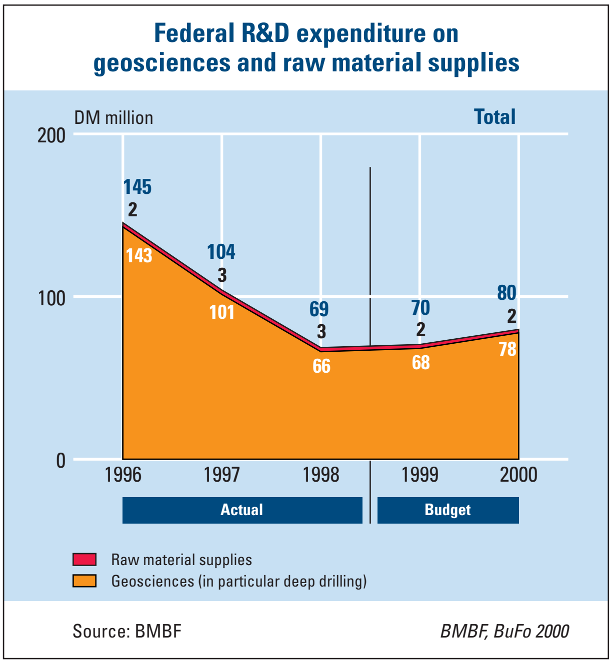
The objective of the research is to understand processes and their interactions and to estimate human impact on natural cycles, and, on the basis of this understanding of systems and processes, to arrive at an approach to earth management. Here, safeguarding resources and using them in a way that spares the environment plays a central role.

Thematic priorities / funding structures / results / developments

Basic geoscientific research

The work focuses on the following topics: (1) remote sensing, (2) the dynamics of the lithosphere, (3) tomography of the earth's crust, (4) causes and effects of global climate changes, (5) establishment of early warning systems, (6) development of information systems and (7) modelling of geoprocesses. In addition to an increasingly application-oriented approach to studies, there is also greater involvement in national and international programmes.

Chart 46



Geodesy and remote sensing

The Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI – Alfred Wegener Institute for Polar and Marine Research) has been able to reveal recent crust movements around the Antarctic Peninsula to a precision of a few millimetres, not least by using satellite-based remote sensing. Relative movements with shifts from local to up to 1 cm/a were documented.

The sets of data from the ERS-1 and ERS-2 European research satellites provided important information about ice-dynamic processes and the distribution of Antarctic ice masses. Selected examples were used to test remote sensing methods, providing information about the horizontal and vertical movement of the ice shelves. It was possible to substantially refine digital relief models. The remote sensing methods and processes are to be extended to cover the entire sixth continent, in order to facilitate understanding of the interactions between ocean, ice and atmosphere and to obtain reliable information for modelling the global climate.

Geodetic research at the GeoForschungsZentrum Potsdam (GFZ – Geoscientific Research Centre) aims at the local examination of the earth's crust and the global sensing of geological provinces. Extended GPS networks for precise positioning by satellite are stationed in Chile, in Central Asia (Pamir) and in Indonesia for the study of crust movements and deformations at continental margins. Together with the German Aerospace Centre, the GFZ operates a mobile antenna for SAR (synthetic aperture radar) interferometry. The aim is to use this radar process to measure the spatial deformations on the earth's surface. Further work is also being done on the development of sensors for the exploration of deposits and for environmental monitoring.

R&D co-operation

The development of a small geo-satellite (CHAMP, challenging microsatellite payload for geophysic research application) is being continued by the GFZ in co-operation with German industry. The positioning of the artificial satellite in a geostationary orbit is planned for 2000, in order to conduct continuous measurements of the earth's magnetic and gravitational fields and to register atmospheric parameters. A deployment of the CHAMP concept for the GRACE (gravity recovery and climate experiment) satellite, built under contract by German industry, has been contractually agreed.

TRANSALP

Studies of the dynamics and structure of the lithosphere of the eastern Alps have been continued by the GFZ and the University of Munich in co-operation with Austrian, Italian and German partners. Geophysical measurements and tectonic studies along a north-south transect are of importance for understanding the formation of hydrocarbon deposits and for an enhanced risk assessment of the seismic potential of this region.

International Continental Drilling Programme (ICDP)
The ICDP was launched in 1996 with German, US and Chinese participation and is co-ordinated by the GFZ; several deep drilling projects were completed under the programme in 1999 (Lake Baikal, Siberia; Long Valley Caldera, California), a drilling on Hawaii of up to 3000 m depth was continued, and other future drillings (Dabie Sulu, China; Chicxulub, Mexico; San Andreas Fault, USA; Gulf of Corinth and Crete, Greece) were prepared. Long-term observatories register processes in the various geological environments. In the KTB Deep Seismological Lab (Oberpfalz), a wide-ranging experiment (VSP) with a high-definition 3D survey of the drilled suture zone was conducted. For 2000, a hydraulic experiment is being prepared which will explore the mechanical properties of the crust in the transitional area from brittle to ductile deformation at 9000 m depth, as part of the collaborative research centre studying the *Rheology of the earth*.

Geothermal energy
Studies in 1999 concentrated on the Hot Dry Rock Project located at Soultz-sous-Forêts (Alsace, France), where the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources) and the Geowissenschaftliche Gemeinschaftsaufgaben (GGA – Joint Geoscientific Research Institute), in co-operation with universities and small and medium-sized companies, are continuing fundamental studies into the extraction of geothermal energy from crystalline rock.

Seismological and volcanological research
As the German contribution to the UN International Decade for Natural Disaster Reduction (IDNDR), the GFZ and the BGR created a historic earthquake catalogue for the countries of the EU and eastern Europe. Furthermore, the BGR is developing a monitoring station to provide insights through long-term studies into chemical changes in emissions and changes in seismic signals prior to periodically recurring eruptions; it is based at the Galeras volcano, Colombia, a high-risk centre of eruptions. Together with the Seismological Office of the People's Republic of China, the BGR is developing a measurement scheme for long-term observations in the Yanquing earthquake zone in the north of China.

Geoscientific marine research
Research operations using the SONNE research vessel, with equipment carriers from the trilateral (Germany, France, UK) agreement and other foreign (particularly Russian) vessels, submersibles and deep-sea robots, primarily aim to clarify geoscientific questions in the marine environment. The activities are focused on

– the exploration and study of minerals and fossil fuels, not least with consideration of environmental aspects (deep-sea mining, release of greenhouse gases),
– the quantification of distributions and flows of materials,
– biogeochemical processes in the near-surface sediment, the water-sediment boundary layer and the water column near to the bottom, and
– petrological issues.

International Ocean Drilling Programme (ODP)
The ODP is in its third phase and will be replaced by the IODP from 2003. The priorities on the German side continue to be the study of the make-up of the oceanic crust, sedimentological studies, particularly into palaeoclimatology, and the further development of technical apparatus and measuring equipment. Since 1999, the international co-ordination office has been located at the GEOMAR research centre; the BGR co-ordinates the German contributions to the ODP.

Gas hydrates
In the context of the *Gas hydrate research* funding priority, which commenced in 1999, the scientific and technological basis is to be established for the description of deposits and quantities of methane-storing clathrate compounds (chemical inclusion compounds). In particular, the formation and decomposition processes and the physical characteristics of these compounds will be studied under natural conditions. The aim is a better assessment of the methane store as a risk factor for the climate and as a potential resource.

Research work is concentrating on the following topics: (1) identification and quantification of hydrates and free gas deposits, (2) methane decomposition in the global carbon cycle, (3) changeability over time of the global methane level: effect on the climate, (4) mechanical instability of the subsurface and risk potential of gas hydrates (submarine slipping), (5) development of technologies to assess gas hydrates as fuels.

14.2 Raw material supplies

A report on the situation of the raw materials supply in Germany is issued annually by the BGR. In country reports, the raw materials potential of major producers is analysed and in some cases supplemented by updated studies on individual raw materials. Furthermore, questions related to raw material supplies are discussed in co-operation with UNESCO and the OECD; a case in point is the Deep Gas project, in which the hydrocarbon potential was studied in areas of the North European Basin which have yet to be developed commercially. New prolific areas were defined to ensure the long-term supply of energy. The hydrocarbon potential of the Laptev Sea (North Polar Sea) is being examined by the BGR as part of Russo-German scientific and technical co-operation; EU funding was used to produce a natural gas atlas. On behalf of the BMWi, a study on *Reserves, resources and availability of energy raw materials* was produced in 1998. The GGA is studying the seabed with a view to deposits and environmental impact.

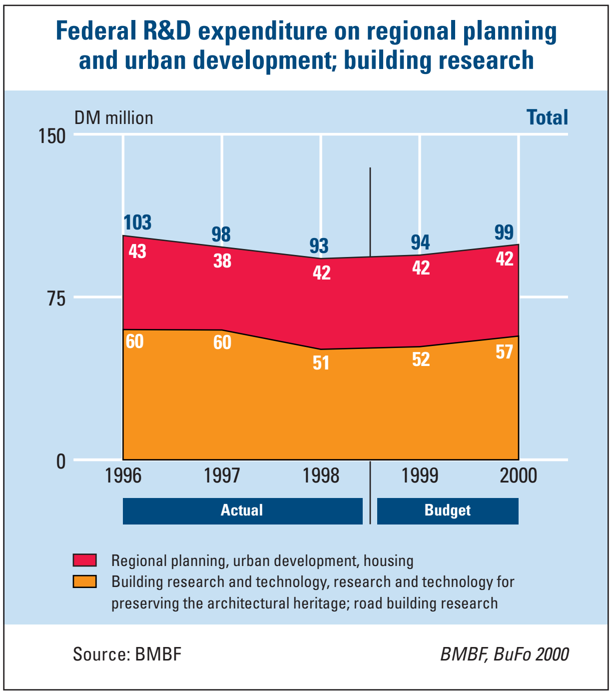
Literature

– BMBF brochure: 1996 annual report on maritime and polar research;
– 1997/98 activity report of the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources);
– 1996/97 biannual report of the GeoForschungsZentrum (GFZ – Geoscientific Research Centre) in Potsdam;
– 1996/97 biannual report of the Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI – Alfred Wegener Institute for Polar and Marine Research).

15. Regional planning and urban development; building research (Funding area P)

Building and housing – more than any other area – forms part of a complex web of interrelationships with the labour market and employment, environmental factors, mobility and transport. Changing values and cultural expectations, coupled with increased environmental awareness and the needs of sustainable and viable development have resulted in different – frequently contradictory – ideas by the general public about building, housing, living and working. Furthermore, Germany is currently experiencing a far-reaching economic, technological and social shift. The globalisation of economic activity and the development towards a knowledge-based society are necessitating innovations in all areas of society. There are substantial repercussions for housing construction policy and housing management, as well as for regional, urban and settlement development. At the same time, the municipalities and regions, and the construction and housing industry, are undergoing a fundamental structural change entailing risks and opportunities in terms of the quality of housing, living and employment conditions. These bring new challenges for those responsible for planning, administration, industry and government. Against this background, the new Building and Housing Research Programme is intended to create fundamental orientational knowledge.

Chart 47



15.1 Regional planning, urban development, housing

Research policy objectives

The objective of the Federal Government's research promotion and departmental research is to generate and make available the knowledge and instruments needed in Germany for regional planning, urban development and housing policy, so that Germany will be in a position to cope with the challenges facing it at the beginning of the 21st century. Oriented towards sustainable and viable development, the BMBF's support programmes aim at producing fundamental orientational knowledge and developing and testing new methods and models for building and housing in the 21st century. In contrast, the application-oriented departmental research of the BMVBW (Federal Ministry of Transport, Building and Housing) is oriented towards fleshing out and implementing the concept of sustainable development.

In the field of regional planning, urban development and housing, the decisions intended to foster sustainable development are supported by:

- the commissioning of research projects (contractual research);
- applied research in the field of experimental housing and urban development;
- the Regional Planning Pilot Projects Programme of Action for regional planning policy;
- the activities of the Bundesamt für Bauwesen und Raumordnung (BBR – Federal Office for Building and Regional Planning) and research institutions receiving basic funding (cf. Part VI).

The BMBF's Building and Housing Research Programme aims to highlight perspectives pointing further ahead into the future. It is intended to address holistic, overarching requirements and interrelationships which extend beyond individual specialisations in an interdisciplinary manner and to bring together the various players and levels of action.

At the same time, it aims to implement the requirements directed at research and science as formulated, for example, in the final report on the sustainability concept of the Bundestag Study Commission on the Protection of Humanity and the Environment of June 1998 and in the report published in March 1999 by the Bundestag Committee on Education, Research and Technology Assessment.

The programme provides for the promotion of research and development in the following key areas:

- Basic research to produce orientational knowledge for future-oriented planning and design concepts for the field of building and housing;
- Interdisciplinary collaborative projects to develop and test models for building and housing in the 21st century;
- Contributions towards the transfer of knowledge and towards training, with an emphasis on the study of best practices.

Thematic priorities / funding structures / developments / results

Departmental research (BMVBW)

– In the field of regional planning policy, important research findings have been achieved in recent years with a view to sustainable development, e.g. on the safeguarding and strengthening of decentralised and sustainable regional and settlement structures, on scope to relieve the burden on high-traffic areas, on the protection of resources and on the regional impact of telematics. The research findings from the *Regional planning in Europe* research priority contributed to the drafting of a European regional development concept (EUREK). A further priority is the strengthening of regional co-operation and competitiveness and a closer integration of regional planning and transport policies.
– In the field of urban development policy, there was a continuation of research activities to implement the resolutions of the 1992 Conference on Environment and Development in Rio and the 1996 HABITAT II Conference in Istanbul, and to prepare for the URBAN 21 World Congress in 2000. Important results for sustainable urban and settlement development refer to urban ecology, to a more socially acceptable urban development, to the (re-)vitalisation of inner cities and suburban centres, and to the "city of short distances". In the new *Länder*, the focus of research work remained on urban redevelopment and renewal, including housing construction.
– In the field of housing policy, research is engaged in reviewing and developing the instruments to promote the supply of housing and the social security of housing. The priorities here are on cutting construction costs, promoting owner-occupied housing and developing instruments to cope with the structural change in the housing sector in the new *Länder*.
– In the field of building policy, research is focusing on the single European market and the effects and requirements of uniform calculation, measurement, testing and approval procedures under the essential requirements of the EU Construction Products Directive. The focus continues to be on quality and efficiency control in the building sector. Issues include protecting health and the environment, energy conservation and cutting CO_2 emissions in the housing sector.

Experimental housing construction and urban development

The experimental housing construction and urban development scheme is a departmental research programme of the BMVBW in which new knowledge underpinned by practical application is derived for federal tasks in the field of urban development and housing construction, and existing knowledge is reviewed for potential application. Pilot projects are used to examine the effects of the instruments of urban development and housing policy, and findings to facilitate their further development are derived from process-oriented measures. The current fields of research are: mixed-use approaches in urban development, city centres, cities of the future, suburbs with a particular need for development.

Pilot projects in the regional planning sector

The *Pilot projects in the regional planning sector* action programme serves to test new instruments and approaches of regional planning in settlement areas where there is a particular need for action from the federal point of view. The pilot projects support a more action-oriented and process-oriented approach to planning which is intended to lend a fresh impetus to federal and *Länder* regional planning policy. The implementation of the action programme has been transferred to the BBR (cf. Part VI). The current priorities are: urban networks forum, regional conferences, rehabilitation and restructuring of polluted regions, regions of the future (sustainable regional development) and transnational co-operation in the field of regional planning.

Building and Housing Research Programme (BMBF)

Support is particularly given to:

– Basic research with a view to forecasting future problems and their solutions, including the designing of suitable methods (e.g. effects of social or societal structural developments and of new technologies and methods of production or of economic change on the current and future demand for housing, the housing needs, choice of location, the world of work and mobility patterns);
– Overarching complex approaches to research and solutions which take up and link social, economic, environmental or cultural issues in the field of building and housing, in the interest of sustainable and viable development;
– Approaches to research and solutions which combine different areas of planning, such as urban development/housing construction and mobility/transport or urban technology (supply and disposal), social and other infrastructure, etc.;
– Evaluation and impact assessment of the fiscal environment for regional, urban and settlement development;
– Research into the relations between the various spatial levels of relevance to building and housing, e.g. suburb – municipality – city/municipality – region.

15.2 Building research

Research into building technology; research and technology to preserve historic monuments; road construction research

Research policy objectives

The BMVBW's research into building technology is primarily aimed at cutting building costs, rationalising building processes and providing decision-making aids with regard to building provisions in the context of civil defence and disaster control.

Building research and technology, a new research priority of the BMBF, is intended to encourage SMEs in particular to undertake research, development and innovation which involves a high commercial risk in the field of housing construction, maintenance and renovation. The focus here is on the development and testing of integrated planning and co-ordination models on the basis of new information and communications technologies and of new construction processes and technologies for new housing and for work on existing buildings, including organisational innovations during the building work. The intention is to improve the conditions for survival of the SMEs and for the creation of jobs which are secure in the long term.

Thematic priorities / funding structures / developments / results

Building technology research

The BMVBW promotes research into building technology on the basis of section 91 paragraph 1 of the Second Housing Construction Act with a view to cutting the costs of construction and rationalising the construction process in the field of house building. To this end, the BMVBW invites proposals each year under a building research programme (investigator-initiated research) which defines the respective research priorities.

The current priorities of building research are:

– Cutting the costs of construction and housing;
– Economic viability and rationalisation;
– Avoiding damage to buildings, novel rehabilitation processes;
– Accessible housing for everyone;
– Sustainable building, healthy housing;
– Conserving heating energy and cutting CO_2.

Theme-oriented funding of building research initiatives conducted in the higher education sector, at research institutes, in industry and by architects and engineers is expected to produce innovations in the building and housing sectors and to facilitate structural adjustment in the construction industry.

The BMBF's *Building research and technology* research priority focuses on the following aspects:

– Development of information and communication systems as a basis for the integration of planning and implementation for new buildings and building work on existing structures;
– Development of building processes and technologies to raise the proportion of off-site prefabrication;
– Development of practicable (partially) automated building processes and technologies for the building site;
– Development of innovative methods for modernisation, rehabilitation and maintenance;
– Scientific studies into interdisciplinary issues related to the economic, structural and social environment and prospects for innovation in the building industry.

The development of new building processes and technologies and of integrated information and communication systems includes the aspect of organisational and skills requirements in SMEs in the building industry.

Research aimed at preserving historic monuments

The BMBF programme aimed at the care of historic monuments was concluded in 1998. The main scientific finding was the enhanced insight into the interaction of the various harmful factors, such as pollutants, the effects of modern use of historic buildings, natural environmental factors, or faulty or inadequate restoration and rehabilitation in the past. This was only possible thanks to interdisciplinary co-operation between different specialisations and their integration with practical work to form a dense network: only in this way was it possible to lay the foundations for a realistic diagnosis and for far more systematic and efficient rehabilitation and damage prevention, compatible with the material composition of the structure, in future work to preserve historic monuments.

Building provisions for civil defence

Part of the BMVBW's building research deals with building provisions for civil defence and disaster control. Research results provide scientifically validated decision-making tools helping to protect people in the case of disasters. The funding for this research comes from the budget of the Federal Ministry of the Interior (BMI).

Road construction research

The BMVBW's research into road construction relates to the preparation of transport and building policy decisions on the cost-conscious development and maintenance of the existing road infrastructure. The aim is the permanent and sustainable adaptation of road construction technology and transport technology in order to ensure a safe, environmentally compatible and flowing movement of traffic. A further aspect of the research is achieving European harmonisation of rules and regulations whilst maintaining the existing national level of quality. The results are always published quickly so that they can be rapidly used in administration and construction work.

The application-oriented issues covered by the BMVBW's research into road construction can be summarised under the following headings:

– Environmental protection: reduction of the harmful effects deriving from the construction, maintenance and operation of road transport facilities; development of a basis for the assessment of compensatory and replacement measures; promotion of the recycling of building materials and waste.
– Road engineering: quality assurance and further development of building materials, building methods, building structures, stress models, maintenance strategies and testing methods in all areas of road construction, bridge construction and civil engineering.
– Road traffic technology: development of strategies, processes and technologies to improve safety and the fluidity of traffic and to guide and influence traffic. Inclusion of new technologies (IST).

In the context of research funding during the period covered by this report, the research supported by the BMBF into the experimental load-bearing capacity of structures, and particularly of bridges, was concluded. The objective was to cut construction costs and environmental damage by extending service lifetimes.

Hydraulic engineering research

The Bundesanstalt für Wasserbau (BAW – Federal Institute for Waterway Engineering) is responsible for scientific and technical testing and research and for practical advice to the Wasser- und Schiffahrtsverwaltung des Bundes (WSV – Federal Waterways and Shipping Administration) with regard to construction technology, geotechnology, hydraulic engineering, machinery and information technology; it provides the scientific and technical basis for the work of the WSV (cf. Part VI).

Literature

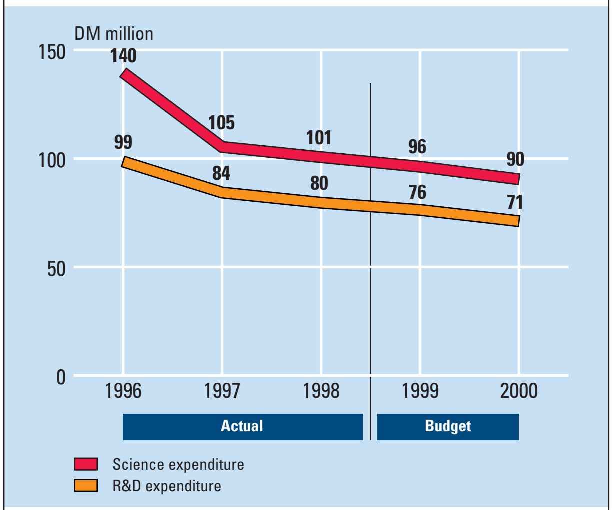
– BBR (ed.): Information on the departmental research programme "Experimenteller Wohnungs- und Städtebau", Bonn 1998;
– BMBF Building and Housing Programme, Bonn, May 2000;
– Guidelines for the funding of research and development projects under the Building and Housing Research Programme, published in the Federal Gazette No. 101 of 27 May 2000.

16. Research and development in the food sector (Funding area Q)

Safe and high-quality foodstuffs are vital for healthy nutrition and the well-being of consumers. The corresponding consumer requirements apply both to foodstuffs left in their natural state and to products which have been processed and preserved. A network of laws and ordinances regulates the field of food safety, covering issues like preventive health protection and protection against fraud and deception, and creates the environment for the production of high-quality foodstuffs. Research supplies the methods and instruments with which to monitor adherence to the rules and to recognise and ward off new risks at an early stage. Beyond this, its tasks include the scientific study of the opportunities and risks inherent in certain products and of minimal processing technologies for healthy nutrition.

Chart 48

Federal science and R&D expenditure in the food sector



Source: BMBF

Research policy objectives

The research in the food sector funded by the Federal Government focuses primarily on the following tasks:

– Maintenance and improvement of food safety and quality, with science helping to produce and process foodstuffs which pose no danger to health and which are of high nutritional quality, free of defects and undesirable substances, and hygienic.
– Reduction of diseases which are in part nutrition-related, by improving the scientific knowledge about a healthy diet and developing and assessing measures to influence people's eating habits.

Thematic priorities

In order to be able to respond appropriately to new problems in the food sector, research needs to consider the potential impact on human health. Research topics aimed at improving consumer health protection include:

– Food hygiene (e.g. salmonella in poultry and poultry meat; EHEC in foodstuffs and animals for human consumption);
– Virus-related infections which can pass from animals to humans (alphavirus);
– Fumonisine intake by the consumer and ochratoxin A in the consumer and in foodstuffs;
– Hygiene criteria for the processing and marketing of fish and fish products;
– Experimental studies into irradiation-induced material changes in plastic food packaging;
– Establishment of a system to analyse potential long-term damage due to the use of genetic engineering in food production and processing;
– Medical issues of nutrition (e.g. food allergies and intolerance reactions, eating disorders, iodine monitoring, folic acid and neural tube defects);
– Eating habits;
– Examinations of residues.

In addition, support is given to the following aspects:

– Further development of quality criteria and the assessment of nutritional characteristics of foodstuffs and their components;
– Further development and standardisation of processes to analyse food ingredients and the factors influencing them at all stages of production, processing, storage and marketing and of processes to detect and assess pathogenic micro-organisms;
– Further development of the processing technology for food processing, storage and preservation with the aim of improving quality, reducing production-related damage to the environment and improving microbiological processes for the processing and preservation of foodstuffs;
– Studies into the manufacture of genetically modified foodstuffs and the detection of biotechnology-induced changes.

Funding structures

The following research establishments are supported from the budget of the Federal Ministry of Food, Agriculture and Forestry (BML):

– Bundesanstalt für Milchforschung (BafM – Federal Dairy Research Centre), Kiel;
– Bundesanstalt für Getreide-, Kartoffel- und Fettforschung (BAGFK – Federal Centre for Cereal, Potato and Lipid Research), Detmold and Münster;
– Bundesanstalt für Fleischforschung (BAFF – Federal Centre for Meat Research), Kulmbach;
– Bundesforschungsanstalt für Ernährung (BFE – Federal Research Centre for Nutrition), Karlsruhe.

In 1997, these institutions formed a network for co-operative research. Together with the establishments listed under the funding area for agriculture, forestry and fisheries, the institutions in this network are united at scientific and organisational level under the umbrella of the Senate of the Federal Research Establishments of the BML and arrange the distribution of work, exchange of experience and co-operation together with this body.

In addition, the BML provides a grant to the Deutsche Forschungsanstalt für Lebensmittelchemie (Federal Research Centre for Food Chemistry) in Garching, a Blue List institution. In total, the BML spends some DM 100 million a year on research in the food sector.

The budget of the Federal Ministry of Health primarily promotes the following research and educational institutions:

- Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (BgVV – Federal Institute for the Health Protection of Consumers and Veterinary Medicine);
- Bundeszentrale für gesundheitliche Aufklärung (BZgA – Federal Centre for Health Education);
- Deutsche Gesellschaft für Ernährung e.V. (DGE – German Society for Nutrition).

Results / developments

The increasing demand for convenience products and the reservations of many consumers about chemical preservatives are leading to a need for natural ways to hygienically stabilise foodstuffs. In this context, research is being done, inter alia, into lactic acid bacteria which can be used to suppress pathogenic germs like listeria in meat products. Procedures for high-pressure sterilisation as an alternative to heating/pasteurisation are also being examined and further developed.

In the context of a comprehensive collaborative project, food research is currently developing methods to detect genetically modified foodstuffs. This is a precondition for the corresponding labelling requirements to be monitored. Initial pilot systems have been successfully established for cereals and dairy products. Procedures have also been checked in round-robbin tests and are available for soya and corn.

The studies conducted as part of the iodine monitoring exercise show that the iodine provision situation in Germany has improved during the last 15 years. In 1996, the intake of iodine amounted to roughly 60 per cent of the level recommended by the DGE. This means that the population in Germany is still suffering from a general lack of iodine, which particularly affects pregnant women and their new-born babies. Breast-feeding mothers receiving no additional supply from iodine tablets are currently the worst supplied group in society in terms of iodine.

Technological advances mean that it will be possible in future to reduce or eliminate allergenic substances in certain foodstuffs.

Literature

- Framework plan on research 1997-2000 for the research institutions reporting to the BML (available from BML, Referat "Öffentlichkeitsarbeit" and on the Internet: www.bml.de under "Service");
- Research within the scope of the BML – Portraits of the research establishments (available as above);
- Research report "Ernährung, Landwirtschaft, Forsten" (available as above);
- Annual reports of the BML's federal research establishments (cf. Part VI, section 5);
- Annual reports of the BgVV (Federal Institute for the Health Protection of Consumers and Veterinary Medicine) (cf. Part VI, section 5);
- Publication on the Internet of research reports (summaries) of the BMG (Federal Ministry of Health) including the agencies of the BMG (www.bmgesundheit.de under "Themen" – "Ressortforschung");
- Jod-Monitoring 1996, vol. 110 of the publications of the BMG;
- Ernährungsbericht 1996, published by the DGE, ISBN 3-921606-33-0.

17. Research and development in agriculture, forestry and fishery (Funding area R)

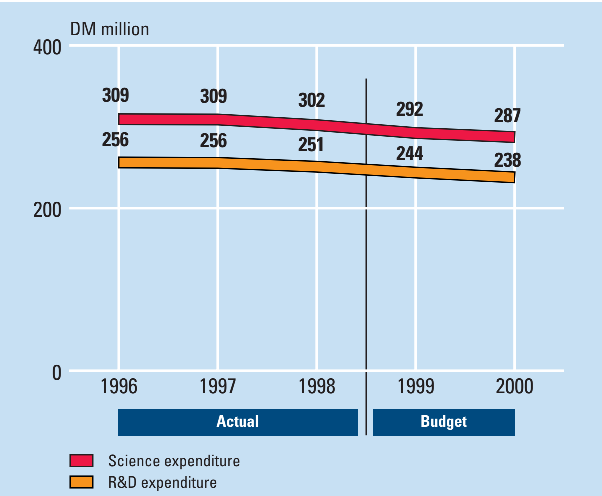
The environmentally compatible, sustainable and high-quality output of farm produce has long been a focus of agricultural research. Research into organic farming and the protection of farm animals, with all its diverse aspects, has become a particular focus of attention and is to be given greater priority. Initial successes have already been recorded here.

Particularly in the field of biotechnology and genetic engineering, long-term monitoring and risk and safety research help to ensure that the potential for innovation is used in a responsible manner. Here, the relevant federal research establishments advise the Federal Government prior to the enactment of legislation and in the run-up to international negotiations.

Biodiversity is a basic good whose long-term preservation and utilisation necessitate permanent and systematic scientific efforts. The reorganisation of gene banks for agricultural plants, a scheme involving federal funding, is intended to enable this work to be done even more efficiently.

Chart 49

Federal science and R&D expenditure on agriculture, forestry and fishery



Source: BMBF *BMBF, BuFo 2000*

Research policy objectives

Agricultural research funded by the Federal Government focuses primarily on the following tasks:

- The creation and provision of a broad and up-to-date knowledge base in the fields of agriculture and forestry, fisheries and socio-economics, for timely and independent advice to the Federal Government prior to the enactment of relevant legislation and in the run-up to international negotiations;
- The drafting of integrated adaptation strategies to improve competitiveness and the employment situation in agriculture and forestry and in rural areas and to strengthen the social and environmental function of rural areas;
- The development and improvement of systems to monitor long-term natural developments in agriculturally utilised ecosystems (biological monitoring, e.g. climate change, biodiversity, stock developments) as well as of instruments to monitor the effectiveness and enforcement of statutory and other regulations (e.g. plant protection, animal protection, animal health, residue control, environmental duties, production restrictions, etc.);
- The development and optimisation of agricultural (including forestry and fishery) production systems which will ensure sustainable high yields and thus maintain and improve the competitiveness of German agriculture. These systems will have as little impact on the natural environment as possible and will contribute to preserving natural resources and genetic diversity, will meet consumer requirements in terms of product quality and variety and will take into account the concerns of animal protection and occupational safety;
- The further development of socio-economic tools that help to assess as reliably as possible the impact of different agricultural measures and of economic and technological development (policy and technology assessment).

Thematic priorities

Funding covers the following thematic priorities:

- Drafting of concepts to improve competitiveness and the employment situation in agriculture and forestry, to create alternative sources of income in rural areas and to safeguard the use of land in a new general setting;
- Studies which improve the understanding of the ecosystemic interrelationships of agricultural and forestry production;
- Studies of the positive and negative impacts of agricultural production and the utilisation of natural resources, including their genetic potential, on the ecological balance;
- Studies of the external influences affecting the performance of utilised ecosystems;
- Assessment of global trends in the ecological balance and climate and their impact on the various production systems.

In addition, the aptness of methods and instruments is being tested and developed for the various types of monitoring which are carried out in agriculture. Furthermore, studies are being conducted with a view to improving the efficiency of the means of production and of biological systems (biological principles of action and feedback systems). Efforts are also being made to optimise product

Part III

cycles in order to reduce excessive nutrient levels and pollutant emissions; holistic concepts relating to plant and animal health are being developed further. Finally, studies are looking into the production and possible applications of biogenic raw materials for industry and energy.

The consideration of socio-economic issues continues to be of key importance:

- Analysis of the economic situation of persons working in agriculture, forestry and the food industry as well as of living conditions in rural regions;
- Analysis of the impact and monitoring of the success of agrostructural and forestry policy measures;
- Presentation of the scope of and ways to develop agricultural structural policy;
- Study of the (national, EU-wide, international) markets for agricultural produce;
- Further development of models for policy and technology assessment;
- Improvement of ecological assessments, life cycle analysis and other instruments for the economic assessment of events which have an environmental impact.

Funding structures

The following research institutions are financed from the budget of the Federal Ministry of Food, Agriculture and Forestry (BML):

- Bundesforschungsanstalt für Landwirtschaft (FAL – Federal Agricultural Research Centre), Braunschweig;
- Biologische Bundesanstalt für Land- und Forstwirtschaft (BBA – Federal Biological Research Centre for Agriculture and Forestry), Braunschweig and Berlin;
- Bundesanstalt für Züchtungsforschung an Kulturpflanzen (BAZ – Federal Centre for Breeding Research on Cultivated Plants), Quedlinburg;
- Bundesforschungsanstalt für Viruskrankheiten der Tiere (BFAV – Federal Research Centre for Virus Diseases of Animals), Riems Island;
- Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH – Federal Research Centre for Forestry and Forest Products), Hamburg;
- Bundesforschungsanstalt für Fischerei (BFAFi – Federal Research Centre for Fisheries), Hamburg.

In addition, there is a Zentralstelle für Agrardokumentation und -information (ZADI – Central Agricultural Documentation and Information Office) in Bonn. The institutions listed here and the four product and food research institutions mentioned under funding area Q are united at scientific and organisational level under the umbrella of the Senate of the Federal Research Establishments of the BML and arrange the distribution of work, exchange of experience and co-operation accordingly.

In addition, the BML funds six Blue List institutions of the Wissensgemeinschaft Wilhelm Gottfried Leibniz (WGL).

The Federal Government is a member of the Consultative Group on International Agricultural Research (CGIAR), a loose association of governments, international organisations and private foundations under the leadership of the World Bank. The CGIAR (cf. Part V, section 3) supports a system of at present 16 international research centres and institutes. These institutions address fundamental questions of central importance for world-wide sustainable food supplies. Themes include the development of resource-protecting production systems which are appropriate to the relevant location, the agricultural policy framework, and the preservation and use of genetic resources. The Federal Government helps to fund international agricultural research with a contribution totalling roughly DM 28 million from the budget of the Federal Ministry for Economic Co-operation and Development (BMZ).

Results / developments

- In order to permit assessment of the impact of anticipated climatic changes on the performance of crops and the nutrient balance in the ground, a multiannual project has been launched in which an increased concentration of CO_2 in the atmosphere can be simulated in the open. Mathematical models support the experimental approach.
- The biotechnological enhancement of renewable raw materials and residual substances is being studied in numerous research projects. The aim is to increase the value-added of these resource-conserving agricultural products.
- The resolution of the Federal Government to "reduce the number of, and streamline, federal authorities" is also affecting the federal research centres receiving basic funding from the BML. Their staff is to be reduced by around 30 per cent by 2008. It is planned to reduce capacities in production-oriented research, while slightly increasing those for research into environmental and animal protection and organic farming.

Literature

- Framework plan on research 1997-2000 for the research institutions reporting to the BML (available from BML, Referat "Öffentlichkeitsarbeit" and on the Internet: www.bml.de under "Service");
- Research within the scope of the BML – Portraits of the research establishments (available as above);
- Research report "Ernährung, Landwirtschaft, Forsten" (available as above);
- Annual reports of the BML's federal research establishments (cf. Part VI, section 5);
- BMZ brochure: "Zukunftssicherung durch Internationale Agrarforschung", 1997.

18. Educational research (Funding area S)

Education and training form the foundation for future-oriented research, for a society capable of innovating and of utilising the opportunities of innovation. Support for research and innovation must therefore aim in particular at a thorough development of human abilities and skills. The Federal Government promotes educational research via its basic funding for research institutions and via project funding. This research – predominantly departmental research – is intended to take innovative approaches and assume a pace-maker function in important, application-related fields of research. In so doing, it needs to draw on the findings from other fields of study, particularly labour-market and vocational research.

Existing research findings and experience from pilot projects form, among other things, the basis for the work of the Education Forum, which has been set up by the Federal Government and the *Länder* to draft recommendations on educational objectives, content and methods by 2001.

18.1 Vocational training research

Research policy objectives

Research in the field of vocational training[1] is primarily directed at developing pertinent arguments and providing decision-making support for necessary changes to and improvements in vocational training.

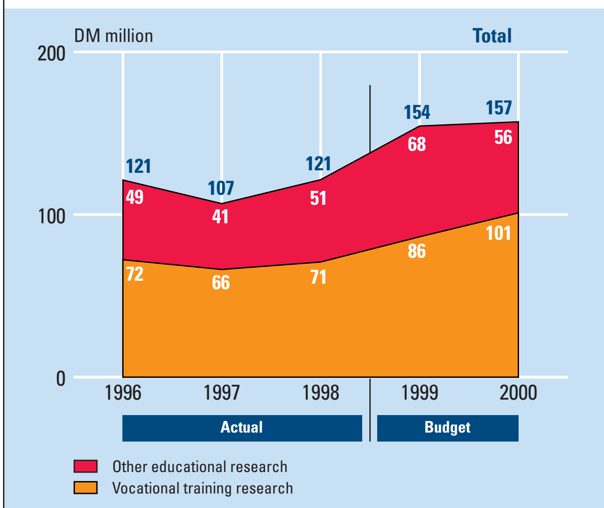
Thematic priorities

Ensuring vocational training provision

The efforts to increase the availability of training places were continued in the period covered by this report. The Federal Government has entered into discussions with business associations and trade unions on an Alliance for Jobs, Training and a Competitive Germany. A key result is the nation-wide consensus on training achieved on 6 July 1999, as part of which the partners in the alliance have agreed a wide-ranging package of measures. Furthermore, the Alliance's working group on initial and further training is discussing the structural renewal of vocational training.

Chart 50

Federal R&D expenditure on educational research



Source: BMBF — *BMBF, BuFo 2000*

Early identification and additional qualifications

The BMBF has launched two initiatives entitled *Early identification of skills requirements* and *Additional qualifications in the dual system of vocational training* in order to back dynamic developments in industry in an innovative manner with appropriate vocational training schemes and to enhance the attractiveness of vocational training. In this context, the *Additional qualifications* initiative provides an important operational means to implement the training needs in high-growth sectors as highlighted by the early identification system. The aim is to develop and utilise (additional) potential for employment in these sectors by permitting additional qualifications to be obtained either in tandem with initial vocational training or shortly after the completion of initial training. In this way, early identification and additional qualifications can help to attract highly-skilled recruits into the respective high-growth sector or to maintain or improve the capabilities of employees in a certain sector.

Initially, BMBF funding will focus on the early identification projects, in order to provide a basis for the planned measures in the field of additional qualifications in the dual vocational training system. This basis is to provide greater transparency, permit fresh approaches, and, where appropriate, encourage a wider range of training courses. The intention is to post the project results on the Internet, initially for the various research institutions involved and later for the interested public. In this way, the modern media can be used to provide scientifically validated support in a problem-free manner to the decision-making processes both of interested parties in their individual situations and of political and other decision-makers. Not least, the BMBF aims to help to spread the idea of lifelong learning via these two initiatives.

The education system, its quality and competitiveness

In Germany, as in other developed economies, employment is particularly dynamic in the services sector. Within the sector, however, the degree of this dynamism varies. Growth is especially high in information-intensive/novel services. This raises the question of the extent to which the dual vocational

[1] Key findings of vocational training research are published in the BMBF's annual vocational training report.

training system meets the new skills needs or whether the novel services require different skills than the "traditional" services.

The Federal Ministry of Economics and Technology (BMWi) has therefore commissioned a study by the Zentrum für Europäische Wirtschaftsforschung (ZEW – Centre for European Economic Research) into the demand for vocational training courses for new occupations in the services sector and the need to revise existing training courses. This study is particularly driven by the expectation that the expansion of the services sector will create potential for employment and training in the short and medium term which will compensate for some of the jobs shed in recent years in the goods-producing sector. At the same time, it is important to counter fears that the novel services industries in particular, which are as yet not very institutionalised, have a need for skills which is not suitably or adequately covered by the system of dual vocational training. The provision of appropriate training courses and the modernisation of existing ones is intended to safeguard the availability of skills and to boost the prospects for development and employment in the new services in particular.

In addition, a study by the Forschungsinstitut für Berufsbildung im Handwerk (Research Institute for Vocational Education and Training in the Crafts Sector) at Cologne University is examining the development of skills profiles and sectoral trends of relevance to training in the crafts sector, in order to support the BMWi when it issues ordinances on initial and further training in the crafts sector. The aim of the project is to develop an information system which collates and evaluates the expertise and specific knowledge of the vocational training committees of the central crafts associations and then presents it to the BMWi for use in future ordinances. The results will become available in spring 2001.

Training disadvantaged young people
Promoting the careers of disadvantaged people is recognised as an integral element of vocational training. In accordance with the Federal Government's political objectives and the resolutions of the Alliance for Jobs, Training and a Competitive Germany, it is a priority of future BMBF initiatives in the field of vocational training policy. Here, research and development are of particular significance, in order to enhance the efficiency of the current approach to support, which is still very disjointed and uncoordinated, by targeting the funding more precisely. In the long term, it will be necessary to move away from the rigid measures currently on offer and to apply flexible forms of support tailored to local needs and the various target groups.

The planned programme entitled *New initiatives to expand vocational support for the disadvantaged* focuses on: innovations in the field of preparation for training, the expansion of the choice of occupations (including media occupations and information and communications technologies), local and regional co-operation, and the training of migrants. Initially, between DM 10 and 12 million is earmarked for the programme. Research work needs to be done in all of these areas in order to review the approaches already being developed in many places from the point of view of the conditions under which they were set up and the possibilities for transfer and expansion. Research is being done in the form of scientific studies in close co-operation with the Bundesinstitut für Berufsbildung (BIBB – Federal Institute for Vocational Training) and other institutes, and in the form of scientific evaluations of ongoing projects. There has already been a comprehensive start to the programme. Together with the Bundesanstalt für Arbeit (BfA – Federal Employment Service), the BMBF is funding the scientific evaluation of the series of pilot projects on *Innovative concepts in the preparation for initial vocational training*.

Continuing vocational education
The BMBF programme entitled *Development of skills for industrial change – structural changes in continuing in-house training*, which is the main focus of research and development in the field of continuing vocational education, comprises the following four projects:
– Individual skills development by learning in the work process;
– Corporate flexibility and skills development;
– Interactions between skills development and individual development, corporate and regional development;
– Skills development for economic change – input from capable works and staff councils.

The programme was launched in 1995 in a first phase of work in which theoretical and empirical research was undertaken into the concepts of skills, skills development and corporate and staff flexibility, and the appropriate range of instruments was developed, the field of study defined and preliminary studies carried out. At present, the projects are in the second phase of work which embraces the main study and the evaluation of the data collected. The main emphasis is on the evaluation, with scientific support, of the 30 participating in-company development projects; these are specific projects of individual and organisation-related skills development, and most of them involve technical changes and changes in the way work is organised. At the same time, they provide information about the extent to which certain employment situations can be used to maintain or develop qualifications and vocational skills. In particular, this also involves fundamental issues of continuous lifelong learning in different contexts. The programme is funded by the BMBF and the ESF, with a total of approximately DM 40 million up to the end of 2000.

The BMBF programme entitled *Learning in a social environment – skills development in the establishment and expansion of regional infrastructures* (LisU) helps to present the various learning processes in the social environment which are related to voluntary, charitable and honorary work at the level of individuals and organisations and, on a pilot basis, to actively support the establishment and expansion of regional structures which foster learning. This includes a demonstration, in these fields of learning and work, that potentials and skills can be not only maintained, but also newly developed. It involves skills which people use outside work but which can maintain and improve their opportunities on the labour market. The work in the social environment is viewed not as a substitute for paid work, but as work of equal value which must be reassessed in the course of the necessary changes in the world of work. For this reason, the programme also pursues the objective of contributing towards innovation in continuing vocational education and skills development. The programme is being funded by the BMBF and the ESF, with a total of approximately DM 5.5 million up to the end of 2000.

Pilot projects in vocational training[1]
In addition to research projects, there are scientifically evaluated pilot projects taking place in all areas of education. Pilot projects in the field of vocational training, for which around DM 25 million of federal funding is allocated each year, are currently in progress on the following thematic priorities in particular:

In vocational schools
– Programme entitled *New learning concepts in the dual system of vocational training* (duration: 5 years; federal funding: DM 14 million);
– Co-operation between places of learning in the field of vocational training (duration: 4 years; federal funding: DM 12 million).

In companies and industrial training facilities
– Methodological concepts to promote the ability to act;
– Ways to deliver additional qualifications and models to link initial and continuing vocational training;
– In-house continuing education and training concepts, development of new in-house career paths;
– Improvement of initial and continuing vocational training networks, co-operation between places of learning;
– Concepts to design learning and working structures for a variety of age groups.

A leading institution active in the field of vocational training research is the BIBB, which is an agency of the BMBF (cf. Part VI).

Surveys and Analyses under the LEONARDO DA VINCI Programme
In the first generation of the LEONARDO DA VINCI European Vocational Training Programme (1995–1999), applied vocational training research was included, for the first time, as a separate programme area entitled Surveys and Analyses. The objective of this programme area is to generate, document and evaluate knowledge in the field of vocational training on the basis of joint European research.

In the 1995–1999 period, 17 research projects from German applicants with 62 partners in a total of 16 countries were supported under LEONARDO DA VINCI. The majority of the project applications were submitted by research institutions and educational bodies, and labour and management, government agencies, institutions closely related to business associations, and consultancies were also involved. The topics include the vocational orientation of disadvantaged young people, monitoring the success of vocational training, acquisition of integrated skills for work and study, and the relationship between double qualifications and mobility.

18.2 Further areas of educational research

General educational research

Research policy objectives
The Federal Government has not only the constitutional right to participate in educational planning, but also the obligation to help to guide the further development of the educational sector. Primarily in the form of departmental research, the Federal Government funds educational research institutions and projects with a view to enhancing the quality and efficiency of the educational system, utilising the potential for innovation, enabling the necessary structural change to take place, and boosting the international competitiveness of the educational system. The switch from providing support for pilot projects to thematic, nation-wide programmes is also helping to define the new research requirements.

Thematic priorities / funding structures / results
Quality assurance in the education sector
The OECD Programme for International Student Assessment (PISA) is a central project aimed at quality assurance in education. The intention is to provide the participating OECD countries with indicators for the knowledge, skills and abilities of 15-year-old students in the fields of reading, mathematics and science. In addition, the project embraces cross-curricula competencies and key motivational indicators. The results of the studies – of the international one and the nationally weighted and extended one – will indicate problem areas and thus highlight where greater efforts are needed to better equip young people for the challenges of the future.

Pilot programmes of the Bund-*Länder*-Kommission für Bildungsplanung und Forschungsförderung (BLK – Federal/*Länder* Commission for Educational Planning and Research Promotion), such as *Enhancing the efficiency of mathematics and science teaching* and *Quality enhancement in schools and school systems*, are also intended to help improve the quality of the educational system (cf. literature at the end of the section).

Education for sustainable development
The objective of the BLK's new Education for Sustainable Development Programme is to develop and test an education for sustainable development in schools in co-operation with, for example, municipalities, industry and non-governmental organisations. Education for sustainable development is to be integrated into the normal school curriculum via the modules for interdisciplinary knowledge, participatory learning and innovative structures.

Equality of opportunity for women and men
In order to increase the participation of women in the information society, the BMBF, together with Deutsche Telekom AG, the Bundesanstalt für Arbeit (BfA – Federal Employment Service) and the

[1] When pilot projects for vocational schools are funded jointly by the Federal and Länder governments in the context of the Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung (BLK – Federal/Länder Commission for Educational Planning and Research Promotion), the federal funding is 50 per cent. In the field of vocational training, and in addition to the pilot projects in vocational schools, there are also pilot projects in companies and industrial training establishments; here, the Federal Government funding amounts to 75 per cent.

magazine "Brigitte", launched a nation-wide Women on the Net campaign in autumn 1999. A total of 33,000 women received free beginners' courses on how to use the Internet.

At the same time, a project entitled *Female teachers and pupils on the Net* aims to establish an Internet forum for female teachers ("*LeaNet*"), facilitating an exchange of experience and practical teaching preparation for female teachers and providing opportunities for further education on-line. The "*LizzyNet*" service aims to motivate girls and young women aged from 14 to 18 to get involved in the Internet and in IT occupations (cf. section 9).

In order to boost the proportion of women studying engineering and computer science, the BMBF launched an information campaign in December 1999 entitled *Be.Ing – in future with women* which primarily targets young women facing a choice of career as well as companies and higher education institutions.

Since 1 April 2000, the BMBF has been funding a centre of excellence called *Women in the information society and technology* which derives from the *New impetus for technology by women* initiative (Facts and Figures 1998, Part II, section 18), and serves as a platform and comprehensive network for all measures aimed at achieving equality of opportunity in this field.

New information and communications technologies

The rapid development of information and communications technologies is creating new material and structural challenges for all fields of education. It is necessary to equip all educational facilities with multimedia-capable computers and Internet access, to provide high-quality educational software and to develop new multimedia-based forms of teaching and learning and processes to introduce their use in educational facilities. To this end, the BMBF has, in co-operation with the *Länder*, launched a range of new activities which are supplemented by additional contributions from the private sector, e.g. in the context of the D 21 Initiative. One key funding measure is the New Media in Education Programme launched by the BMBF on 20 March 2000, which focuses on the development, testing and broad use of teaching and learning software in schools, higher education and vocational training (cf. section 9) and for which some DM 400 million has been allocated up to 2004. Campaigns like *Connecting Schools to the Internet*, the *Marketplace for Schools*, the *Internet Classroom* and other schemes sponsored by business are intended to help resolve the problem of equipping schools with high-grade hardware and Internet access.

The BLK programme for the *Systematic inclusion of media, information and communications technologies in teaching and learning processes* also serves this objective.

Promoting gifted children

Federal research into and promotion of gifted children at the school and preschool stage supports the activities of the *Länder*, who are responsible for this field. A BMBF research priority in 1999 and 2000 is the improvement of advice for the highly-gifted child. A further programme covers support for gifted individuals in vocational training.

Continuing general education

Lifelong learning and continuing general education was of particular importance for research and development in the field of continuing general education. The main objective of general adult education is the broad development of lifelong, skills-enhancing learning which extends to learning in the social environment and merges with continuing vocational education. In order to attain this objective, innovative measures have been funded in the following areas:

– Improvement of the infrastructure for lifelong, self-directed learning;
– Contributions towards the reform of institutionalised continuing general education;
– Motivation and enabling of as many people as possible to engage in lifelong learning, campaigning for continuing education;
– Professionalisation of the personnel engaged in general adult education, including the use of the new media as a particular learning opportunity.

Lifelong learning

In the coalition agreement, the achievement of lifelong learning for all in the context of an expansion of continuing education into an educational field of equal status is regarded as a necessary and central element of the educational reform. The BMBF is therefore currently drafting an Action Programme on Lifelong Learning for All. The aim of this Action Programme, which is scheduled to begin in mid-2000, is to stimulate learning itself and a willingness in all people to engage in lifelong learning and to orient the educational services and basic conditions more strongly and lastingly towards this objective.

The central field of action here is the Federal Programme on Learning Regions – Promotion of Networks, for which funding of up to DM 25 million a year is envisaged for a total of five years starting in 2000 (with DM 8 million). The aim is to help create "learning regions" by promoting the self-direction and individual responsibility of learners and via increased co-operation between providers and consumers of education as well as between the fields of education themselves.

Another element of this Action Programme is the BLK's *Lifelong learning* pilot programme. Arching across different areas of education, this project aims to take first steps towards researching, testing and implementing appropriate measures.

Cultural education

Cultural education helps people of all age groups to perceive, understand and actively shape art and culture. The new media (computer-based and network-based forms of multimedia) are becoming increasingly significant for initial and further cultural education. Here, funded research and pilot projects primarily address the use of multimedia technologies in cultural education, the expansion of the potential applications in all areas of art (music, theatre, film, design, dance, literature, media art) and in many fields of cultural activities (museums, youth and leisure activities, cultural management, etc.) and new skills requirements in artistic and cultural occupations.

The BLK has set up a programme on *Cultural education in the media age* to run from 2000 to 2004. It will support new developments in the linking of art and the new media in teaching at schools, in extracurricular facilities and in higher education.

Higher education research

Germany only has very limited capacities for research into science in general and for research into higher education in particular. By way of example, mention should be made of the work of the Wissenschaftliches Zentrum für Berufs- und Hochschulforschung (Centre for Research on Higher Education and Work) at Kassel University and the AG Hochschulforschung (Higher Education Research Working Group) at Constance University. The Hochschul-Informations-System (HIS – Higher Education Information System) develops information systems providing a basis for decision-making in the higher education sector (cf. section 22).

In addition to the panel studies, e.g. the surveys of graduates and the surveys of people entitled to study and people beginning their studies, which have been carried out by HIS since the early 1980s, the BMBF funds two further long-term studies/surveys of students in Germany. The survey on *The social situation of students* in Germany examines and analyses the economic and social situation of students, and the long-term study on the *Study situation and student orientations* complements the social survey by examining the motivational trends and decisions of students, their study strategy and their acceptance of higher education reforms. It is managed by the Higher Education Research Working Group at Constance University.

EUROSTUD, a European social survey

In some EU member states (France, Belgium, Netherlands, Ireland, Italy, Austria, Finland), a co-ordinated survey is being conducted simultaneously at national level in 2000 on certain issues, such as financing university studies, participation in education, social composition, housing; it is being evaluated at national level and collated in a joint Euro Student Report. On the initiative of the BMBF, the preparatory and co-ordination work and the collation of the data are being done by HIS.

Study : Overview – the MBA and the fate of MBA graduates on the labour market

Foreign providers, private and public-sector institutions now offer MBA courses which are proving increasingly popular. This study gives an overview of the MBA sector in Germany, Europe and the USA. The aim is to assess potential repercussions on the German education system and to provide pointers to how the availability of MBA courses at German universities and colleges can make studying in Germany more attractive to the rest of the world. The project is being run by the Foundation for International Business Administration Accreditation (FIBAA) in co-operation with Flensburg University. The first results are to be available in mid-2000.

Pilot projects by the BLK

The BLK – not least in response to the new Framework Act for Higher Education – has adopted two pilot programmes in the higher education sector:

– Modularisation: the aim is to develop and test new structural approaches which are basically interdisciplinary in nature, whereby the focus is on new, modular, short courses using new information and communications technologies. Internationally recognised degrees are to be covered, as are the development, testing and introduction of credit point systems.
– New courses: the aim is to relate the new courses to current and future labour-market and job trends (particularly for occupations in public and private-sector services) and to the new communications technologies and the fields of leisure and culture. Also, part-time study courses are being developed and tested for students in employment.

Promotion of university distance learning

The Federal Government is providing approximately DM 50 million from 1996 to 2000 for the further development of university distance courses. The BMBF provides basic funding of roughly DM 5 million a year towards the Deutsches Institut für Fernstudienforschung (DIFF – German Institute for Research into Distance Education) at Tübingen University. The BMBF provides the same annual amount towards the development and testing of what are now more than 40 innovative distance study courses under the BLK's *University distance* learning funding priority which was established in 1993.

Current and foreseeable developments in the fields of computer networks and multimedia will lead to fundamental changes in teaching and learning structures for distance learning and on-campus studies.

By funding concepts for a "virtual university" as part of the lead project to use knowledge available world-wide for initial training, continuing education and processes of innovation, the BMBF is making a clear contribution towards a shift away from traditional forms of learning and study towards self-directed learning.

Contributions towards educational research are also being made by Blue List institutions (e.g. the Deutsches Institut für Erwachsenenbildung (DIE – German Institute for Adult Education), the Deutsches Institut für Internationale Pädagogische Forschung (IDIPF – German Institute for International Educational Research), cf. Part VI, section 5) and the Institut für Hochschulforschung Wittenberg e.V. (HOF – Institute for Higher Education Research) at the Martin Luther University in Halle-Wittenberg, which was set up in 1996 on the initiative of the Federal Government together with the state of Saxony-Anhalt (and is co-funded at a ratio of 35:65). This institute focuses on the topic of *Higher education in a changing society*, including key aspects like the differentiation and flexibilisation of course systems, higher education, the region and the labour market, or the impact of processes of internationalisation on the national scope to direct the higher education system. Mention should also be made of the work done by the Max-Planck-Institut für Bildungsforschung (Max Planck Institute for Educational Research) which works on a multidisciplinary basis (cf. Part VI, section 2.1).

Literature

– BMBF (ed.): Berufsbildungsbericht 2000, Bonn 2000;
– BLK pilot projects: http://www.blk-bonn.de;
– BLK (ed.): Gutachten zur Vorbereitung des Programms "Steigerung des mathematisch-naturwissenschaftlichen Unterrichts", Materialien zur Bildungsplanung und zur Forschungsförderung No. 60, Bonn 1997;
– BLK (ed.): Gutachten zur Vorbereitung des Programms "Qualitätsverbesserung in Schulen und Schulsystemen", Materialien zur Bildungsplanung und zur Forschungsförderung No. 71, Bonn 1999;
– BLK (ed.): Programmbeschreibung für das BLK-Modellversuchsprogramm "Lebenslanges Lernen", Bonn 2000 http://www.blk-lll.de;

– BLK (ed.): Bildung für eine nachhaltige Entwicklung – Orientierungsrahmen, Materialien zur Bildungsplanung und zur Forschungsförderung No. 69, Bonn 1998;
– BLK (ed.): Gutachten zur Vorbereitung des Programms "Bildung für eine nachhaltige Entwicklung", Materialien zur Bildungsplanung und zur Forschungsförderung No. 72, Bonn 1999;
– BLK (ed.): Gutachten zur Vorbereitung des Programms "Systematische Einbeziehung von Medien, Informations- und Kommunikationstechnologien in Lehr- und Lernprozesse", Materialien zur Bildungsplanung und zur Forschungsförderung No. 66, Bonn 1998;
– BMBF (ed.): Weiterbildungsinstitutionen, Medien, Lernumwelten – Rahmenbedingungen und Entwicklungshilfen für das selbstgesteuerte Lernen, Bonn 1999;
– BMBF (ed.): Zur Zukunft der Weiterbildung in Europa – Lebenslanges Lernen für Alle in veränderten Lernumwelten, Bonn 1998;
– BMBF (ed.): Selbstgesteuertes Lernen – Dokumentation zum KAW-Kongress vom 04. bis 06.11.1998 in Königswinter, Bonn 1999;
– BMBF (ed.): Menschen im Übergang von der Erwerbsarbeit in den Ruhestand – Eine Herausforderung für die Erwachsenenbildung, Bonn 1999;
– Forum Info 2000 (ed.): "Kunst und Kultur in der Informationsgesellschaft".

INFO-BOX

THE BLK'S PILOT PROGRAMMES AT A GLANCE

General education

- Enhancing the efficiency of mathematics and science teaching
- Systematic inclusion of media, information and communications technologies in teaching and learning processes
- Education for sustainable development
- Quality enhancement in schools and school systems
- Lifelong learning
- Cultural education in the media age

Vocational training

- New learning concepts in the dual vocational training system
- Co-operation between places of learning in the field of vocational training

Higher education

- Modularisation
- New courses

Information: BLK, Hermann-Ehlers-Str. 10, D-53113 Bonn (http://www.blk-bonn.de)

INFO-BOX

LEAD PROJECTS ON *UTILISING THE KNOWLEDGE AVAILABLE WORLD-WIDE FOR INITIAL TRAINING, CONTINUING EDUCATION AND PROCESSES OF INNOVATION*

The objective of the five lead projects on *Utilising the knowledge available world-wide for initial training, continuing education and processes of innovation* is to promote the targeted and needs-oriented use of information and communications technologies in education. The range of projects corresponds to both the diversity and the overarching function which the use of IT already has in education today and will continue to have in the future.

The five lead projects, all of which are already underway, are:

- **L^3 Lifelong learning** – Continuing education as a basic need – consists of 17 sub-projects and receives approximately DM 29 million in funding from the BMBF. The project consortium headed by SAP is contributing about DM 16 million. The objective of the L^3 lead project is to develop, test and provide modern information technology and the necessary tools for vocational training. The core idea of the project can be described as a new, holistic multimedia service concept for education which integrates the fields of infrastructure, learning centres, content, technology and didactics.
- **MedicDAT** – Media interface for content-based connection of scientific documents, abstracts and textbooks – consists of 6 sub-projects and receives roughly DM 9 million in funding from the BMBF. The project consortium headed by Regensburg University Hospital is contributing funding of about DM 3 million. The objective of the project is to develop an integration platform for all types of electronically available knowledge.
- **SENEKA** – Service networks for initial and further training processes – consists of 26 sub-projects and is being provided with about DM 20 million in funding from the BMBF and about DM 24 million from the project consortium, which is headed by Aachen Technical University. SENEKA aims at the networking of providers and users of educational services and, based on this, the establishment of service networks.
- **VSC** – Networked chemistry studies – is headed by the Fachinformationszentrum Chemie Berlin (Berlin Chemistry Information Centre) and involves 15 university institutes; funding amounts to about DM 41 million. The aim is to create an electronic platform consisting of a network of knowledge modules which allows the available knowledge of chemistry to be optimally accessed, networked and used in training. The modularisation permits virtually any individual design of training course and thus takes into account the needs of a labour market which will be characterised by increasing dynamism in the future.
- **VFH** – Virtual Fachhochschule for technology, computer science and business – is being sponsored by a consortium of eleven Fachhochschulen (Universities of Applied Sciences) and two other higher education institutions, headed by Lübeck Fachhochschule; BMBF funding amounts to approximately DM 43 million. The services of various higher education institutions are being used to create a virtual Fachhochschule whose services are flexibly adapted to learning needs and will lead to internationally recognised degrees.
- The lead projects in this thematic area thus embrace both technical and organisational issues. The BMBF funding for the projects amounts to some DM 140 million. Together with the funding invested by the project partners in the total of 78 sub-projects, the overall funding volume easily exceeds DM 180 million.

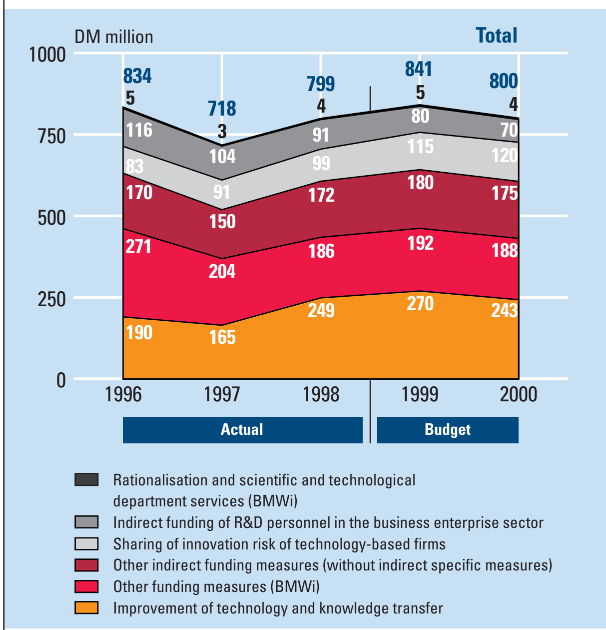
19. Innovation and improved basic conditions (Funding area T)

In order to safeguard Germany's competitiveness, it is important for small and medium-sized enterprises to become quicker at transforming the results of research and development into marketable products, processes and services, thereby creating jobs with a future. The Federal Government aims to put in place a technology-friendly and innovation-friendly environment and operates so-called indirect support measures which back the general innovative activities of small and medium-sized firms. Particularly intensive support goes to eastern German research and development activities, and especially the ongoing establishment of an innovative SME sector in the new *Länder*.

The Federal Government is particularly focusing on making its support for innovation more transparent and orienting it to the needs of small and medium-sized firms. The aim is to give the support system a clearer profile and to design the support programmes in a more consistent way. As part of the redistribution of responsibilities amongst federal ministries in autumn 1998, the primary responsibility for the promotion of innovation in small and medium-sized firms moved from the BMBF to the Federal Ministry of Economics and Technology (BMWi). Funding area T covers only part of the measures of the BMWi and the BMBF to promote innovation in small and medium-sized enterprises, since further support measures, e.g. support from specialised programmes in which small and medium-sized firms participate, are presented under the relevant funding areas.

Chart 51

Federal R&D expenditure on innovation and improved basic conditions



Source: BMBF *BMBF, BuFo 2000*

19.1 Indirect funding of R&D personnel in industry

Research policy objectives

The *R&D personnel funding* programme line in the BMWi programme for *Funding and promoting research, development and innovation in small and medium-sized enterprises and extramural industrial research institutions in the new Länder* marks an attempt by the Federal Government to stop the loss of commerce-related R&D capacities which is going hand in hand with the structural change in the economy in the new *Länder* and helps to strengthen the innovative capacity of small and medium-sized firms and of eastern German industrial research in general.

Thematic priorities – funding structures – results / developments

The BMWi supported numerous companies between 1992 and the end of 1997 under its *R&D personnel funding in the new Länder (PFO)* programme, which was designed to boost the number of R&D personnel in goods-producing companies in the new *Länder* and to encourage them to use their own R&D resources to implement product and process innovations. Since 1 January 1998, this measure has been continued in a modified form and on a degressive scale under the programme for *Funding and promoting research, development and innovation in SMEs and extramural industrial research institutions in the new Länder* as part of the BMWi's *R&D personnel funding* programme line. Support goes to the costs of personnel on permanent contracts working in the field of research and development in the companies and consists of grants of 40 per cent of the eligible expenditure up to a maximum of DM 300,000 per applicant and year. In 1999, some 1,340 firms received support totalling DM 76.7 million.

19.2 Improving the transfer of technology and knowledge

Research policy objectives

Innovative small and medium-sized enterprises have proved to be an important driving force behind economic performance and the creation of new, future-oriented jobs in Germany. In an environment of international competition, the demands imposed by globalisation, increasingly intensive research and rising product development costs necessitate an ability to co-operate on research, not least on the part of small and medium-sized firms. The Federal Gov-

Part III

ernment promotes such co-operation so that the results of research and development can quickly be utilised on the market. For the first time, the aim is to include even those small and medium-sized firms – such as crafts firms – which have not yet engaged in research. Also, greater attention is being given to a cross-sectoral approach involving different project sponsors.

Further to this, the BMBF's patent initiative, which was launched in 1996, aims at increased use of the patent system, particularly in the field of publicly funded research and of small and medium-sized companies, and at the increased use by industry of inventions and intellectual property from the research world.

Thematic priorities – funding structures – results / developments

Research co-operation among small and medium-sized enterprises – PROgramme INNOvation skills of small and medium-sized firms (PRO INNO)

The programme on *Research co-operation among small and medium-sized enterprises* which was launched in 1993 has over the last few years assisted more than 4,700 small and medium-sized firms in 6,700 projects to rapidly and successfully translate ideas into new products, processes or technical services via early co-operation between different companies and between companies and the scientific world. More than 1,800 of these assisted companies were from the new *Länder*. For more than 1,100 firms, the programme represented the first time they had engaged in transnational co-operation – involving partners in 60 countries and on all continents.

The total funding approved was DM 961 million, initiating R&D projects by small and medium-sized firms costing roughly DM 3.5 billion.

In May 1999, the BMWi's PROgramme INNOvation skills of small and medium-sized enterprises (PRO INNO) was launched as a new measure. The programme promotes innovation in various areas of technology and boosts the experience of small and medium-sized companies in the field of technology co-operation.

PRO INNO provides grants towards:

- Joint R&D projects between companies or between companies and research institutions implemented in a national or international framework;
- R&D projects by companies which are engaging in their own research and development for the first time or for the first time in five years, including the subsequent market launch of the results;
- Temporary secondment of R&D personnel between companies or between companies and research institutions in Germany and abroad for an R&D project.

The new programme component entitled *Gateway projects* is expanding the group of companies submitting applications from the current level of 30,000 or so to 50,000. This will also introduce craft firms to research and development.

PRO INNO has rapidly become an important means of innovation promotion in small and medium-sized firms. Up to 2003, there will always be some 1,500 R&D projects receiving support, with at least 6,000 employees working on them each year in the development phase alone.

Since roughly seven downstream jobs depend on each job in research and development, the programme is helping to safeguard or create roughly 48,000 jobs a year.

Advice on ways to initiate and develop cross-border projects is available from an international technology co-operation network. This network has been built up in co-operation with the Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V. (AiF – German Federation of Industrial Co-operative Research Associations), the Deutscher Industrie- und Handelstag (DIHT – Association of German Chambers of Industry and Commerce) and the Fraunhofer Gesellschaft (FhG – Fraunhofer Society) in technologically interesting countries and in growing markets in central and eastern Europe, south-east Asia and Latin America. At present, there are 19 contact offices for German small and medium-sized firms – e.g. in Moscow, Kiev, Minsk, Warsaw, Budapest, Prague, Beijing, Jakarta, Singapore, Malaysia, New Delhi, Seoul, Buenos Aires and Mexico.

INFO-BOX

PROMOTION OF INNOVATIVE NETWORKS

In September 1999, the BMWi launched the Promotion of Innovative Networks – InnoNet Programme. InnoNet promotes precompetitive collaborative projects involving at least four companies and at least two research institutions of different funding organisations. It is intended to facilitate the transfer of knowledge to small and medium-sized companies and also to encourage German research and higher education institutions to orient their research work more to the needs of small and medium-sized companies. A competitive tender procedure ensures that only projects with a high innovative benefit are funded.

Almost 300 sketches of ideas were received during the first round of competition, reflecting the great interest of small and medium-sized firms in practical research co-operation. It is encouraging that roughly half of the project proposals are coming from research institutions in the new Länder. Furthermore, the vast majority of proposals aim at co-operation between the eastern and western parts of Germany. This shows that Germany's research system is integrating.

BMBF patent initiative

Innovations and their transformation into technology and commercial production are central to ensuring Germany's continuing competitiveness. Inventions and patents are essential parts of the process of innovation. For this reason, the BMBF took the initiative in 1996 to target support at inventions and to ensure that broad use is made of the instrument of industrial property rights. Major focuses and results of the patent initiative are currently:

- Improving the basic conditions for patenting and exploiting the results of publicly funded research: under the reformed accounting rules, the institutions may now utilise all the revenues from patent exploitation. This stimulates greater responsibility in the field of patent management in the research institutions.
- Reformed rules on property rights for the research funded by the BMBF and the BMWi (partially): the recipient of the funding is obliged to exploit the results of the research. To this end, he is given the necessary legal scope (possibility of exclusive use and

of issuing exclusive licences). All the revenues from this are retained by the grantee. As in the past, the costs of patenting for publicly funded research institutions and small and medium-sized enterprises are eligible for support.

– Establishment of efficient and nation-wide exploitation networks for the publicly funded research institutions (e.g. patent and licensing agency for the German Human Genome Project).
– The Patentstelle für die Deutsche Forschung (PST – Patent Agency for German Research), which is funded jointly by the Federal Government (BMBF) and the *Länder*, advises inventors (especially from the scientific world) and research institutions on invention and patent matters and supports them in safeguarding their industrial property rights and exploiting their inventions.
– As part of the BMBF's INSTI project to stimulate innovation in German industry (http://www.insti.de), a nation-wide network of 30 institutions in the field of inventions and patents has been established. These offer companies, researchers and individual inventors advice and support in evaluating, patenting and exploiting inventions.
– The BMBF's patenting campaign for small and medium-sized firms supports the first patent application by such a firm or by a start-up. In view of the great demand (over 2,000 funding approvals), the scheme has been extended. The back-up and financial support for their first patent application enables the assisted firms to make proper use of the patent system and of patent information.
– 1998 saw the launch of Innovation Market (http://www.venture-management-services.de/innovation), an Internet marketplace for high-value inventions run by Deutsche Börse AG and the Kreditanstalt für Wiederaufbau (KfW – Reconstruction Loan Corporation). Special quality standards and consistent demand-oriented handling of the inventions and their market opportunities ensure the high quality of what is on offer and thus the particular interest of the capital providers for this intermediary service. The BMBF is supporting involvement in Innovation Market via its exploitation-promoting INSTI project.

Projects to improve technology transfer

From 1989 until 1999, the BMWi promoted technology transfer benefiting small and medium-sized manufacturing companies and crafts firms. The emphasis was on the new *Länder*, where an infrastructure for technology transfer covering the whole area was set up consisting of 20 regionally-based Agenturen für Technologietransfer und Innovationsförderung (ATI – Agencies for Technology Transfer and Innovation Support) with 5 branch offices and 12 supraregional industry-specific or technology-specific transfer centres. Since 2000, the programme has been converted to performance-based and results-oriented support requiring a substantial contribution from the companies receiving advice.

Technology-oriented visit and information programme (TOP)

Under this programme, the BMWi offers innovation-oriented corporate specialists and managers the chance to visit leading technology firms and to attend one-day events at such firms in order to learn about the successful use of innovative technologies and corporate structures. The participants are offered up-to-date knowledge which has been tested in practice. This is an example of direct technology transfer. The TOP programme has developed into a well-established element of innovation-oriented information provision by businesses for businesses.

19.3 Sharing the innovation risk of technology-based firms

Research policy objectives

The availability of venture capital is vital if rapidly growing technology companies are to succeed. That is the only way to finance this growth and to turn it into viable jobs. For this reason, the Federal Government has created incentives for capital providers to invest in small technology companies. Since the beginning of 2000, the support has been focused more on the early phase. Also, direct support is being given to technology-oriented start-ups in the new *Länder*.

Thematic priorities – funding structures – results / development

"Venture capital for small technology-based companies" (BTU)

This programme was started in March 1995 as a follow-up to the BJTU programme (Direct investment capital for new technology-based companies). The aim of the present programme is to broaden the equity base of small companies so that they can implement risky R&D projects. This is achieved by providing incentives for venture capitalists to involve themselves more intensively than in the past in the early phase of small technology-based firms. The BMWi backs part of the risk of the equity providers with a guarantee.

The programme is run in two forms by the KfW and the Technologie-Beteiligungs-Gesellschaft (tbg – equity investment company for technology-based firms), a subsidiary of the Deutsche Ausgleichsbank (DtA – German Equalisation Bank). The tbg invests in young technology-based firms where a lead investor provides at least the same amount of investment capital (co-investment form). The tbg can recompense the lead investor for part of any losses from his investment. The KfW uses long-term loans to refinance venture capitalists who pass this money on to young technology-based firms in the form of equity (refinancing form). The KfW can exempt the equity provider from liability for the refinanced loan.

Funding and supporting new technology-based firms in the new Länder (FUTOUR/FUTOUR 2000)

The recently modified FUTOUR 2000 programme helps people wishing to start up a technology-based firm (no more than one year old, with a maximum of ten staff members) in order to foster innovative structures of small and medium-sized companies in the new *Länder*. R&D projects are financed via a combination of grants and project-related dormant equity holdings and assisted by comprehensive advice during the start-up phase and support during the entire project.

During the three years from 1997 to 1999, under the original FUTOUR programme, 160 technology-intensive and research-intensive start-ups were assisted with grants totalling about DM 110 million and venture capital totalling DM 120 million. Together with the previous *Technology-oriented start-ups (TOU)* programme, this support has stimulated the establishment of more than 500 highly innovative firms.

INFO-BOX

HIGH RATE OF NEW START-UPS OF SMALL TECHNOLOGY-BASED FIRMS

Venture capital

The venture capital market for innovative companies in Germany has developed in an extremely dynamic manner, particularly due to the BMWi's *Venture capital for small technology-based companies (BTU)* programme. This programme strengthens the equity base of small and medium-sized enterprises by providing incentives to venture capital companies and other equity providers to become more intensively involved in the development phase of small technology-based firms. In 1999, the programme was able to mobilise some DM 1.5 billion for small and medium-sized technology-based enterprises, almost twice as much as in 1998. Germany thus takes a leading place in Europe in terms of early-phase financing. The outlook is good for Germany to become a top address for young, innovative companies around the world. If one compares the German figures with those of the United States, however, there is still considerable potential for growth in the German venture capital market for early-phase financing.

Successful young technology-based companies make an above-average contribution to job-creation. After four years, they employ approximately 20 staff on average. On top of this, there are effects on employment levels in supplier firms and customer companies. Studies show that the costs incurred by the BTU programme per assisted job are DM 15,000.

In addition, the BMWi supports events which bring together those providing and those needing capital. One example is the Equity Forum series of events organised by the KfW together with Deutsche Börse AG.

EXIST – Business Start-ups from Universities

In order to improve the climate at higher education institutions for starting new businesses and to boost the number of start-ups originating in the academic world, the BMBF launched the EXIST competition in 1997. In five selected regions, the integration of existing capacities and the creation of optimal structures and innovative strategies are producing models for the motivation, training and support of new entrepreneurs. The higher education institutions and their partners in the academic world, business and government are working together in these regions to build up a networked service for students, staff and graduates (cf. section 22).

Business Angels Netzwerk Deutschland

Germany lacks a culture of private support for new entrepreneurs. There is a need for business angels – i.e. private venture capitalists who inject equity and management know-how into young firms, thus acquiring a participation in the company. Germany has a large number of entrepreneurs, senior managers, university lecturers interested in business, etc. who are prepared to get involved with innovative start-ups. The number of active business angels is currently estimated at roughly 27,000. The potential number is probably several times that. The Business Angels Netzwerk Deutschland (BAND), which is supported by the BMWi together with sponsors from business, provides an important stimulus towards mobilising this potential. Since it was founded in 1998, BAND has particularly fostered contacts between business angels and innovative entrepreneurs, and has supported the establishment of regional networks.

With FUTOUR 2000, the BMWi is making an important contribution towards the rate of business start-ups in the new *Länder*. By 2003, the programme will have helped some 200 technology-based companies to get going. Going by past experience, these firms will directly create about 3,500 sophisticated and viable jobs in the first six years.

19.4 Other indirect funding schemes

BMWI support for co-operative industrial research

The programme supporting *Co-operative industrial research by small and medium-sized enterprises (IGF)* is based on the experience that small firms cannot generally afford to engage in their own research activity. For this reason, some 50,000 generally small and medium-sized firms have formed 107 sector-based or technology-based research associations, which in turn are members of their umbrella organisation, the "Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V." (AIF – German Federation of Industrial Co-operative Research Associations) (cf. Part VI, section 1.5).

Within these research associations, the companies formulate research projects in direct contact with some 800 research centres and assist in their realisation. The involvement of the small and medium-sized firms in the realisation of the projects ensures that the results are rapidly transferred into practice. The results are published and are available to all companies.

The BMWi supports the IGF projects on top of the contribution made by industry. In 1998, the contribution from industry was two and a half times as high as the government funding.

In order to encourage cross-sectoral research and development within the AiF, the BMWi launched an initiative programme on *Future technologies for small and medium-sized enterprises (ZUTECH)* in 1999. The R&D projects funded under this programme are expected to bring about results which will lead to new technologies or transfer them to other sectors. At least two research bodies must be involved in the projects. The projects are selected on the basis of competitive principles (project ranking).

ERP innovation programme

In the framework of the ERP innovation programme and its loan-based and equity-based forms of support, the BMWi uses funding from the ERP (European Recovery Programme) special fund to foster the technological competitiveness of small and medium-sized firms. On the loan-based side, the KfW provides low-interest loans via commercial banks to implement market-oriented research and development for new products, processes and services and their market launch. Depending on the size of the firm to be financed, the commercial banks can be granted partial exemption from liability for their loans.

This loan-based side of the ERP innovation programme has succeeded in encouraging companies which had previously done little R&D to increase their commitment in this area. From the launch of the programme in 1996 to the end of 1999, more than 2,300 loans totalling some DM 5.2 billion were granted via the KfW. In 1999, the volume of loans was around DM 1.4 billion. Studies of loans in the technology sector confirm their significant positive contribution towards creating and safeguarding jobs.

Since the beginning of 1999, the BMWi has supplemented the range of support available towards the provision of venture capital for innovative companies by introducing an equity-based side to the ERP innovation programme. Under this option, the KfW offers venture capital providers which invest in small and medium-sized firms in order to realise research, development and market launches the chance to receive low-cost refinancing with partial exemption from liability. In 1999, 101 holdings involving venture capital totalling DM 163 million were refinanced.

19.5 Rationalisation and scientific and technological departmental services

Rationalisation, research, development and innovation are of great significance for the performance and competitiveness of German industry. Under the umbrella of basic funding for institutions the BMWi supports these aspects by providing grants to the Rationalisierungs- und Innovationszentrum der Deutschen Wirtschaft (RKW – Rationalisation and Innovation Centre of German Industry), the Arbeitsgemeinschaft für Wirtschaftlichkeit in der Verwaltung (AWV – Association for an Efficient Administration) and the Institut für Mittelstandsforschung (IfM – Institute for Research into Small and Medium-Sized Enterprises) in Bonn. In this way, companies are assisted in economic, technological, environmental and social terms in the form of advice, information and training events, scientific, economic, technological, ergonomic and social science studies and in implementing rationalisation results.

The aim is to ensure top-quality German products. The agencies of the BMWi, i.e. the Bundesanstalt für Materialforschung und –prüfung (BAM – Federal Institute of Materials Research and Testing), the Physikalisch-Technische Bundesanstalt (PTB – Federal Institute of Physics and Metrology) and the Bundesanstalt für Geowissenschaften und Rohstoffe (BGR – Federal Institute for Geosciences and Natural Resources) ensure that the infrastructure for technical services to industry is maintained at a high level and also make important contributions towards technology transfer.

19.6 Other funding schemes (BMWi)

BMWi innovation funding in the new Länder

Support for projects by innovative companies and extramural industrial research institutions in the new Länder

This scheme is a modified continuation of the programme for *Funding R&D projects conducted by industry-related research institutions in the new Länder* and supports the establishment of efficient, market-oriented R&D facilities in the new *Länder*. Under the new guidelines, which have been in force since 1 January 1998, young innovative companies which have not existed for longer than three years are also eligible for the R&D project support. The prime target groups are research-intensive companies, R&D service providers and extramural industrial research institutions. To some extent, these are research capacities which have been hived off from the former state-owned "combines" and from institutes of the former GDR Academy of Sciences.

Between 1991 and the end of 1999, a total of roughly DM 1,253 million was granted to 5,611 research projects. A growing proportion of the projects receiving funding can be categorised as recognised forward-looking technologies, such as information and communications technologies, new technologies in mechanical engineering and environmental technology. The programme for the *Promotion of research, development and innovation in small and medium-sized enterprises and extramural industrial research institutions in the new Länder*, which also includes the *R&D personnel funding* programme line, will probably be continued until the end of 2004.

Programme to boost innovation and the transfer of technology in small and medium-sized enterprises (crafts, industry, trade, services and liberal professions)

In 1999, together with the Heinz-Piest-Institut für Handwerkstechnik (Heinz Piest Institute of Crafts Technology) at Hanover University, the BMWi launched a nation-wide technology campaign aimed at the crafts sector and comparable small and medium-sized enterprises. In co-operation with business and the Länder, a range of measures were designed, e.g.

- advice centres in the chambers of crafts, to form a nation-wide network,
- technology transfer agencies in selected inter-company vocational training facilities,
- management courses to impart management and decision-making expertise in the field of the new technologies, and
- integrated advice and information systems to network the expertise of many technology advisers.

The intention is to pass on up-to-date technological expertise to the companies and ensure more rapid implementation of research findings. The measures are jointly managed and financed with the *Länder* and the business sector. The projects require a substantial contribution from the companies themselves.

Part III

Improvement of regional economic structures – a joint responsibility
The aim of the joint scheme is to promote measures in structurally weak regions which serve a lasting increase in per-capita income and the creation/preservation of competitive long-term jobs in the region. In line with Article 91a of the Basic Law, the Federal Government is involved in the framework planning and the funding of the scheme, but its implementation is the responsibility of the Länder. Since the 24th framework plan from 1995, the scheme – in addition to investment grants towards trade and industry projects and towards municipal business-related infrastructure measures – has been able to give support to certain clearly defined non-investment-related projects. This broader mandate means that the scheme also contributes to innovation and technology policy, e.g. in the form of:
– Grants towards corporate investment in the field of research and development;
– Investment in industry-related infrastructure (e.g. facilities for retraining and further training, trade and technology centres);
– Promotion of non-investment-related measures, e.g. applied research and development or formation of human capital.

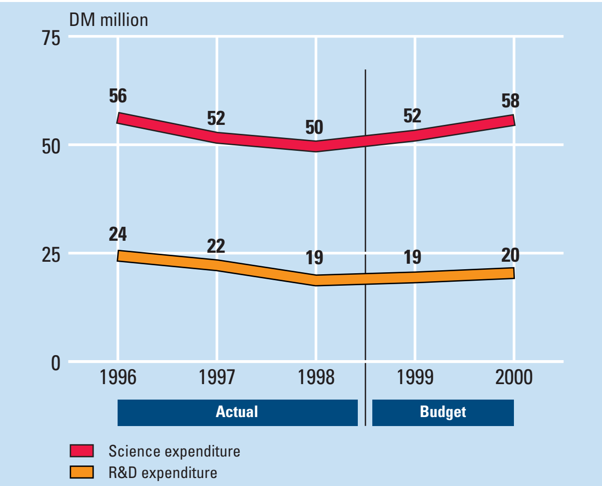
Literature
– BMBF/BMWi brochure: Innovationsförderung – Hilfen für Forschung und Entwicklung, 2000;
– BMWi brochure: Wirtschaftliche Förderung – Hilfen für Investitionen und Innovationen, 2000;
– BMWi brochure: Technology policy – paths to growth and employment; December 1999
– On the BMBF patent initiative:
– BMBF patent server with information on patent policy and all BMBF funding measures for inventions and patents: http://www.patente.bmbf.de

20. Specialised information (Funding area U)[1]

Research and development to improve the scientific and technical infrastructure of information is increasingly aimed using the electronic media to gain optimal low-cost access to information, and at making use of their capacities in a world-wide network. The *Information as raw material for innovation 1996–2000* programme, which in the past formed the core of the specialised information funding priority, has now become an integral element of the Federal Government's multimedia strategy (cf. section 9). The guiding concept in the field of scientific and technological information/libraries is the gradual formation of a Digital Library which permits rapid and comprehensive access to the scientific information available around the world.

Chart 52

Federal science and R&D expenditure on specialised information



Source: BMBF — *BMBF, BuFo 2000*

Research policy objectives

The funding activities aim at the creation of a Digital Library based on a division of labour and distributed information systems. This implies not the establishment of a new central institution or the implementation of an abstract concept, but the integration of targeted development activities by all participants. In addition to the outstanding technical problems related to the provision of electronic information, the main problems are that a never-ending quantity of scientific information is accessible via numerous "information channels", in various publications and in ever more complex delivery forms, and that it is becoming more and more difficult to offer the user a reliable orientation whilst retaining any claim to completeness. Many issues related to ensuring the quality and authenticity of electronic information, long-term availability and respect for copyright interests in accessing electronic publications remain to be resolved.

[1] Since 1995, the activities of the BMBF in the field of specialised information have been covered by the multimedia funding priority (cf. section 9). Individual measures of other ministries have not yet been transferred, but are still temporarily allocated to funding area U (specialised information). In order to present this funding area in a coherent fashion, the thematically similar activities of the BMBF (cf. section 9) are included; the BMBF's spending on R&D in this area is covered in section 9 (multimedia).

Funding structures
The measures are concentrated on the development of an Internet-based infrastructure and comprise the improvement of the basic conditions (standards, technical standards), institutional funding in certain priority areas and knock-on funding for development projects.

Thematic priorities – results / developments

Ongoing development of the scientific and technical information structure for a Global Digital Library
Extension of the electronic publication structure from generation to refinement, collation and publication through to preparation, distribution and ensuring the availability of the information, especially in multimedia forms of publication. Creation of technical tools (e.g. intelligent user systems, content-based search modes, archiving processes which offer long-term stability).

Electronic and multimedia publishing
Further development of the scientific and technological book into a multimedia representation of knowledge via 13 collaborative projects.

Expansion of the electronic information and document delivery services at scientific libraries
Further development of the co-operative electronic document delivery service of German libraries, a scheme initiated by the BMBF together with the *Länder*.

Promotion of the use of electronic and multimedia information in initial and further training, research and business
– Applications of information technology in the business sector, acceptance of and basic conditions for the information industry (BMWi);
– Pilot projects on the thematic use of electronic and multimedia sources of information in specialised school teaching at upper secondary level;
– Further development of the science information service (idw) for quick information research by journalists and for their rapid referral to experts.

Funding of the information infrastructure
Provision of constantly updated specialised information for the (specialised) public and the Federal Government by the Deutsches Institut für medizinische Dokumentation und Information (DIMDI – German Institute for Medical Documentation and Information), the Fachinformationszentrum Karlsruhe (FIZ-Ka – Specialised Information Centre), the Fachinformationszentrum Chemie (Specialised Chemistry Information Centre), the Technische Informationsbibliothek (TIB – Electronic Specialised Information Library) in Hanover, the Zentralstelle für Psychologische Information und Dokumentation (ZPID – German Centre for Documentation and Information in Psychology) at Trier University, and the Zentralstelle für Agrardokumentation und -information (ZADI – Central Agricultural Documentation and Information Office).

The specialised information centres and the specialised libraries are continuously expanding their electronic information services via the Internet. In order to give users a full overview of the publications in the relevant specialisation and immediate electronic access to the full text, the BMBF is funding the establishment of information networks between libraries and other service providers. This is resulting in the creation of large Internet-based information systems via which the participating institutions can offer the relevant scientific information and publications in their specialisation on the basis of co-ordination and a division of labour.

Literature
– BMBF brochure on the Federal Government's "Information as raw material for innovation 1996-2000" programme;
– BMBF brochure on the Federal Government's "Innovation and Jobs in the Information Society of the 21st Century" action programme, section on the Digital Library;
– For development projects cf.: http://www.darmstadt.gmd.de/PTF;
– http://www.GLOBAL-INFO.org;
– http://www.subito-doc.de;
– http://www.tu-clausthal.de/idw/.

Info-Box
Science information service
The science information service (idw) has been built up by the press offices of Clausthal Technical University, Bochum University and Bayreuth University in order to improve contact between science and the public. Some 450 higher education and research institutions are now included. The idw particularly supports journalists researching scientific topics and refers them to experts who can provide specialist knowledge. Companies searching for scientific findings are also supported. In addition, the service runs a "science marketplace" with information for the general public. The BMBF is providing funding of roughly DM 1.7 million as initial support for the online service.

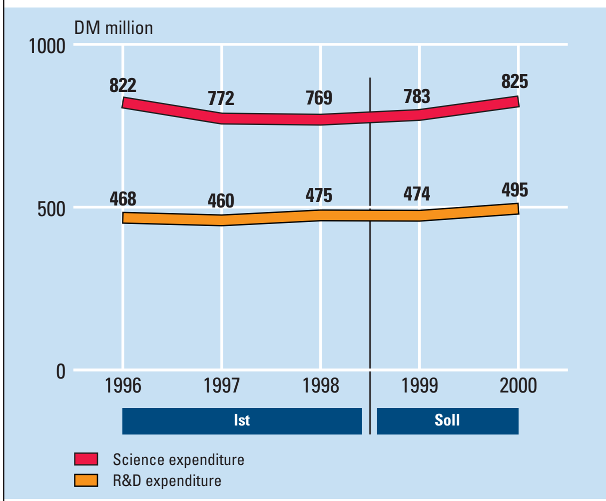
Further information at http://www.tu-clausthal.de/idw/

21. Humanities; economic and social sciences (Funding area V)

Questions and findings from the humanities and social sciences are becoming more and more important in modern industrial nations. The ongoing and ever accelerating change is making them indispensable in order both to preserve culture and identity and to cope with changes in a sustainable manner. Increasingly, they are being funded on an international basis.

Chart 53

Federal science and R&D expenditure on humanities, economics and social sciences



Source: BMBF — *BMBF, BuFo 2000*

Research policy objectives

The *humanities* – society's sophisticated long-term memory – have come to embrace further new areas of significance in recent years. Today, they are viewed as an indispensable counterweight to the constant threat of loss of culture due to an overemphasis on "technical sciences". Here, the emphasis is on their great potential to create links between people – from individuals to the world's cultures. Their approach – albeit lagging behind other fields of science – is increasingly based on interdisciplinary and international co-operation.

The *social and economic sciences* analyse the causes and directions of social and economic change and development and endeavour to indicate options for solutions to social problems. The guiding concept of a sustainable development that is viable in the long term presents a challenge to socio-economic research in Germany in view of the continuing lack of specific knowledge and understanding of social and economic innovations which lead towards sustainable development. The social and economic sciences are called upon here to make their contribution.

Thematic priorities – funding structures – results / developments

21.1 Humanities

The subject of the humanities in all the various disciplines – from theology and philosophy to studies of antiquity and history, languages and arts – is the cultural form of the world.

Traditionally, most research in the humanities in Germany has taken place at higher education institutions. A considerable proportion of the funding for it is therefore provided solely by the *Länder*. However, on the basis of agreements between the Federal Government and the *Länder* on the joint funding of research pursuant to Article 91b of the Basic Law, selected activities in the humanities are now jointly funded both at universities and in the non-university sector. Important criteria for this are that the activities funded are of supraregional significance and of interest in terms of national science policy.

The funding provided by the Deutsche Forschungsgemeinschaft (DFG), a body which is jointly financed by the Federal Government and the *Länder*, is of fundamental importance for the humanities in Germany (cf. Part VI, section 1.1). A new aspect here since 1996 is the funding of projects in the six humanities research centres set up in the new *Länder* at the recommendation of the Science Council following the closure of the Academy of Sciences of the GDR.

There are currently around 160 Academy of Science projects of the Federal and *Länder* governments, and these are co-ordinated by the Union der deutschen Akademien der Wissenschaften (Union of German Academies of Science). As part of the streamlining of government work, the joint funding of the projects has been included in the funding programme of the BLK's research funding committee from 2000.

The non-university research institutes, museums and archives primarily do research and documentation work which, in view of its scale and the effort required, cannot be usefully done at higher education institutions.

In one area, the 1975 Skeleton Agreement on Research Promotion forms the basis for financing: In addition to eight institutes of social and legal sciences, the Max-Planck-Gesellschaft (MPG – Max Planck Society) runs three humanities institutes (cf. Part VI, section 2.1). In addition, six Blue List humanities institutions are funded (cf. Part VI, section 4). Federal funding comes from the Federal Ministry of the Interior (BMI), the BMBF and the Federal Government Commissioner for Culture and Media Affairs (BKM).

Beyond the Skeleton Agreement on Research Promotion , the Federal Government (in the form of the BKM) and the *Länder* jointly fund the Stiftung Preussischer Kulturbesitz (Prussian Cultural Heritage Foundation), which pursues research in the humanities, particularly in the State Museums, the State Library and the Staatliches Institut für Musikforschung (State Institute for Musical Research) in Berlin.

Also, the BKM – in some cases together with the host *Land*, in other cases jointly with all the *Länder* – funds the institutions united in the Arbeitskreis selbständiger Kulturinstitute (ASKI – Working Group of Independent Cultural Institutes). Particular mention should be made of the research into original sources from collections in the Deutsches Literaturarchiv der Deutschen Schillergesellschaft (German Literary Archive of the German Schiller Society) in Marbach, the Freies Deutsches Hochstift/Goethe-Museum (Free German High Foundation/Goethe Museum) in Frankfurt am Main, the Beethoven Archive of the Verein Beethoven-Haus (Beethoven's Birthplace Association) in Bonn and the linguistic studies of the Gesellschaft für deutsche Sprache (German Language Society). The Stiftung Weimarer Klassik (Weimar Classics Foundation) and the Stiftung Bauhaus Dessau (Bauhaus Dessau Foundation) also receive basic funding from the BKM and the respective host *Land*.

Without contributions from the *Länder*, the Federal Government finances the following institutions dedicated to the humanities, and projects of national significance, some of them as projects of departmental research:

The joint task of the eight humanities research institutes abroad funded by the BMBF (cf. Part VI, section 5. 14. 2-9) is to act as nodes of communication in the humanities through research, service and support for young researchers and thus to intensify international scientific co-operation. As the Wissenschaftsrat (Science Council) confirmed in November 1999, these institutes are not merely a key part of the institutional structure of German research, but also make an important contribution to the infrastructure of international research into the humanities.

The **BMBF** intends from 2001 to participate in the funding of the *Centre Marc Bloch* in Berlin, which so far has been funded exclusively by France. In 1997, the *Deutsches Kunsthistorisches Forum Paris* (German Art History Forum Paris) was established as a project of the Munich-based Zentralinstitut für Kunstgeschichte (Central Institute of Art History).

In addition, the BMBF funds selected individual projects, particularly in the fields of protecting cultural assets and of applying methods used in the natural sciences and new technologies in the humanities. The worrying structural damage to the monuments of history and cultural identity, particularly in the 20th century, necessitates increased efforts to preserve them. Here, consideration must be given to the relevant EU support measures under the research and culture framework plans. Important findings are deriving from co-operation with China and Japan. Also – particularly under the US-German Transcoop programme – there is the possibility for joint projects by German and foreign experts in the humanities and social sciences, so that bridges can be built and extended here too.

The **Federal Foreign Office** funds research into the humanities through the Deutsches Archäologisches Institut (DAI – German Archaeological Institute) in Berlin and its numerous branches in a range of countries (cf. Part VI, section 6), and also via the various programmes of the Alexander von Humboldt-Stiftung (AvH – Alexander von Humboldt Foundation) and the Deutscher Akademischer Austauschdienst (DAAD – German Academic Exchange Service) (cf. Part VI, sections 1.2, 1.3).

The **BKM** funds scientific libraries and archives (e.g. the Deutsche Bibliothek (German Library, Frankfurt am Main)) and institutions of political education (the Konrad Adenauer House and President Friedrich Ebert Memorial Foundations), the Hochschule für jüdische Studien (Institute of Jewish Studies) in Heidelberg and the Leo Baeck Institute with branches in Jerusalem, London and New York. In addition, the BKM funds the Institut für Kulturpolitik der Kulturpolitischen Gesellschaft e.V. (Cultural Policy Institute of the Cultural Policy Society), which provides expert back-up for future cultural policy decisions through its work to clarify the conditions and impact of decisions, processes and actions in the field of cultural policy.

21.2 Economic and social sciences

The scientific and technical, economic and political developments in modern societies are engendering deep-rooted changes at the level of social co-existence. To achieve a comprehensive and integrated understanding of these developments and to assess how to deal with them in future, it is vital for the social sciences, including legal and economic sciences, to interact. At the European level, there is a clear emphasis on strengthening the basis of socio-economic knowledge. This funding area has gained substantially in significance in the Fifth Framework Programme for Research of the European Union, both in terms of science policy and of funding, and it is to be developed further in future (cf. Part V).

Funding in the BMBF's sphere of responsibility

From the point of view of research policy, the social sciences are called upon to give active consideration to the guiding concept of sustainable development (cf. in this regard the recommendations submitted by the Bundestag Enquete Commission on the Protection of Humanity and the Environment [cf. Literature]). The social conditions for sustainability, which so far have been largely neglected, must be researched in just as concentrated a form as the tolerance limits of the natural environment. The analysis of the interactions and links between natural and social systems can result in substantial progress on defining the concept of sustainability more specifically and developing successful sustainability strategies.

The funding aims to strengthen and develop expertise and research capacities in the social sciences, not least with a view to implementing the guiding concept of sustainability. The BMBF is already supporting the main large-scale instruments and infrastructures of the social sciences, such as the Sozioökonomisches Panel (SOEP – Socio-Economic Panel), the Gesellschaft Sozialwissenschaftlicher Infrastruktureinrichtungen (GESIS – Association of Institutions Providing a Social Science Infrastructure), etc. and will continue collating the data collected with their assistance. In addition to the data collected by the scientists themselves, the data provided by official statistics are one of the most important sources of information for empirical social and economic sciences. It has already been possible to make important sources of microdata from official statistics available to science in an anonymous form. In order to improve co-operation between science and official statistics, the BMBF set up a Commission to Improve the Information Infrastructure Between Science and Statistics in September 1999, involving representatives from official statistics, science and administration. The Commission will probably present its proposals at the end of 2000.

The social science-based reporting on technology, which investigates the interrelationships between the use of new technologies and structural changes in important social fields, has been continued. On this basis, the focus in future is also to be on addressing questions of social and economic sustainability. In the field of science research, work has been encouraged on innovative search processes in order to support new scientific ideas and topics which run across the individual disciplines and traditional structures.

In addition, social science research is integrated as an element in many of the BMBF's technology funding programmes (cf. in particular sections 8 and 22).

The BMBF and the Berlin government provide basic funding for the Wissenschaftszentrum Berlin für Sozialforschung (WZB – Social Science Research Centre Berlin), an institution which is working on problem-oriented basic social science research and which is achieving an exemplary and internationally recognised combination of basic research and a focus on individual problems (cf. Part VI). The Federal Government and the *Länder* jointly fund GESIS, which is tasked with providing basic social science services for the scientific world and for government on a supraregional and international basis (cf. Part VI). The Federal Government and the *Land* government of Berlin each provide half of the funding for the „Wissenschaftskolleg zu Berlin" (German Institute for Advanced Study), an institute based on the Princeton model.

Funding in the sphere of responsibility of the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ)

The research funded by the BMFSFJ supports the departmental work being done by the ministry by providing the back-up required for its specialised and political work. New findings are needed, particularly in view of the current priorities, in the fields of family affairs, senior citizens, women, children and adolescents and their interrelationships. This work is being done both via contract research into specific issues and via basic funding for research institutions (Deutsches Jugendinstitut [DJI – German Youth Institute], Deutsches Zentrum für Alternsforschung [DZFA – German Centre for Research on Ageing], Deutsches Zentrum für Altersfragen [DZA – German Centre for Gerontological Issues], Institut für Sozialarbeit und Sozialpädagogik [ISS – Institute for Social Work and Social Education]).

Family research

The focus of research into family affairs is on the ongoing observation of the development of the material and actual situation of families and of the ways in which families and generations live together. Current research work is focusing on the economic situation of families (especially measures to prevent poverty, e.g. of single mothers), behaviour towards family members (non-violent upbringing, prevention of social disorders in children and adolescents) and the division of labour between the parents (particularly fathers' motivation to share upbringing and family duties on a basis of partnership).

Gerontological research

The aim of gerontological research is to obtain insights into the conditions of ageing and of life in old age, into the repercussions of an ever increasing proportion of old people in society, and into questions of integrated relationships. It is necessary both to develop future scenarios for society and to prepare political and structural measures in good time, in particular for older people who need help and care. Here, special significance attaches to the development of quality standards for the care of patients with dementia and to more efficient and economic assistance systems (structures of assistance for the elderly in future). Beyond this, the continuation of the survey on ageing is a priority of gerontological research.

Gender research

R&D projects in the field of gender research aim to make progress on the equality of women and men in all areas of social reality, to promote the integration of girls and women into the world of work, to achieve equal pay, to reduce barriers in the way of equal participation of women and men at home and at work, and to promote access for women to decision-making processes and positions in politics and society. Research into the causes of violence and the exclusion of women in particular situations is a further priority. As a cross-disciplinary task, the BMFSFJ provides backing for these issues not only via its own research and pilot projects, but also by endeavouring to entrench gender issues in the other federal funding priorities (e.g. in health research, environmental research, etc.) on the basis of a gender-mainstreaming approach.

Children's and youth studies

The aim of children's and youth studies is to analyse the repercussions of structural change on the lives of children and adolescents – and particularly on their educational and developmental processes – and to study the public welfare systems in the field of child and adolescent welfare. Important instruments here include the Federal Government's Youth Reports, the DJI youth survey and the permanent monitoring project on assistance for young people and social change, run by the DJI.

Funding in the sphere of responsibility of the Federal Ministry of Labour and Social Affairs (BMA)

The BMA's departmental research focuses on shaping the basic social policy conditions and their integration with other policy fields, such as economic, structural and fiscal policy. It is intended to make conceptual contributions towards policy development and to analyse and assess the effectiveness of instruments of social policy.

Important fields of study include the acquisition of socio-economic data on the pension insurance systems in Germany and on pension provision for future pensioner households, the effectiveness of the instruments of active labour market policy, health protection at work, the employment of foreign workers and their integration into the company and society, occupational rehabilitation and European labour market and social policy.

Since 1998, the BMA has also been responsible for welfare assistance. Here, the research priorities are on preventing social exclusion, avoiding the need to receive public assistance, creating targeted incentives to work, and achieving an adequate and socially acceptable way of meeting the demand for social assistance.

The BMA is supported in projects involving labour studies and in labour market research by its agencies: the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA – Federal Institute for Occupational Safety and Health) and the Institut für Arbeitsmarkt- und Berufsforschung (IAB – Institute for Employment Research) of the Bundesanstalt für Arbeit (BfA – Federal Employment Service) (cf. Part VI, section 6).

Funding in the sphere of responsibility of the Federal Ministry of Health (BMG)

Research in the field of social sciences has made a vital contribution to the success of the psychosocial measures carried out in Germany to combat AIDS. All the educational, care and advisory measures are based on the findings and results of such research. In particular, without social science research and the implementation of its results, a climate of understanding for and solidarity with people infected with HIV and suffering from AIDS would not have developed in society.

In future, studies in the field of social sciences will have to look at issues like how the effectiveness of information and educational measures can be maintained, so that there is no retrograde development in the way people protect themselves, and what psychosocial support and advice is needed to complement the use of new drugs against AIDS in order to ensure successful treatment. Following the evaluation of a public contest for ideas for HIV/AIDS research in the area of social studies, new projects are to be funded in 2000 with a view to developing and improving measures in the field of HIV/AIDS prevention and to providing support on the health side for people with HIV/AIDS.

Funding in the sphere of responsibility of the Federal Ministry of Justice (BMJ)

Legal facts research is focusing on social, political and other actual conditions determining the development and impact of legal norms.

Current research priorities in this area are:

– Study of the length of criminal trials in regional courts;
– Implementation of the new arrangements following the reform of law pertaining to parents and children;
– Study of the financial impact of no-fault state liability.

Criminological research is looking into manifestations, causes and developments of crime as well as into the fight against crime by means of criminal prosecution, enforcement of sentences and imprisonment. Current research projects include the recidivism and criminal careers of sex offenders, studies into economic crime (money laundering), designing statistics on recidivism, and surveys of victims of crime.

Funding in the sphere of responsibility of the Federal Ministry of Finance (BMF)

Research in the field of fiscal and economic sciences examines longer-term economic trends and considers their significance for fiscal and economic policy from the scientific standpoint. It takes up current problems and debates on reform and provides scientific back-up for these in the form of efficiency and feasibility studies and conceptual contributions towards policymaking. In view of the advance of European integration and the rules on budget discipline, the scope for national economic and fiscal policy is increasingly being considered in the European context.

Policy on tax reform is given scientific support in the form of analyses of its economic impact and administrative practicality. Research work looks into the extent to which conclusions and recommendations can be drawn for German tax policy from international trends of national tax systems. Incidence analyses of the German system of welfare contributions are intended to improve the basis for an analysis of the effective burden on the taxpayers. The planned establishment of a reporting system on tax compliance costs will create an information base on the costs of taxation. Research into labour market and social policy is concentrated on, for example, fiscal policy aspects of the tax transfer system and on questions of the effectiveness and efficiency of labour market and economic policy; increasing significance attaches to improving the empirical basis and data for scientific evaluation of the measures of labour market and economic policy.

A further research priority is the analysis and forecast of macroeconomic development both of the world economy and of the German economy. This includes monitoring and analysing the adjustment process in the new *Länder*. In the international context, questions and problems relating to money, capital and financial markets are also of significance.

The Federal Government and the *Länder* are jointly funding the six supraregional economic research institutes and Blue List research-based service institutions (cf. Part VI, section 5). A key task for the institutes is to use empirical economic and fiscal research to improve the information base for discussions and decision-making by government, administration, the research community and the interested public. The service departments of the economic research institutes provide important economic data and information for research, government and the public.

In addition, the BMF commissions fiscal and economic research and advice with regard to current problems and issues.

Funding in the sphere of responsibility of the Federal Ministry of Economics and Technology (BMWi)

Empirical economic research focuses on the observation and study of economic processes in Germany and abroad. In view of globalisation, international economic relationships are continuing to grow in importance. New priorities are emerging in particular in the field of new technologies (telecommunications, multimedia, electronic commerce) and energy policy. Structural developments in the sector of small and medium-sized enterprises – e.g. the increasing significance of the services sector – are another priority. Great significance continues to attach to the observation of the consequences of structural change in the new *Länder* and the establishment of market economy structures in the central and eastern European countries in transition.

Literature

– Report of the Bundestag Enquete Commission on the Protection of Humanity and the Environment – Objectives and General Conditions of Sustainable Development, Deutscher Bundestag, Document 13/11200 (German version), 1998;
– BMG: AIDS-Bekämpfung in der Bundesrepublik Deutschland; 7th edition, Bonn 1999.

22. Other activities not assigned to other sectors (Funding area W)

The Federal Government has developed new concepts and measures with the aim of establishing a modern education and research system and of safeguarding Germany's future viability and competitiveness. Strategic measures and structural reforms are intended to bring Germany's education and research system up to an internationally competitive level.

These measures particularly include strategies to ensure equal opportunities for women, the promotion of innovative regional development concepts in the new *Länder,* the provision of the necessary orientational knowledge via the analysis of technologies and innovations, and the promotion of structural innovations in education and research. Measures of a more generic kind and the promotion of institutions active in interdisciplinary science and research are also covered by this section.

Education and research belong together. Their interplay makes a vital contribution towards coping with structural change and resolving social problems, as well as to cultural renewal.

22.1 Structural, innovative (generic) measures

Research policy objectives

The quality of the research and science system is of outstanding importance for the creation of a modern education and research system and for safeguarding Germany's future competitiveness. The Federal Government has developed a range of new measures and concepts aimed at structural renewal and at boosting the innovative capacities of the German science and research system.

Funding structures / thematic priorities / results / developments

Centres of excellence

In order to boost the performance of the scientific institutions in the new *Länder*, the Federal Government is using innovative measures which foster the formation of interdisciplinary research priorities. In co-operation with other public research institutions and with business, these are intended to contribute towards ensuring technological competitiveness. The measures include the establishment of interdisciplinary centres of excellence at higher education institutions, which co-operate with non-university institutions and corporate research departments. The measure is equipped with funding of roughly DM 20 million a year and is scheduled to expire in 2001.

InnoRegio

The InnoRegio special programme supports innovative regional development concepts in the new *Länder*, it concentrates on training, research and development as well as skills enhancement. There are incentives to focus regional policy more on the development of core areas of innovation.

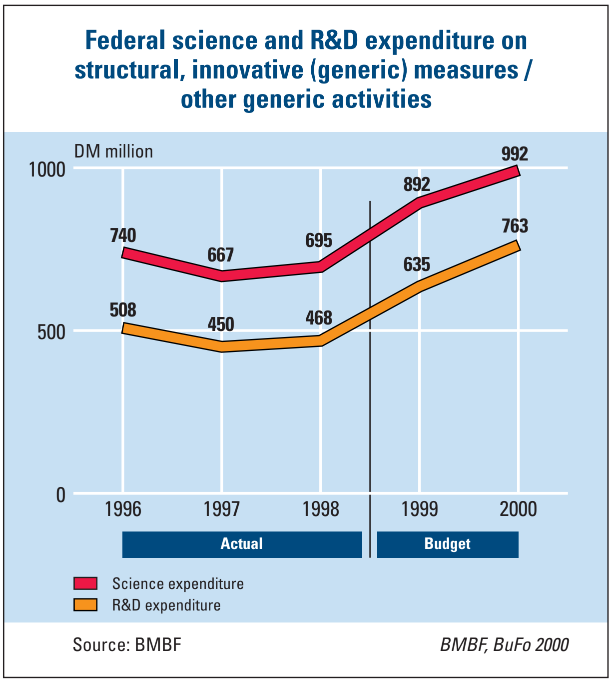
In a competition open to any topic and applicant, 25 innovative regions were selected from 444 regional initiatives; they are now drafting detailed innovation concepts. The objective is self-sustaining initiatives and structures in the new *Länder*. A total of DM 500 million is earmarked for this programme, with DM 30 million to be provided in 2000.

Strategies to implement equal opportunities for women

A new budgetary item consisting of DM 12 million in 2000 is intended to help achieve a breakthrough in equality of opportunity for women. Strategic measures and the establishment of structures are planned. These include:

– The promotion of women's studies and gender research in the field of education, science and research;
– Measures to promote equal opportunities for women in science, research and technology;
– Internationale Frauenuniversität Technik und Kultur (International Women's University on Technology and Culture);
– Women in the information society, and particularly the *Internet access for women* scheme.

Chart 54



Source: BMBF — *BMBF, BuFo 2000*

Technology and innovation analysis

The policy area of technology and innovation analysis (TA) is of high priority for the Federal Government. It is becoming increasingly difficult to grasp the complex interrelationships between modern technology developments, open markets and social conditions. It is therefore necessary to provide orientational knowledge for the public, government, science and industry.

At present, the BMBF is re-orienting this policy area: TA will become even more strongly linked with the BMBF's policy on innovation and with corporate innovation management. For this reason, the BMBF is providing funding totalling DM 7 million in 2000 for the identification of potential for innovation and of its repercussions, for analyses and debates on the interrelationships between technology development, education and employment and for the promotion of the understanding of technology. The amount available will keep being increased in the coming years.

Structural innovations in education and research
In order to remain internationally competitive, the infrastructure and organisational structures of the education and research system need to be developed further. The promotion of innovative projects will lend a fresh stimulus to the development of structures in education and research.

Funding goes to projects aimed at the development and testing of new concepts in the following areas:

– Strategy fund: In a competitive process, strategically important research projects and organisational measures and incentives are to be promoted in the research centres of the Helmholtz Association and in other research institutions; the aim is to increase the contribution of the research institutions towards business innovation and to promote networking in future-oriented programmes.
– Funding of projects to develop and test new concepts throughout the education system and in the research, organisational, management and operational structures throughout the education sector and in research; strengthening of European and international co-operation; promotion of young academics. Technology transfer from higher education to business and public-private partnerships as under the *EXIST – Business Start-ups from Universities* initiative (establishment and promotion of regional networks for innovative start-ups by students, university staff and graduates and of supraregional and international structures to support knowledge-based business start-ups); establishment and promotion of structures to translate inventions and research findings into added commercial value.

22.2 Other generic activities

Development policy research
To fulfil its departmental functions the Federal Ministry for Economic Co-operation and Development (BMZ) finances development policy research. This provides the basis for future-oriented recommendations for practical development policies. The new Federal Government has upgraded development policy into global structural policy; it aims to improve the basic social, environmental, political and economic conditions for sustainable development and thus to make a contribution towards securing peace. Central issues include the creation of humane living conditions and the alleviation of poverty, the maintenance of the ecological balance, the promotion of basic democratic principles and peaceful conflict management, the economic development of the partner countries and their involvement on the world market. To meet the challenges posed by this, German development policy needs powerful research.

Subjects of current research projects include in particular:

– Analysis of the conflict potential of the countries covered by development policy;
– Development policy and the international financial architecture;
– Consideration of the interests of the developing countries in the restructuring of the WTO;
– International water policy – conflict prevention and sustainable development;
– Poverty alleviation and gender issues in development co-operation.

International co-operation, exchange of scientists, support and promotion of young scientists, higher education research
There is a range of specific measures, in addition to the co-operation on research and science under the specialised programmes, designed to promote *international co-operation*. Overall, international co-operation is a high priority in the work of the Federal Government (cf. Part V). The measures include, for example, the promotion of the exchange of scientists and scientific personnel under bilateral R&D programmes and projects, co-operation on basic scientific research and technological development (e.g. at international research institutes) and the drafting of agreements. Here, an estimated DM 80 million was spent on promoting research and development in 1999.

Supporting the exchange of scientists and promoting young scientists is another area to which the Federal Government is committed in many ways. Here, an important role is played by institutions and their relevant activities – not only the Deutsche Forschungsgemeinschaft (DFG) (cf. section 1), but also the Alexander von Humboldt-Stiftung (AvH – Alexander von Humboldt Foundation) and the Deutscher Akademischer Austauschdienst (DAAD – German Academic Exchange Service [cf. also Part VI, section 1]), as well as the organisations for the promotion of young talent (cf. Infobox). Under this funding priority, a total of around DM 250 million (in the budgets of the Federal Foreign Office and the BMBF) is currently (1999) allocated to basic funding of institutions, fellowships and grants for (post-)graduates (especially doctoral candidates).

Other activities
Further Federal Government activities in this context include support for the links between German and foreign scientists and higher education institutions (from the budget of the Federal Foreign Office), for competitions and prizes for young scientists and for outstanding examples of technology transfer (BMBF).

Higher education research
The Federal Government provides funding for higher education in a variety of ways; special mention should be made of the *university construction* and *university-related special programmes* (section 1); the funding of research and development in the higher education sector under specialised departmental programmes, primarily of the BMBF, is also of particular significance (the BMBF spends more than DM 700 million a year on this).

Further Federal Government funding measures include innovative centres of excellence (cf. beginning of this section) and a scheme specifically targeted at Fachhochschulen (Universities of Applied Sciences):

DM 14.5 million (planned for 1999) and DM 16.5 million (planned for 2000, compared with DM 14.5 million originally allocated in the Federal Government's budget draft) is available for the BMBF's *Application-oriented research and development at Fachhochschulen (aFuE)* programme, which funds application-oriented projects in all the disciplines represented at Fachhochschulen. The funding provided for this programme, which aims to improve the ability of Fachhochschulen to attract external funds, has thus been substantially increased since 1998 (DM 11 million).

Foundations, academies; research and service institutions

The Federal Government (BMBF) helps to promote science and research by funding interdisciplinary institutions. These institutions include:

– the Deutsche Akademie der Naturforscher LEOPOLDINA zu Halle/Saale (German Academy of Natural Scientists), the oldest and only international academy in Germany;
– the Volkswagen Foundation;
– Blue List institutions, e.g. Stiftung Deutsches Institut für Fernstudien (DIFF – German Institute for Research into Distance Education) at Tübingen University; Institut für den wissenschaftlichen Film (IWF – Scientific Film Institute) in Göttingen; Forschungsinstitut Senckenberg der Senckenbergischen Naturforschenden Gesellschaft (SNG – Senckenberg Research Institute of the Senckenberg Nature Research Society) in Frankfurt am Main, and the Institut für Zoo- und Wildtierforschung (IZW – Institute for Zoo Biology and Wildlife Research), a member of the Berlin research network (for further details cf. Part VI, section 4);
– the Hochschul-Informationszentrum (HIS – Higher Education Information System) in Hanover, a service for higher education institutions and their administrations, which assists such institutions in their efforts to accomplish higher education tasks in an efficient and cost-effective manner (federal contribution to funding 33.3 per cent);
– the Stiftung Deutsch-Amerikanisches Akademisches Konzil in Bonn (DAAK/GAAC – Foundation German-American Academic Council), which so far has particularly focused on bilateral co-operation in the humanities, social and natural sciences, and whose financing is covered by this funding area up to 2000, will be dissolved at the end of 2000 (cf. Part V, section 2.1 and Part VI, section 5).

INFOBOX

ORGANISATIONS FOR THE PROMOTION OF YOUNG TALENT

Support for particularly able undergraduates and doctoral students is not centrally organised in Germany. A substantial proportion of this funding is managed on behalf of the state by eleven organisations dedicated to promoting young talent.

The gifted education funding association includes:

- Studienstiftung des deutschen Volkes (German National Merit Foundation)
- Cusanuswerk – Bischöfliche Studienförderung (scholarship organisation for Roman Catholic students)
- Evangelisches Studienwerk Villigst (scholarship organisation for Protestant students)
- Hans-Böckler-Stiftung (Hans Böckler Foundation)
- Stiftung der Deutschen Wirtschaft für Qualifizierung und Kooperation–Studienförderwerk Klaus Murmann (Foundation of German Industry for Training and Co-operation – Klaus Murmann agency for able students)
- Konrad-Adenauer-Stiftung (Konrad Adenauer Foundation)
- Heinrich-Böll-Stiftung (Heinrich Böll Foundation)
- Friedrich-Ebert-Stiftung (Friedrich Ebert Foundation)
- Rosa-Luxemburg-Stiftung (Rosa Luxemburg Foundation)
- Friedrich-Naumann-Stiftung (Friedrich Naumann Foundation)
- Hanns-Seidel-Stiftung (Hanns Seidel Foundation)

The shared objective of these organisations is the encouragement of highly motivated, responsible young people undergoing scientific training. Their basic aim continues to be to identify individual abilities and support them in many ways.

Individuality, democratic plurality and socially responsible actions are the guiding principles shared by all the organisations involved.

These organisations are being funded with DM 110 million (1999) and roughly DM 116 million (2000) (in each case planned figures) from the budget of the BMBF. This funding covers both support for doctoral candidates and for undergraduates (for reasons of definition, the latter is not included in the federal spending on science, research and development).

Others

Funding area W also embraces further activities and expenditure on R&D of a generic nature; this includes basic institutional funding for areas which cannot be categorised in the other funding areas.

Literature

– On centres of excellence: http://www.dfg.de;
– On InnoRegio: http://www.innoregio.de;
– Harig, Helmuth and Langenbach, Christian J. (ed.): Neue Materialien für innovative Produkte, in: Wissenschaftsethik und Technikfolgenbeurteilung, Schriftenreihe der Europäischen Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen, vol. 3, Berlin, Heidelberg and New York 1999;
– Streffer, C. et al.: Umweltstandards: kombinierte Expositionen und ihre Auswirkungen auf den Menschen und seine Umwelt, in: Wissenschaftsethik und Technikfolgenbeurteilung, Schriftenreihe der Europäischen Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen, vol. 5, Berlin, Heidelberg and New York 2000;
– Development research: "Forschungsberichte des Bundesministeriums für wirtschaftliche Zusammenarbeit und Entwicklung"; Bonn, various years;
– BMBF programme "Anwendungsorientierte Forschung und Entwicklung an Fachhochschulen (aFuE) – Bilanz der Jahre 1992 – 1996", Bonn 1997;
– BMBF brochure: "Fachhochschulen in Europa", 1997;
– Information brochure on the organisations for the promotion of young talent in Germany, Bonn 1999.

23. Defence research and technology (Funding area X)

The term 'defence research' covers not only defence technology R&D, but also the areas of military medicine and psychology as well as non-technical research and studies by the Bundeswehr.

Defence technology research and development is governed by the principle that the results of civil research should be used wherever possible and that Bundeswehr research projects should only explore specific defence technology aspects. The Federal Ministry of Defence (BMVg) distinguishes between the stage of research and technology (R&T), covering the lead time of defence material from the beginning of pertinent research to the decision on a specific project, and the stage of development proper, which covers definition and testing of defence material.

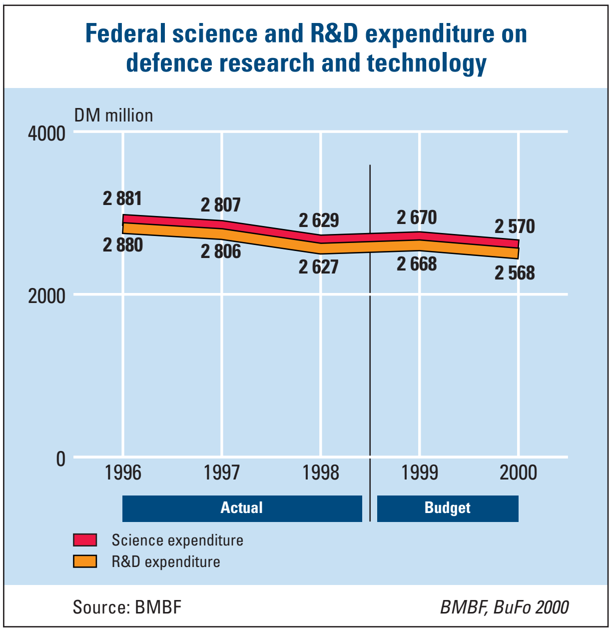
23.1 Research and technology

Research policy objectives / Funding structures

The purpose of defence research and technology is to create the technological basis for meeting the demand for defence material and for the development and production capabilities needed in the long term. It also serves to maintain the ability to assess and forecast developments and to examine the relevance of civil research and technology results for defence research, to provide technical skills for preparing alternative concepts and, finally, to develop the basis for scientific and technical input into the activities during the predefinition phase of defence material.

In 1999, research and technology activities were restructured, and tasks were reassigned among the BMVg and its subordinate agencies („delegation"). In future, the Ministry will concentrate on its core functions of planning, management and control, while the Bundesamt für Wehrtechnik und Beschaffung (BWB – Federal Office of Defence Technology and Procurement) will be responsible for implementation. The BWB consults with the offices and commands of the various services on input into the planning of research and technology activities and coordinates such contributions across the various organisational units.

Chart 55



The medium- to long-term basis for planning is the R&T sub-concept derived from the defence policy guidelines and from the conception of the Bundeswehr (Federal Armed Forces). The basis for the annual planning process is the annual R&T appropriation, an instrument used by the BMVg to give its subordinate agencies planning and prioritising instructions for the Bundeswehr's development and budget.

The BMVg awards contracts for individual projects of defence research and technology both to defence research institutions (see Part VI, section 5.7) and to industry and higher education institutions.

Results / Developments

Due to resource scarcity and the steadily growing complexity of technology, transnational co-operation is a permanent goal. A particular impetus to this effect was provided by the Letter of Intent about measures to facilitate the restructuring of the European defence industry, signed in July 1998 by the defence ministers of the United Kingdom, France, Spain, Italy, Sweden and Germany. With regard to R&T, the intention is to avoid a duplication of work as well as deficits in covering the range of technologies, jointly to implement technological developments and to ensure adequate funding through efficient cost sharing.

The first step towards an international agency for defence materials announced in the 1998 Facts and Figures Report is the newly established OCCAR organisation (Organisme Conjoint de Co-opération en Matiere d'Armament; so far without a mandate for R&T); the WEAG Research Cell has an analogous function for R&T.

Thematic priorities

To increase the transparency of R&T activities and improve the controls on implementation, a number of special priorities were defined in 1998. They are designed for the medium term, but their relevance is reviewed annually. Topics range from more comprehensive fields such as enhanced air defence or reconnaissance systems to weapons systems (new armoured platform, missiles and guided missiles) to individual technologies such as vector steering, fuel cells or sonar technology. The particular importance of information technology is reflected by the fact that information warfare was made a special priority.

The BMVg has appropriated the following amounts for defence research and technology:

	1997	1998 Actual	1999	2000 Target
	– DM million –			
Total R & T	645	600	570	550

23.2 Defence development

Research policy objectives / Funding structures

The purpose of defence development is to develop mature material, test it and ensure the post-design support of mature defence material.

Thematic priorities / Results / Developments

Command, control and reconnaissance systems are a priority spanning the different services.

- The following development activities are priorities for the army: medium-weight armoured transport vehicle for a wide variety of leadership, support and transport tasks; combat training centres for training under near-operational conditions; drones for reconnaissance and fighting of armoured targets; various types of ammunition. Furthermore, support (TIGER) and transport helicopters (NH 90) are being developed.
- The air force's priorities will continue to include development of the EF 2000 fighter aircraft and combat efficiency improvement for the TORNADO weapons system. These include radar alarm receivers, defensive aids subsystem management, laser inertial navigation system with GPS, laser designator pod as well as the cockpit display concept.
- For the navy, research and development efforts are undertaken in the following fields: systems technology for future combat ships and boats, submarines, torpedoes, torpedo defence, countermine equipment and mines. Further priorities include anti-aircraft defence from ships and boats, studies on novel platforms and propulsion systems (including air-independent propulsion systems) and studies on weapons, sensors and control and reconnaissance systems.

23.3 Non-technical research and studies in the Bundeswehr

The Bundeswehr depends on studies carried out by institutions from within and outside the Bundeswehr organisation as decision-making tools for planning, command and control.

These studies primarily take their cue from the decision-making requirements of the top level of the BMVg and of the Inspector General of the Bundeswehr, who bears overall responsibility for conception and planning of the Bundeswehr, as well as from the decision-making requirements of the chiefs of staff/directors general and of the major commands. They cover the objectives and priorities of Bundeswehr planning and meet the requirements security and defence policy analysis. The studies should not to exceed two years in duration.

At present, research and study activities centre on the following priorities:

- Evolving the conceptual and operational foundations for missions of the armed forces, with a special focus on TSK joint and combined missions.
- Continuing the study carried out under the *Armed forces employment 2020* project with the SFT 21 follow-up study (*Armed forces: capabilities and technology in the 21st century*). Intended to provide a vision, this study is to focus on future capabilities of the Bundeswehr, placing special emphasis on technological development.
- To conduct these studies the armed forces have a comprehensive set of analytic instruments (operations research) in place. One of the priorities of present activities is maintenance and upgrading of standardised, modular, multiple-use simulation models that can be networked internationally.

23.4 Research in the field of military medicine and psychology

(including veterinary medicine and odontology as well as defence pharmacy)

Research in the field of military medicine and psychology is indispensable for fulfilling the mandate of the medical service of the Bundeswehr.

The spectrum of military medical research covers the entire range of medicine and related fields. This type of research explores scientific issues relating to the conditions, stress and hazards of military service in peacetime and wartime which have a bearing on the health and well-being of the members of the armed forces.

The exclusive humanitarian objective of military medical research is

- to protect, safeguard or restore the physical and mental health of the members of the armed forces, and
- to ensure – in the long term – the soldiers' physical and psychological ability and resilience for service in the armed forces.

The priorities of military medicine and psychology research include scientific studies of military medical issues relating to hazards typical of the armed forces, e.g. impact of nuclear, biological and chemical agents as well as of pressure, acceleration, impulse noise, oxygen deficiency and mission-related psychological stress; development of measures to build up, maintain or restore the physical and psychological ability and resilience for service in the armed forces, e.g. defence-related assessment criteria in military medicine and psychology and measures to prevent disease and injury.

The feasibility of military medicine and psychology research is guaranteed by:

- The operation of Bundeswehr research institutions wherever typical issues of military medicine and psychology are not dealt with by civil sector institutions;
- The promotion of young Bundeswehr researchers to guarantee

that knowledge in military medicine and psychology is always state of the art;
- Close co-operation with civil institutions and medical services of other countries' armed forces, in order to avoid duplication of research and meet civil and/or international quality standards;
- Maintaining epidemiological and research databases to guarantee the implementation of the findings obtained;
- Demonstrating to military leaders the need to integrate technical knowledge into the areas of training, command and control as well as supply and
- Publication and presentation of the results of military medicine and psychology research with a view to heightening the general public's awareness of this discipline.

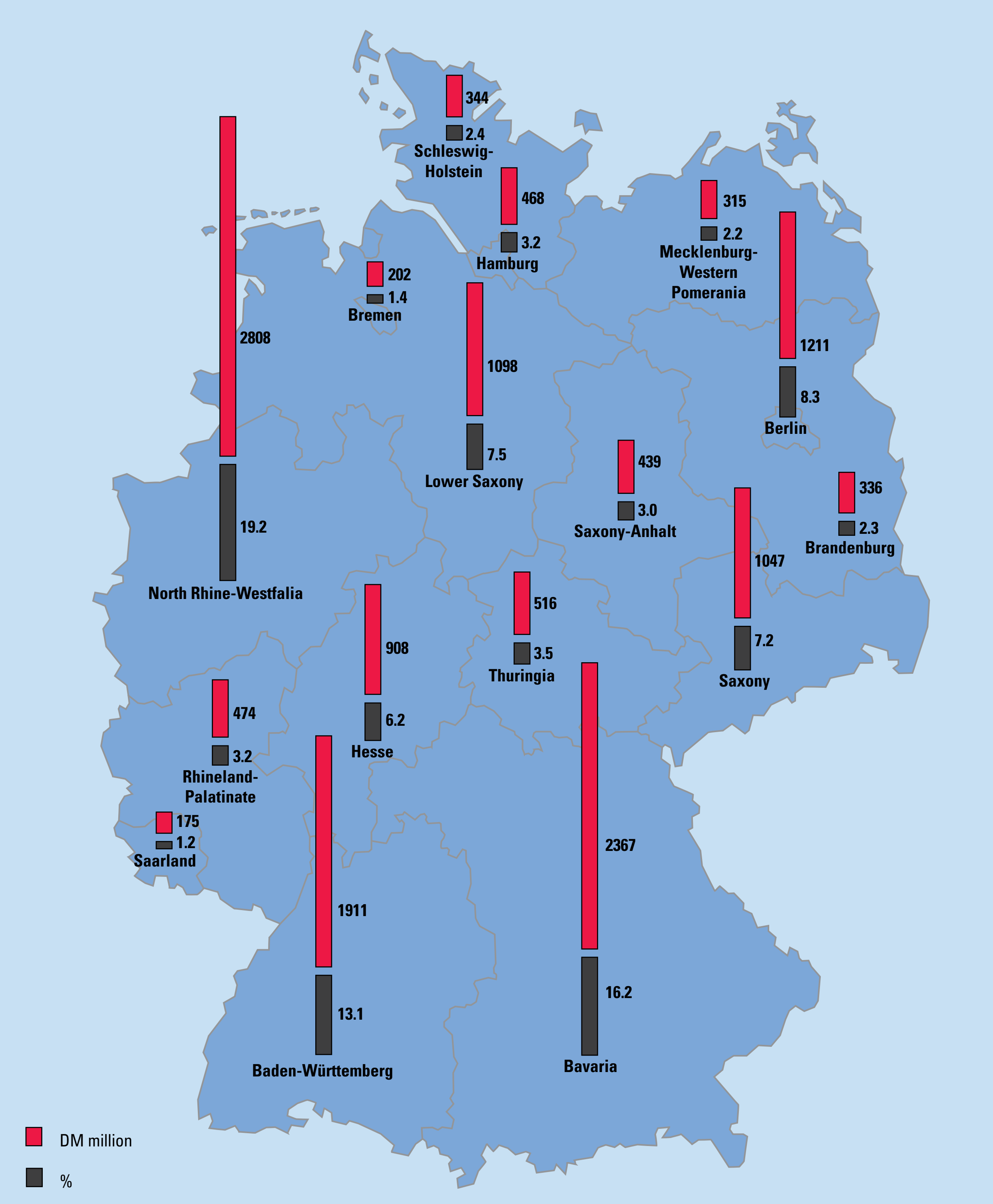
Part IV

Research and technology policy in Germany's *Länder* individual reports

Chart 56

Research and development expenditure by the *Länder*[1]

– Financing of R&D –



1 Estimates based on *Länder* budgets (transfer of funds between the *Länder* partly not taken into account); the calculation of the R&D expenditure of higher education institutions financed by the *Länder* is based on the procedure agreed by Conference of *Länder* Ministers of Education and Research and the Federal Ministry of Education and Research and the Federal Statistical Office.

Source: Federal Ministry of Education and Research   Rounding error   *BMBF. BuFo 2000*

Introduction

As in the 1996 Report of the Federal Government on Research and the 1998 Facts and Figures report, this year's Report of the Federal Government on Research also contains a part in which Germany's individual *Länder* (federal states) present their research and technology policies. This approach highlights the diversity of the German research system, a diversity which reflects Germany's federal structure.[1]

In the interest of uniformity and, consequently, greater clarity and readability, the BMBF suggested that the *Länder* use the following structure for their reports: [2]

1. Underlying principles and priorities of research and technology policy
2. University research
3. Non-university research
4. Promotion and transfer of technology
5. International co-operation

Since the *Länder* limited their reports to core information, references to more detailed literature, important publications (such as *Land* research reports) and/or references to Internet homepages have been included wherever possible.

1. Baden-Württemberg

Measured in terms of universities and research activity, Baden-Württemberg is one of Europe's most densely "populated" regions. As such, it offers a highly diversified research infrastructure in which basic research and application-oriented, industry-related research are represented in balanced measure and are augmented by a ramified system of transfer agencies. Baden-Württemberg has nine universities, two private institutions of higher education, six teacher training colleges, eight academies of art, 22 public Fachhochschulen (Universities of Applied Sciences, including 16 which are technology-oriented), seven colleges of public administration, ten private Fachhochschulen and eight colleges of advanced vocational studies which are classified as belonging to the higher education sector. Baden-Württemberg is also home to 14 institutes of the Max-Planck-Gesellschaft (MPG – Max Planck Society). In addition to the higher education sector and facilities that are geared more to basic research, Baden-Württemberg's application-oriented research institutions include 14 institutes of the Fraunhofer-Gesellschaft (FhG – Fraunhofer Society), nine co-operative industrial research institutes, seven contract research facilities at universities, and the Steinbeis-Stiftung (Steinbeis Foundation). Two Helmholtz Centres, the research centre of a third Helmholtz Centre, two international research centres and 58 other non-university research institutes round out the picture of Baden-Württemberg's research system. The Steinbeis Foundation's 250 transfer centres in Baden-Württemberg give priority to transferring research findings from the *Land*'s universities to enterprises via development projects, consultancy services and training. Most of the Steinbeis transfer centres are located at Fachhochschulen (approximately 140) and, to an ever-greater extent, at universities (approximately 40).

Baden-Württemberg expended nearly DM 7.2 billion in government funds (net expenditure) on science and research in 1997. The amount of external revenue raised by the *Land*'s universities (not counting university medical centres) rose from DM 548 million in 1992 to some DM 690 million in 1998. Baden-Württemberg accounted for 10,879 of the patent applications received by the German Patent Office in 1998. This translates into 105 patent applications per 100,000 residents, the highest patent rate in Germany (national average: 58).

1. Underlying principles and priorities of research and technology policy

Baden-Württemberg's research and technology policy activities are marked by close co-operation between individuals and institutions in science, industry and politics, a co-operation that has been cultivated for many years. With a view to fostering innovation activity in the entire *Land*, the government of Baden-Württemberg considers it particularly important that measures which are more research policy-related and fall under the purview of the Ministry of Science, Research and Art be cross-co-ordinated with the more technology policy-related measures which are the responsibility of the Ministry of Economic Affairs and with the efforts being made in the general and continuing education fields.

Research funding in Baden-Württemberg follows the priority objective of ensuring, via structural and financial measures, that the *Land*'s research infrastructure is preserved and expanded in all its diversity – both along a broad base and at its upper-most levels. The primary economic goal of the *Land*'s innovation and technology policy is to strengthen the innovation capabilities of Baden-Württemberg's industry in general and of its many small and medium-sized enterprises (SMEs) in particular, building on the new knowledge that is being generated and transferred. For this reason, the government of Baden-Württemberg – in spite of the tight finan-

[1] The individual reports were edited.

[2] Not all of the *Länder* followed the suggested structure.

Part IV

cial situation of the last few years – has adopted various measures to improve the universities' basic resources and safeguard the *Land's* research infrastructure. It is guided here by the following *principles*:

- A *Land's* scientific level and its ability to meet the challenges of the future are determined by the quality of its basic research. Diligent and conscientious appointment policies are the foundation for all performance-oriented research funding. Baden-Württemberg's government and universities work hand-in-hand in vying for the best minds.
- The quality of the research being done as well as the productivity and motivation of individual researchers and research groups are decisive criteria for the provision of research funding.
- Research funding must ensure that basic resources and equipment are adequate, also with regard to ensuring the individual university's ability to attract external funding.
- Utmost importance is attached to providing sound training for young scientists and scholars and to improving their opportunities for independent research.
- One of the fundamental objectives pursued by Baden-Württemberg's research policy is to promote excellence in research. It accomplishes this by establishing priority research fields that are geared to the international level of research-policy, science and financing developments and which allow the efficient use of limited research funds. At the same time, research funding must differentiate on the basis of performance criteria, with the object of fostering outstanding research.
- Government-funded research must be subject to stringent quality control that is effected through independent external review. Research projects and research priorities are to be set up for limited periods only. Research funds must be granted on a performance-related basis. Decisions regarding the allocation of funds for basic equipment must also incorporate performance-based criteria which ensure continued efficiency control.
- Comprehensive evaluations of research performance are to be used to ensure efficiency control and systematic quality management.
- Like research, research funding also requires a certain amount of willingness to take a risk. Financing research means financing risk. It must be long-term in order to give researchers the necessary scope for answering the questions they raise.
- Research must be designed to be more interdisciplinary in nature and to include various types of institutions of higher education.
- The transfer of knowledge and technology between universities and publicly funded research institutes on the one hand and industry on the other must be improved. Co-operation between science and industry must be developed even further in a spirit of partnership.
- Science and research must grow and develop through cross-border and international co-operation.
- Outstanding research can flourish only in a research-friendly climate. A broad-based dialogue between the political sector, science, industry and the public at large is a prerequisite for a favourable research climate.

Baden-Württemberg uses a variety of *funding instruments* for responding within the parameters set by budgetary constraints to the ever-changing demands facing its conscientious research policy. These instruments consist of

- a research priority programme
- a research pool
- a pool of "kw" posts (established posts which will be abolished when the present holder leaves)
- project sponsorship in the area of applied environmental research
- the Baden-Württemberg Research Prize
- "kw" posts created through the Fiebiger Programme and
- a special Buildings for Research construction programme.

The focus of Baden-Württemberg's technology funding – which in turn determines the most important areas of activity – has been and continues to be on providing an efficient research infrastructure (particularly in the area of industry-related research), on ensuring a workable technology transfer, and on project funding. The set of instruments used for this purpose helps ensure that Baden-Württemberg and its universities can respond flexibly to current developments in science and research, that it is possible to establish priorities which promise success, and that structural change at Baden-Württemberg's universities can be purposefully supported with an eye to increasing intradisciplinary and interdisciplinary co-operation.

Land research and technology policy is pegged to national and European research and technology policy. By the same token, it is also embedded in the political realm with all its economic, environmental and social provinces. However, given that it is the thinking and actions of the real players in innovation – people – that matter, the truly decisive factors are proximity, contacts and interaction. For this reason, not only does *Land*-level policy have to be oriented to and help shape national and international standards, it must also pay increased attention to the emergence and activation of regional innovation systems.

Today, Baden-Württemberg is home to a large number of regional innovation networks. Representatives from universities, research institutes, industrial organisations, local government and economic development agencies – working in concert with firms and often with union involvement – are implementing active communication measures aimed at strengthening their respective location as a site for science and industry.

The main goal for all involved must be to ensure that the innovation system that has evolved over the years in Baden-Württemberg remains open to continuous and dynamic development, adaptation and improvement.

The government of Baden-Württemberg has set up two advisory boards to advise it on research and technology policy issues. The *Landesforschungsbeirat* (*Land Research Advisory Board*) was initially established in 1990 at the recommendation of the Forschung Baden-Württemberg 2000 Kommission (Baden-Württemberg Research 2000 Commission). During its first term, the Board dealt primarily with implementing the Commission's recommendations. During its second term, it issued extensive recommendations on research structures and conditions. The Board's third term which began in December 1999 will be dedicated to developing recommendations for strategic action in core research policy fields. Bearing current scientific and technological developments in mind, it will be evaluating Baden-Württemberg's research system, analysing its strengths and weaknesses and pointing out new technological and structural trends in advanced fields of knowledge. For this purpose, it will be conducting prospective cross-sectional evaluations of these fields.

In its final report "Aufbruch aus der Krise" (Departure from Crisis) which it issued in August 1993, the Zukunftskommission Wirtschaft 2000 (Commission on the Future of the Economy 2000) recommended setting up a "technology board" at federal level and an inter-ministerial *advisory board on innovation* at *Land* level. Both recommendations have been implemented. Established in 1994, the Innovation Advisory Board advises the government of Baden-Württemberg regarding the strategic orientation of its technology, economic and research policies. The Board currently has 16 members from industry and science. Its work to date has focused on, among other things, application-oriented research, technology transfer and start-ups. The Innovation Advisory Board submits its suggestions to the *Land* government as recommendations. In nearly each case, the government of Baden-Württemberg has implemented or is currently in the process of implementing the Board's recommendations. By contrast, the focus of the Research Advisory Board's work is on the *Land*'s concrete research and technology policy measures.

Applied R&D at Germany's Fachhochschulen (Universities of Applied Sciences) has a twofold task. It helps ensure innovative teaching and constitutes an offer – particularly to small and medium-sized business and industrial enterprises – to draw upon the resources available at these institutions. The focus here is on application-related problems. Research and development activities at Fachhochschulen are to give special attention to translating the findings generated by basic research into products and processes. At the same time, university research is to concentrate on pre-competitive activities, while also keeping in mind the next step of developing findings into marketable products and processes.

In Baden-Württemberg, the R&D plan for Fachhochschulen generally rests on two pillars – on core funding provided by institutes that conduct applied research and on project funding.

All of Germany's larger Fachhochschulen have their own institutes for applied research which pool their professors' research activities and foster interdisciplinary co-operation. In order to improve the ability of these Fachhochschulen to attract external funding, the government of Baden-Württemberg provides up to DM 2 million in funding each year for these key scientific institutions. In addition to this, it also provides – on the basis of an application procedure – grants for the procurement of equipment for those of these institutes' priority research fields which have been positively evaluated. Baden-Württemberg presently allocates DM 1 million a year for this purpose as part of a special programme.

As a rule, research conducted at Fachhochschulen takes the form of funded projects. This is because project-based research continually updates the subjects it is involved in and is obliged to translate findings quickly into products and processes. It is therefore the type of research which is most likely to ensure the legally mandated practical relevance of research. One clear indication of a project's level of application-orientation is the amount of financing provided by industry or other bodies that sponsor applied research (such as mission-oriented or departmental research) which documents a corresponding interest on the part of the future user. Baden-Württemberg currently allocates approximately DM 4 million a year just for project funding at Fachhochschulen. These funds are awarded on the basis of evaluations conducted by panels of experts in the course of an application procedure. Projects which are conducted in collaboration with industry or universities are given special consideration. Further, the cost of applying for industrial property rights was added to the list of expenses that can be funded under project funding in 1998.

As a result of these efforts, Baden-Württemberg's Fachhochschulen increased their external funding from some DM 10 million in 1996 to approximately DM 20 million in 1998.

2. University research and non-university technology policy

Even though the size of the student population began to decline again recently, the basic personnel and material resources available to Baden-Württemberg's universities have not been able to keep pace with either the dramatic growth in the number of students or the increase in teaching requirements seen in the last 15 years. This has led to problems in both teaching and research. Cuts in planned appropriations for science and research further aggravate this problem and are having an enormous impact on research funding in Baden-Württemberg. This is reflected in the research activities being conducted at the *Land*'s universities.

Despite this, important measures are being implemented with funds from the *Young Generation Campaign to Ensure Future Development*. Approximately two thirds of the about DM 1 billion in privatisation revenues that this campaign has at its disposal for allocation will be invested in science and research. Measures funded in the science field include

- a collaborative research programme
- the Young Innovators programme
- a university and university hospital construction programme
- the expansion of Baden-Württemberg's Fachhochschulen (Universities of Applied Sciences) and colleges of advanced vocational studies
- a virtual university
- measures to improve library resources and equipment and increase their use.

Over the years, Baden-Württemberg has systematically fostered a concentration of expertise in the biotechnology and genetic engineering fields in the Rhine-Neckar triangle. As part of these activities, it has brought in and "bundled" several non-university centres and implemented supportive measures to promote the activities of young scientists, the transfer of technology, and deregulation. In the process, it also built the foundation that enabled this region to become one of the winners in the BioRegio competition and to mobilise a further DM 50 million in federal funding alone.

Three other regions in Baden-Württemberg also participated in the BioRegio competition. In order to inject greater stability into these initiatives, a biotechnology promotion programme was set up under the *Young Generation Campaign to Ensure Future Development* to augment the federal measures being undertaken. This biotechnology promotion programme permitted the funding of the entire range of research and development projects, starting with applied basic research (collaborative scientific and industrial projects) and extending to funding for particularly high-risk research and development projects in small and medium-sized enterprises. As a result, a number of projects, particularly in the areas of biochip technology and tissue engineering, could be bundled into *Land*-

Part IV

wide competence clusters. This programme has proven itself to be an important instrument for fostering technology so that the possibility of extending it is presently being examined.

In addition, steps are currently being taken to set up a Pflanzenmolekularbiologie Süd-West (South-West Plant Molecular Biology) competence cluster to further strengthen the efficiency, effectiveness and competitiveness of Baden-Württemberg's capabilities in this area. Further examples of concentrations of expertise in Baden-Württemberg include the Interdisziplinäre Zentren für Klinische Forschung (IZKF – Interdisciplinary Centres for Clinical Research), the Freiburger Materialforschungszentrum (FMF – Freiburg Materials Research Centre), the centres of excellence in biomaterials, and the new BMBF centre of excellence in nanotechnology at the University of Tübingen in conjunction with the Saarland University, Saarbrücken campus. Baden-Württemberg is promoting the development of a centre of excellence in nanotechnology in the Karlsruhe area as well.

Baden-Württemberg's Ministry of Economic Affairs purposefully supports the establishment of *Land-wide research alliances* such as the Scientific Computing Research Alliance or the Parallel Simulation Instruments Research Alliance; it also fosters plans for research alliances in the laser/optics field, a *Land*-level drug resistance centre and the establishment of a priority research field that revolves around addiction.

Founded by Baden-Württemberg and the Federal Government, the *Deutsches Zentrum für Alternsforschung* (*German Centre for Research on Ageing*) in Heidelberg deals with all aspects of ageing on an interdisciplinary basis. Baden-Württemberg is home to 20 per cent of all of Germany's medical collaborative research centres, two of the country's eight *Interdisziplinäre Zentren Klinischer Forschung (Interdisciplinary Centres for Clinical Research*, at the university medical centres in Tübingen and Ulm), three of the eight German Koordinierungszentren für Klinische Studien (Co-ordinating Centres for Clinical Trials), two of eight rehabilitation research alliances, one of three infection epidemiology networks and two of the country's five Hermann and Lilly Schilling Chairs set up as part of the Clinical Neuroscience Programme. Further, two of Germany's four BMBF-funded *Centres of Excellence in Biomaterials* were set up in Baden-Württemberg – one at the University of Ulm and the other at the *Institut für Textil- und Verfahrenstechnik Denkendorf (Institute of Textile Technology and Process Engineering Denkendorf)* in conjunction with the Universität Stuttgart (University of Stuttgart) and the University of Tübingen. These centres ensure interdisciplinary collaboration between materials scientists, chemists, biologists and physicians, and work together with industry to translate their research findings into medical products. Federal funding for these two centres totals DM 8.4 million for a five-year period. Baden-Württemberg's Ministry of Science, Research and Art has allocated a total of DM 1 million for them for the same period. These examples illustrate how the Federal Government and Baden-Württemberg co-operate with productive results in providing complementary funding for research measures.

In order to boost and bundle research activities in the media technology field, the *Länder* of Baden-Württemberg and Rhineland-Palatinate established the Southwest Media Technology Research Alliance in 1992. In 1997, this alliance entered phase II (1997 – 2001) which focuses on digital studio engineering, spectrum efficiency, and access networks. The Universities of Kaiserslautern, Karlsruhe, Mainz and Stuttgart, the Südwestfunk public broadcasting corporation and several industrial firms are participating in this alliance. Baden-Württemberg is providing 70 per cent and Rhineland-Palatinate 30 per cent of the DM 25 million in government funding being made available for phase II. This is augmented by matching financing from participating facilities and companies. Information about this alliance is available at the Internet address http://www.inue.uni-stuttgart.de/FMS.

The Margarethe von Wrangell Professorial Qualification Fellowship Programme fosters the work of qualified young women scientists. A total of some DM 4 million was allocated in the 1998 fiscal year to fund the work of 39 women scientists. Approximately DM 3.8 million and DM 3.6 million have been allocated for approved applications for the years 1999 and 2000, respectively.

Application-oriented R&D facilities that are geared to the needs of industry are of special importance to small and medium-sized business and industry in Baden-Württemberg. Such centres serve as a bridge between basic research and the technical development of new products and production processes in industrial enterprises. Fourteen of the 47 research and service institutions and one of the branch offices which the Fraunhofer Society maintains in Germany are located in Baden-Württemberg, making this *Land* home to approximately 30 per cent of the Fraunhofer Society's research capacity – some 2,700 employees.

Nine of the institutes belonging to the Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e.V. (AiF – German Federation of Industrial Co-operative Research Associations "Otto von Guericke") and one of its branch offices are located in Baden-Württemberg. Sponsored and supported by industry and trade associations, these sector-oriented institutes are important partners to SMEs in particular when it comes to dealing with technological progress. Baden-Württemberg supports these institutes with core funding.

Several legally independent institutes were established at a number of universities in Baden-Württemberg in the 1980s with a view to increasing the usability of university research findings in certain fields of technology. Their vehicle for accomplishing this objective is application-oriented R&D and contract research which they conduct on behalf of trade and industry in Baden-Württemberg. These contract research institutes are located at various universities throughout the *Land* and are sponsored by private and public foundations. These sponsors also include approximately 40 firms. Members of the expert committees and sponsoring organisations connected with these institutes include representatives from more than 200 enterprises, a clear indication of industry's interest in having fast access to application-oriented research findings. Since the heads of these institutes are generally also employed at the respective university, there is an intensive exchange of personnel and knowledge as well.

In Baden-Württemberg, the Ministry of Transport and the Environment provides special funding for environmental research. The Baden-Württemberg Programme for the Environment as the Basis of Life and its Protection (BW PLUS) at the Forschungszentrum Karlsruhe (FZK – Karlsruhe Research Centre, Technology and Environment) supports projects that take an interdisciplinary and cross-media approach and are geared to ensuring that scientific work can be put to use in government, industry and society in the interest of ecological innovation. Up-to-date information about this programme and a database on the projects that are being funded can be accessed at the Internet address http://www.bwplus.fzk.de.

Using the means of environmental research, Baden-Württemberg has also generated new impetus for environmental protection policy through its Noise research competition (launched in 1998 and scheduled to be concluded by the end of 2001) and through its development of flexible economic instruments for post-Kyoto global warming managment.

Research projects and studies that fall under the purview of the Ministry of Rural Affairs are conducted by *Land* agricultural institutions, the Forstliche Versuchs- und Forschungsanstalt (Forestry Testing and Research Institute), the *Land*'s chemical research institutes, *Land*-operated veterinary research offices and other institutes. This departmental research is generally application-oriented and focuses on the areas of environmentally-sound land management, non-food crops, the production of quality foodstuffs, analytical and detection procedures for food quality control, ecosystem-based forest research, nature conservation and the promotion of rural areas. These projects are often regional in nature.

In addition to this and independently of the core funding provided by the *Land*, the Ministry of Rural Affairs also grants external funds to universities and other research institutions to directly assist current research projects whose findings are especially to be used to provide advice and assistance to agricultural operations.

3. The promotion and transfer of technology

In the face of the continued severe spending constraints on the *Land*'s budget, Baden-Württemberg attaches special importance to maintaining the efficiency and productivity of the core activities pursued by *research centres that have close ties to industry*. The government of Baden-Württemberg supports these centres' efforts to gear their work even more than ever to the needs of the *Land*'s small and medium-sized businesses. Further, it launched *Acquisition Centres in 1999,* a new promotion instrument designed to help the *Land*'s universities raise external funding from trade and industry. Given the increasingly intense competition for this external funding, it is wise to bundle – on a decentralised basis – measures aimed at acquiring funding and to establish efficient facilities for this purpose. Funding is being provided to cover the costs of an office which assists the collaborative efforts undertaken by several institutes with related specialties at one or more universities to acquire external funding from industry.

A large portion of the economics ministry's technology funds is earmarked for the basic funding of research institutes that have links to industry. The majority of the research projects which the government of Baden-Württemberg is also currently funding with proceeds from the privatisation of *Land*-owned assets are *collaborative research projects*. These projects involve either one research centre that collaborates with at least two SMEs or a minimum of five research centres which are co-operating with one another on an ongoing, interdisciplinary basis while maintaining continual contact to enterprises. The goal of these projects is to boost the efficiency and speed of innovation processes by ensuring a faster transfer of technology. Baden-Württemberg's Ministry of Science, Research and Art and its Ministry of Economic Affairs launched a total of 96 projects in 1998 and 1999 as part of its Young Generation Campaign to Ensure Future Development. These projects – the results of a competition that was held in two rounds in the areas of production engineering/new materials; biotechnology; and services, software, information and communication, media, energy and the environment – have led to co-operative ventures involving some 500 companies and 196 research centres. Those collaborative projects that are currently being conducted represent a total of DM 197 million in financing, DM 113 million of which is being provided by the companies involved.

The *Programme to Promote the Development Projects of Small and Medium-Sized Enterprises* rounds out Baden-Württemberg's range of technology policy measures in the area of funding for individual firms. This programme was renewed in early 1998. In contrast to collaborative projects, it targets projects for developing close-to-market products and processes at individual companies.

The objective that the government of Baden-Württemberg follows as it organises the *technology and knowledge transfer* process is to see companies – particularly SMEs – cultivate closer relations with research centres than they have in the past and put these centres' findings to use for their own particular business. For this reason, it supports first and foremost those measures which serve to establish and improve contacts between science and industry in the region, with two major criteria being geographical proximity and relevance to the problem to be solved. This is accomplished with the help of the Steinbeis Foundation's transfer system, the various chambers and trade associations' broad-based network of points of contact and brokerage agencies (innovation consultants) and the network of technology consultancy offices at Baden-Württemberg's universities. This *Land*-spanning transfer system also includes the Ministry of Economic Affairs' Commissioner for European Affairs and the Steinbeis-Europa-Zentrum (Steinbeis Europe Centre) which he heads. This centre has access to the European Union's R&D programme. Also to be mentioned are the Biotechnologie-Agentur Baden-Württemberg (Biotechnology Agency Baden-Württemberg) and the Media Development Division of Medien- und Filmgesellschaft Baden-Württemberg (MFG Media and Film Society Baden-Württemberg) which locate and pass on selected information and provide consultancy services.

Technology-oriented *entrepreneurs* are shaping the "mind-to-mind transfer of technology". Such entrepreneurs also provide evidence of active structural change and stimulate competition. For this reason, Baden-Württemberg has made this area one of its funding priorities. In addition to the numerous technology parks which were set up in the vicinity of universities and research centres in the years since the early 1980s, Baden-Württemberg presently has five newly established software centres and four biotech parks which play a special role in this connection.

Special attention is given to *spin-off activities at universities* and research laboratories. So-called on-campus start-up networks are one approach that Baden-Württemberg uses here. These networks support entrepreneurs who have a viable business idea but still have to develop it into a prototype, reference system or marketable service. The networks allow participants to remain on campus and continue to make full use of the particular university or research centre's resources during their business' development phase. During this period, they are advised and assisted by a network of business people and entrepreneurs. Today, Baden-Württemberg has a total of eight such on-campus networks.

The Young Innovators scheme which the Ministry of Science, Research and Art sponsors together with the Ministry of Economic Affairs also makes it possible for people from universities or research institutions who start up new businesses not only to receive consultancy services and assistance but also to continue working for a period of up to two years as an academic employee in the same job context they have worked in to date. This allows them to further optimise their product or process with an eye to an eventual market launch and to continue moving forward with starting their new company.

4. International co-operation

International exchange and cross-border co-operation are the lifeblood of research and development. Examples of this include the *Deutsch-Französisches Institut für Umweltforschung* (*French-German Institute for Environmental Research*) and the *Ecotoxicology* project being conducted by the *Länder* and cantons bordering on Lake Constance. Both the Institute and the project were continued through the period covered by this report. In the *field of astronomy*, Baden-Württemberg allocates additional funding to help research institutes in the *Land* participate in large-scale international projects. For example, the Landessternwarte Heidelberg (Heidelberg Observatory) was granted an additional DM 1.5 million in funding to enable its participation in the Large Binocular Telescope project. The Federal Government and the government of Baden-Württemberg are together providing the Kiepenheuer Institut für Sonnenphysik (Kiepenheuer Institute for Solar Physics) DM 2.4 million in additional investment funding through the year 2003 for the development of the adaptive optics system for the planned GREGOR solar telescope. When completed, GREGOR will be the most powerful solar telescope in the world.

Baden-Württemberg's Ministry of Science, Research and Art also plans to step up co-operation with the Chinese Academy of Sciences in Beijing in the area of life sciences. Closely co-ordinated with the Max Planck Society, this co-operation will focus particularly on fostering the activities of groups of young researchers and on supporting a guest laboratory at the Life Science Centre in Shanghai.

Strengthening the European angle

In addition to the many international agreements on scientific co-operation between universities, the integration of universities and companies into the *EU's research funding* system is becoming increasingly important. The focus here is on assisting and co-ordinating universities that are participating in the current Fifth Framework Programme of the European Community for Research, Technological Development and Demonstration Activities and on being involved at Bundesrat level (parliament's upper house) in preparations in connection with the Sixth Framework Programme.

Funding for university participation in the second generation of the SOCRATES/ERASMUS, LEONARDO DA VINCI and YOUTH FOR EUROPE European education programmes and in the First European Community Framework Programme in Support of Culture (Culture 2000 programme) constitutes a further focal area of this work.

Activities to prepare universities for participation in European funding schemes that are part of the Community's INTERREG III initiative and in Baden-Württemberg's structural programme within the framework of the European Social Fund are also given special attention. The integration of the Euro-Institut Kehl (Euro Institute in Kehl) into the Upper Rhine Conference and the simultaneous co-ordination of the Euro Institute's activities with comparable partner institutes will also be important in this connection.

The responsibilities of publicly financed research institutes include acting as a kind of "antenna" and absorbing external academic and entrepreneurial knowledge and subsequently making it usable for regional industry and for training skilled personnel.

Literature

- The Landesforschungsbericht (*Land* Research Report, 1995, published by the Ministry of Science, Research and Art) and the electronic LandesForschungsDatenbank (*Land* Research Database) provide a broader overview of the research system in Baden-Württemberg.
- The *Land* Research Database can be accessed at no charge at the address http://www.forschung.belwue.de.
- The brochures "Innovationssystem Baden-Württemberg", "Wirtschaftsnahe Forschungseinrichtungen in Baden-Württemberg" and "Technologietransfer-Einrichtungen in Baden-Württemberg" are published by the Ministry of Economic Affairs.
- Information regarding the project funding provided by the Ministry of Transport and the Environment can be accessed on the Internet at the above-listed address.

INFO-BOX

FOREIGN STUDENTS IN GERMANY

The number of foreigners studying in Germany has risen continually in recent years, from 123,000 foreign students in 1992 to 165,000 during the 1998/99 academic year. However, this figure includes foreigners who have acquired qualification in Germany to attend an institution of higher education and who account for some 35 per cent of this total. Foreigners who receive initial training and continuing education in Germany become tomorrow's friends and partners throughout the world. Consequently, providing foreign students training in Germany is in the country's long-term economic interest. Germany's Federal Government, Land governments and universities are stepping up their efforts to enhance Germany's attractiveness as a place to study and conduct research in order to attract a greater number of qualified foreign students (and scientists) from those nations in Asia, America and Europe which are important to the country for cultural or economic reasons. These efforts include scholarship programmes, English-language study courses, structured courses of study with internationally compatible degrees such as bachelor's degrees and master's degrees, and improvements in the regulations governing residence permits and work permits. The activities and measures being undertaken to strengthen Germany's international competitiveness and attractiveness as a location for higher education and scientific work are outlined in a joint report sunmitted to the heads of Federal and Länder governments (16 December 1999).

2. The Free State of Bavaria

1. Underlying principles and priorities of research and technology policy

With the launch of its new *High-Tech Offensive* in the year 2000, the Free State of Bavaria will be giving its science, research and technology policy new momentum and pushing forward with the Free State's development as a location for science and industry. The High-Tech Offensive thus picks up from the Offensive for Bavaria's Future which provided the framework for the implementation of important measures for fostering and promoting science and technology in recent years (cf. the 1998 Facts and Figures report). In the years since 1994, the Offensive for Bavaria's Future and the High-Tech Offensive have invested a total of DM 8.2 billion from privatisation proceeds in modern projects to get Bavaria into shape for meeting the challenges of the future, assigning special attention to the area of research and technology policy.

The High-Tech Offensive consists of four pillars:

- Developing Bavaria's high-tech centres into world-class facilities;
- Developing technology plans for Bavaria's administrative districts;
- Establishing *Land*-wide training, start-up and technology infrastructure programmes;
- Internationalising the High-Tech Offensive.

At content level, the High-Tech Offensive will be focussing on five fields of technology:

- Life sciences
- Information and communication technology
- New materials
- Environmental engineering
- Mechatronics.

With this campaign, Bavaria is responding to the challenges of increasing globalisation and giving priority to advanced technologies which will have a lasting impact on technological and economic developments in the coming century.

In addition to this, the Bavarian government has taken a further step to strengthen Bavaria as a location for science by *overhauling the Free State's legislation on higher education*. The further streamlining of the decision-making structures at the *Land*'s universities, the introduction of an improved performance-based incentive system and the assignment of greater budget responsibility to the individual universities will all strengthen the autonomy of Bavaria's universities on a long-term basis.

2. University research and non-university technology policy

Examples of the measures that are anchored in the *High-Tech Offensive* include:

- The development of the Weihenstephan and Martinsried locations into leading centres for "green" and "red" biotechnology (Weihenstephan and Martinsried, respectively).
- The construction of a Zentrum für experimentelle molekulare Medizin (ZEMM – Centre for Experimental Molecular Medicine) in Würzburg which will establish an internationally first-class centre for basic research in the field of molecular biology. This measure is part of a Würzburg-Erlangen-Bayreuth Biomedical Research Network.
- A new building for immunology, medical genetics, epidemiology and preventive medicine is on the drawing board at the University of Regensburg. The University's expertise in the area of basic medical research will be boosted by this expansion of the University's medical department.
- The University of Passau's expertise in the area of information and communications technology will be funnelled into a Zentrum für Anwendungen der Informatik (Centre for Computer Science Applications). One important task for the Centre will be to foster the transfer of technology in the computer science field.
- The construction of a new building for the mathematics and computer science departments at the Technical University of Munich will spur the Garching campus' development and expansion as a location for scientific work.
- An internationally-ranked research network for composite materials and material combinations will be set up in northern Bavaria. A centre of excellence for all research locations in the area will pool the substantial know-how to be found in this region in general – and in the Bayreuth, Fürth/Erlangen and Würzburg areas in particular.
- The environmental engineering capabilities located in Augsburg will be further strengthened.
- A Bavarian mechatronics competence network will bundle mechatronics skills and expertise throughout the *Land*, particularly that of industry-oriented research teams.

Steps are also being taking outside the framework of the High-Tech Offensive to continue Bavaria's development as a location for scientific research.

Construction of the *FRM II Neutron Source Research Reactor at the Technical University of Munich in Garching* is progressing well. This facility is being largely financed using proceeds from the privatisation of *Land*-owned assets as part of the Offensive for Bavaria's Future. The Bavarian government expects the FRM II to begin operation as scheduled in early 2001.

The number of *collaborative research centres* at Bavaria's universities has grown to 47 today.

The establishment of Bavarian *research co-operations* has proven to be a particularly effective instrument for promoting interdisciplinary and cross-university research. Bavaria currently counts 21 (active) regional interdisciplinary research co-operations. Within the framework of these co-operative alliances, scientists from various departments and universities conduct joint research and development in specific areas on a temporary basis with partners from the industrial sector. They work in particular in promising fields of information and communications technology, new materials, biotechnology and research into future needs.

Bavaria's new research co-operations include:

- The Elevated Solar UV Radiation Research Network (FORUV)

which has the task of appraising risks and developing recommendations for the political sector, administration, trade and industry which would permit appropriate and adequate action in light of the current level of UV exposure to which the public, agricultural crops and natural resources are subject in Bavaria.
– The Biomaterials II (FORBIOMAT II) research co-operation will build on the experience and findings gathered by the FORBIOMAT I project and focus primarily on structuring and/or functionalising materials for medical products for long-term use in the human body in the areas of cardiology, orthopaedics, dentistry and allergology.
– The Medical Image Processing (FORMED) research alliance which deals with issues of three-dimensional imaging and image processing.

The *Bayerische Forschungsstiftung (Bavarian Research Foundation)* was established back in 1990 to support promising projects conducted by university and non-university research institutions and to ensure that scientific findings would be quickly transferred to industry for translation into products and processes. The Bavarian Research Foundation promotes projects which must involve partners from both the scientific community and industry. This can also be done within the framework offered by research co-operations. The focus of such projects to date has been on electronics, biotechnology, laser technology, energy technology, process engineering, surface technology and mechanical engineering.

The *Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. (MPG – Max Planck Society for the Promotion of Science)* opened its new administrative headquarters on Marstallplatz in Munich in the summer of 1999. Bavaria supported the construction of this new building by supplying DM 11 million in special funding and providing the property at no charge through a lease in perpetuity. With this new building, the Max Planck Society's administrative headquarters now have permanent accommodations in Munich which will facilitate operations and reflect the Society's importance.

3. The promotion and transfer of technology

The transfer of technology from Bavaria's universities to industry is an excellent instrument for safeguarding and expanding businesses' competitive strength and technological leadership. In order to improve the flow of information in this area, the Free State's universities have established *technology transfer agencies* which set up contacts with industry and increase awareness of this subject among relevant players at universities (students, professors and non-professorial teaching staff). As the annual TBU (Association of Transfer Agencies of Bavarian Universities) report confirms, the work of these offices is an integral part of the transfer of technology in Bavaria today.

Another highly effective method for getting universities in touch with industry is the participation of university working groups and research groups at relevant trade fairs such as CeBIT, Laser, Materialica, Medica, and Systems.

As part of the BONUS programme, universities receive performance-linked bonuses for the external funding they raise through application-oriented research contracts. The response to this programme has been excellent, with 366 applications for projects worth a total of nearly DM 30 million being submitted during the last four years.

Bavaria's (then) Ministry of Education, Culture, Science and Art launched the Bavarian Programme to Facilitate the Transition to Entrepreneurship (or *FLÜGGE*, its German acronym) during the 1997/1998 winter semester. This programme is aimed at engendering a new corporate and entrepreneurial culture in the higher education sector. It fosters start-ups from the university sphere by offering young graduates the opportunity to work on a part-time basis at their university for a period of up to two years, parallel to their start-up's conception phase, giving them a means of supporting themselves during this time. Today, the FLÜGGE programme is assisting a total of 30 people who are starting up their own companies.

Also part of the High-Tech Offensive, the *Bavarian Entrepreneurs' Network* follows the same idea. This project is being developed in conjunction with the technology transfer agencies operated by Bavaria's universities. Its objective is to provide the best consultancy services possible for people interested in starting up a business. Components include the establishment of start-up assistance offices, organising continuing education and training activities on the subject of start-ups, and developing a network out of all university activities for fostering entrepreneurs.

The *Bayern Innovativ GmbH* technology transfer agency was founded in March 1995 and operates throughout Bavaria. It augments and interlinks the many technology-transfer offerings in the Free State and taps new means for collaboration between science and industry. DM 100 million from Bavaria's privatisation proceeds have been made available for Bayern Innovativ.

Initiated by the Ministry of Economy, Transport and Technologies and the Ministry of Education, Culture, Science and Art, the *New Materials* action programme has the task of promoting collaborative projects between companies and research centres for the purpose of stepping up the development and use of new materials. This programme targets businesses with headquarters or a branch office in Bavaria and Bavarian research institutes. A total of DM 48.8 million in grants was awarded in the years 1991 (the year the programme was launched) through 1998. All in all, 194 companies and research institutes participated in the programme's funding projects. The brochure "Neue Werkstoffe" (New Materials) which is published by the Bavarian State Ministry of Economy, Transport and Technology contains further details.

The *Bavarian Microsystems Programme* promotes collaborative projects between companies and between companies and research institutes with the objective of accelerating the development of microsystems components and the use of microtechnology in new products.

The *Bavarian Programme for the Promotion of Technology-Oriented Start-Ups (BayTOU)* is geared to development projects that entail technological or economic risk. This programme targets people who plan to start up a technology-oriented firm and industrial companies which are less than three years old and have no more than five employees. Assistance can be provided for, among other things, personnel and material expenses, project-related consultancy services (such as evaluations, reports by experts, market studies) and project guidance from technology parks, business incubators and/or seed capital companies. Between its launch in 1996 and the end of 1998, the programme provided 98 young companies a total of DM 15.8 million in funding.

At Bavaria's *technology-oriented business incubators*, young entrepreneurs find an innovative spirit driving the discussions and collaboration between scientists, engineers and managers. The companies particularly benefit from their close physical proximity to renowned research centres. Bavaria has allocated a total of DM 73 million since 1984 to foster technology-oriented business incubators. The specialised business incubators in Martinsried (biotechnology), Augsburg (environmental engineering) and Prien (logistics) are funded through the Offensive for Bavaria's Future. Further incubators are in the planning as part of Bavaria's High-Tech Offensive.

The Bavarian government generated important impetus for the provision of venture capital to young technology firms by founding the *Bayern Kapital* Risikobeteilungs GmbH company in Landshut in December 1995. Since then, participating interests totalling some DM 117.4 million have been acquired in 84 cases. The focus here has been on biotechnology, software/multimedia and medical technology. Bayern Kapital has the decisive advantage that private lead investors and the Deutsche Ausgleichbank's Technologie-Beteiligungsgesellschaft tbg (equity investment company for technology-based firms) which is usually involved both match the amount of venture capital being provided by Bayern Kapital. Some DM 350 million have been mobilised in this way since 1996.

4. International activities

Bavaria's universities were able to raise more than DM 31 million in EU funding in 1998, nearly eight per cent more than in the previous year. The lion's share – more than DM 25.8 million – went to research and development programmes. This was the fourth year in a row in which Bavaria's universities have increased the amount of EU funding they were able to recruit. This competence in dealing with EU funding mechanisms has been acquired over the years – through, for example, the work of the research officers and EU consultants at all of Bavaria's universities – and makes itself felt here in a positive way. Special mention should also be made of the participation of Bavaria's Fachhochschulen (Universities of Applied Sciences) in EU programmes. These universities were able to attract almost DM 3.4 million in EU funding in 1998, nearly 44 per cent more than in the previous year. Participation in EU research and development programmes is expected to be even greater in the coming years because new legislation that was passed during the reform of Bavaria's higher education system expressly provides for the possibility of application-oriented research and development projects being conducted by Fachhochschulen. The inclusion of Bavaria's higher education institutions in EU research programmes and education programmes is making a significant contribution towards enhancing these institutions' international competitiveness.

In the area of international research co-operation, Munich's two universities founded the *Bayerisch-Französisches Hochschulzentrum (BFHZ – Bavarian-French University Centre)* in conjunction with universities in Paris and the Grand-Sud regions of France in 1997. Bavaria provides DM 300,000 a year in funding for the BFHZ which has set itself the twofold task of supporting ambitious, cross-border projects in the higher education sector which would otherwise not receive funding and of mediating information about Franco-German facilities and their offerings. In particular, the BFHZ assists dissertations and doctoral theses which are based on work done at a research centre in the other country, research projects during their development stage, exchanges and collaborative ventures on the part of professors, researchers and university lecturers, and the organisation of colloquia and seminars (for which it makes particular use of mobility grants). This initiative is currently receiving considerable attention in Germany and France. The number of applications being submitted by Bavarian universities is growing steadily.

Following the example of this successful project, plans are currently on the drawing board to establish a *Bayerisch-Kalifornisches Hochschulzentrum (Bavarian-Californian University Centre)* at the University of Erlangen-Nuremberg. This centre is to be financed with funds from the High-Tech Offensive.

Literature

Further information regarding Bavaria's research and technology policies can be found on the Internet at http://www.stmukwk.bayern.de, http://www.bayern.de and http://www.stmwvt.bayern.de.

3. Berlin

1. Underlying principles and priorities of research and technology policy

Science and research are decisive elements in Berlin's regional economic policy. The science and research field accounts for more than 50,000 jobs in Berlin; the *Land* of Berlin allocates more than DM 3.5 million a year in funding for these activities. If Berlin is to turn its vision of being a "global city of knowledge" – the model for the "new Berlin" – into reality, the *Land* must take its achievements in this field and present them compellingly, market them aggressively and provide an easily accessible overview of them.

Berlin gives systematic attention to *developing research priorities* and *a future-oriented profile for its research system*.

A general analysis of the research activities being conducted in Berlin reveals the following rough outline of priority fields – an outline that makes no claim to being comprehensive and does not aim to completely avoid overlaps:

- Molecular medicine, biotechnology, genome research
- Information and communications technology
- Transport research and engineering (including aeronautics and aerospace)
- New materials and processes (including surfaces and interfaces, catalysis and photovoltaics)

Part IV

– Structural research
– Optics and optical technologies
– Microsystems
– Production engineering and mechanical engineering
– Environmental research
– Geosciences
– Applied mathematics.

The first three areas are also the three most important priorities set by Berlin's technology policy which the government of Berlin co-ordinates with the government of Brandenburg's priorities in these areas. Both *Länder* have agreed to give these fields priority and to promote them on a joint basis. In doing so, they want first and foremost to strengthen the link between science and industry, foster the rapid translation of relevant research findings into marketable products and support innovative start-ups. The heads of government of both *Länder* are personally overseeing this process.

By contrast, it is not possible to provide a similar summary of priorities for the diverse capabilities of Berlin's humanities and social sciences. High-quality research activities that are being pursued in Berlin on an inter-university and cross-institutional basis are to be interlinked with one another under the heading "Cultural and social change" and given special assistance in the future.

Aiming to give Berlin's research system a more clear-cut profile, the *Strategy Forum for Science, Research and Innovation* – a panel of high-ranking representatives from science, research, industry and technology – has made it its business
– to ascertain and analyse the strengths and weakness of research being conducted in Berlin;
– to put this information to use to develop joint suggestions for Berlin's future science policy and to set up and/or deepen networks; and
– to organise concerted science marketing activities for Berlin.

The Strategy Forum has appointed experts to co-ordinate the work that is necessary for developing a profile for each of the most important focal areas of Berlin's science and research system.

As part of this profile-development process, stock is to be taken of the *Land*'s most important research priorities in terms of quantity and content and first attempts are to be made at a qualitative evaluation. The process will also be concerned with presenting a suitably broad picture of research capabilities – while nonetheless focussing on the most important topics – and emphasising their national and international importance and the innovative impetus they generate.

A start is to be made with the focal areas of molecular medicine, biotechnology and genome research; applied mathematics; structural research; transport research and – looking at the humanities and social science fields – the issue of cultural and social change.

2. University research

The amount of external funding which Berlin's universities are able to raise through the Deutsche Forschungsgesellschaft (DFG) and in other competitive procedures is decisive confirmation of the quality of the research they conduct. Berlin's universities expended approximately DM 372 million (this includes spending on university medical activities) in external funding in 1998.

This confirmation is evidenced by the funding provided for Berlin's
– 23 collaborative research centres (approximately double the number in 1993)
– 32 postgraduate research groups (four times the number in 1993)
– 2 centres of excellence and
– 12 research units

and by the many other projects which are funded through the DFG's individual grants programme and priority programmes, the EU, and private or public bodies.

In addition to this, Berlin's universities and institutions of higher education have also developed their own internal research funding instruments which they use to fund interdisciplinary projects and prepare contract research. The Berlin Senate (state government) expressly supports the practice of granting universities research funding on a performance basis.

Budget policy potentially jeopardised the planning security that is necessary for research projects by requiring budget cuts in the higher education sector. It was possible to circumvent this problem by concluding *framework agreements on higher education financing* with Berlin's universities, *initially for the period through the year 2000*. A two-year extension of these agreements was negotiated in June 1999. In return, the *Land*'s universities have committed themselves to a number of quality assurance and profile-building measures and have launched organisational reforms.

Thanks to the legally binding ceilings agreed upon for the years 2001 and 2002, it will be possible to implement the legislated target of funding 85,000 staff-related study places in a structure of acceptable quality.

The university agreements call for *structural plans* containing *information about future resources and priorities*. These have been completed and are now undergoing a thorough assessment by the Science Council. The results of this evaluation can be expected to provide valuable clues as to how Berlin's research system should be organised in the future, also in regard to linking university research and non-university research even more closely with one another. One example of this interlinkage are the (currently) 98 university professors who have been jointly appointed on the basis of co-operation agreements. Implementing these recommendations as systematically and consistently as this has been the case at non-university facilities will be an important task for Berlin's science policy in the coming years.

3. Non-university research

In addition to its universities and other institutions of higher education, Berlin can also point to a large number of publicly financed non-university research facilities (and their branches). The Adlershof and Buch Science Parks play a special role in this connection. Developed by the government of Berlin as specialised large-scale centres, these two parks were conceived and planned as integrated science and industry locations right from the start. The hallmarks of these two science parks are interaction between basic research and application, the integration of research, training and actual practice, research-based spin-offs, and the development of international markets.

The most important innovation project is the *WISTA project to develop Adlershof as a location for science and industry*. Besides some 300 firms, Adlershof's "tenants" presently include twelve non-university research institutes which employ approximately 1,400 people and have an aggregate annual budget of more than DM 200 million, two thirds of which are financed by the Federal Government and external sources.

The research work being done at Adlershof focuses on four priority fields: new materials and processes, photonics, information and communications technology, and environmental research.

Since early 1998, Adlershof has also been able to offer national and international user groups in the physics, chemistry, biology, materials science, chip technology and microsystems fields a synchrotron radiation source of the third generation – the BESSY II electron storage ring which was built at a cost of some DM 190 million.

A binding decision was taken to expand Berlin-Adlershof as a location for science and industry by transferring Humboldt University's natural sciences to it. A total of DM 550 million in funding is foreseen for this. Construction has already started. Humboldt University's computer science department has already moved to the Adlershof campus. The mathematics department is to follow in 2000.

The only science and industry centre of its type in Germany, the *Biomedizinischer Forschungscampus (Biomedical Research Campus) in Berlin-Buch* combines basic molecular biology research with clinical research and technology transfer activities.

Located in close proximity to the specialised clinics operated by Humboldt University's medical department, the campus has succeeded in creating a configuration that is new for Germany and allows researchers to conduct modern clinical research which includes the use of molecular-biological, cell-biological and physiological techniques.

Sponsored by the Max-Delbrück-Centrum für Molekulare Medizin (MDC – Max Delbrück Centre for Molecular Medicine), the Forschungsinstitut für Molekulare Pharmakologie (FMP – Research Institute for Molecular Pharmacology) and the Schering company, the Biomedizinisches Forschungscampus Berlin-Buch GmbH company has the task of developing the campus, persuading existing firms to relocate to it, and fostering start-ups. A total of 1,900 people already work at this 32 hectare facility in Berlin's northern suburbs. The 30 companies presently located at the Buch campus cooperate closely with the Max Delbrück Centre and the university clinics. Their work focuses on developing marketable products and processes involving all aspects of biomedicine.

However, a location that specialises in innovation cannot be built on the natural sciences and technology alone. Proximity to and interaction between the natural sciences, engineering, the humanities and social sciences create favourable conditions for a climate that produces innovation. In this regard, Berlin offers optimal prerequisites for this with its universities and numerous non-university facilities such as the Wissenschaftskolleg (Institute for Advanced Study), Wissenschaftszentrum (Social Science Research Centre Berlin), Deutsches Institut für Wirtschaftsforschung (German Institute of Economic Research), Berlin-Brandenburgische Akademie der Wissenschaften (Berlin-Brandenburg Academy of Sciences and Humanities), and three centres for the humanities.

4. The promotion and transfer of technology

Berlin will remain competitive over the long term only if it is able to use co-operation between science, research and industry and the transfer of knowledge to overcome existing structural weaknesses and only if it develops a specific regional culture of innovation and co-operation.

The *Senate's plans for developing productive innovation networks and competitive structures* focus on this objective. Berlin itself maintains a network of transfer facilities and activities for this purpose:

For instance, *Interdisziplinäre Forschungsverbünde (IFV – Interdisciplinary Research Alliances)* foster the formation of regional networks for specific topics. These alliances have proven to be extremely successful in organising areas of scientific expertise. Berlin's (currently) 11 Interdisciplinary Research Alliances have the job of intensifying collaboration between researchers and facilities, promoting the development of priority research areas, building competitive structures, and providing subject-specific support for the transfer of knowledge and technology. Put in a nutshell, Interdisciplinary Research Alliances have the task of organising areas of expertise on the science side. Industry will be incorporated into this structure wherever possible.

The government of Berlin provides special assistance for the fields of molecular medicine and biotechnology, medical technology, information and communications technology, and transport research and engineering which are co-ordinated by the Technologiestiftung Berlin (Berlin Technology Foundation). The Interdisciplinary Research Alliances prepare these fields and subsequently continue to support them.

The *Research Policy Dialogues* were also established as an instrument for strengthening the link between science and industry in the region. These one-day events are aimed at publicising competitive priority fields and initiating concrete collaborative activities.

Berlin has other transfer activities and facilities in addition to the *transfer agencies at its universities*. The *Berlin-Brandenburg BioTOP Initiative*'s transfer record is particularly impressive. Within a period of less than three years, the region has seen the launch of nearly 30 new companies in this area of innovation. Selected research findings are presented at trade fairs via the *Forschungsmarkt Berlin (Berlin Research Market)*, a joint undertaking on the part of Berlin's universities and non-university institutions. The *business incubators* which work closely together with Berlin's universities also serve to facilitate the transfer of knowledge and technology. The Wissenschafts- und Wirtschaftsstandort Berlin Adlershof (WISTA – Science and Business Park at Berlin-Adlershof) described above and the Buch Biomedical Research Campus are especially important in this connection. Non-university research institutes in particular are additionally gearing their work to an ever-growing degree to applications that can be put to commercial or industrial use. They are also collaborating with specialised firms or carrying out industrial contract research for this purpose. Noteworthy examples of such institutes include the Heinrich-Hertz-Institut für Nachrichtentechnik (Heinrich Hertz Institute), the Ferdinand-Braun-Institut (Ferdinand Braun Institute) and the Konrad Zuse-Zentrum (Konrad Zuse Centre).

The Berlin Senate plans to establish a *technology and innovation fund* in the near future, using part of the proceeds generated by the sale of *Land*-owned assets. This fund will be used to finance on a targeted basis particularly outstanding projects – especially the building of networks – in selected innovative fields.

5. International activities

Berlin attaches great importance to international relations and endeavours to develop and cultivate them in the scientific sphere as well. This is apparent not only from Berlin's *particularly large portion of foreign students* which at 12.7 per cent is considerably higher than in Germany's other *Länder* where the average is 8.5 per cent. It is also evidenced by the unusually large number of co-operation agreements – some 440 – which Berlin's universities have concluded with universities and research centres throughout the world. The range of fields which revolve around the language and culture of other countries is particularly broad at Berlin's universities.

Islamic studies are one of the *focal areas of research being pursued in Berlin to tap other cultural and economic spheres*. At the "Moderner Orient" Geisteswissenschaftliches Zentrum (Modern Orient Centre for the Humanities), researchers from various countries work together on analysing the political, economic and social problems of the Middle East and South-West Asia. The Modernity and Islam Study Group – comprised of scientists from institutes and centres in Berlin – is also responding to Islam's growing political importance through its work which combines historical-philological methods with sociological approaches. Centre-stage is given to conducting "research with" rather than the customary "research on".

Berlin also offers outstanding capabilities in the area of *European studies*. The Humboldt University, for example, has a Centre for Britain Studies and a Department of Northern European and Scandinavian Languages and Cultures, while the Technical University of Berlin has a Centre for French Studies, and the Free University of Berlin has a Centre for Italian Studies and an Institute for Eastern European Studies. The Europäisches Zentrum für Staatswissenschaften und Staatspraxis (European Centre for Comparative Government and Public Policy) is jointly funded by all of Berlin's universities.

In addition, Berlin also has expertise in North and South American studies and in African and Asian studies that is of particular scientific, cultural and political value.

The exceptional variety, quality and geographic concentration of Berlin's scientific (and cultural) institutions is an important locational advantage and a starting-point for international contacts, activities and co-operation.

In light of its future role as a capital in the heart of Europe, it is imperative that Berlin cultivate its sizable scientific capabilities (which have become even more diverse since the city was reunified), publicise them and put them to use for European and international communication.

Literature

– Information on Berlin's research system can be accessed at the Internet address www.berlin.de.
– Information can also be found in the brochure "Forschung in Berlin: Politik, Potenziale, Projekte" which was published in 1999.

4. Brandenburg

1. Underlying principles and priorities of research and technology policy

Although Brandenburg is Germany's fourth largest *Land* with a surface area of approximately 29,000 km_, it has only 2.5 million residents. At the same time, the metropolis Berlin is also located in this sparsely populated *Land*. As a result of this circumstance, Brandenburg and Berlin form an interlocked area and are dependent upon one another in special ways.

Brandenburg's science policy has proven itself to be an efficient instrument for initiating and organising necessary structural change in the region. In developing its research policy, the government of Brandenburg followed the Science Council's recommendations, launching the sustained development of the *Land*'s infrastructure with its universities and non-university research centres, a development which has accelerated considerably in recent years.

A particular hallmark of Brandenburg's development has been the strengthening of the *Land*'s scientific expertise which was undertaken with an eye to stabilising and boosting the amount of knowledge being generated. In this connection, Brandenburg understands investment in research and science to mean the safeguarding of:

– Brandenburg's job qualification structure
– The *Land*'s research infrastructure
– Outstanding achievements in the high-tech industry
– Jobs for the future.

Besides founding the University of Potsdam, the Brandenburg Technical University of Cottbus, the European University Viadrina in Frankfurt an der Oder, the Hochschule für Film und Fernsehen in Potsdam (Film and Television Academy "Konrad Wolf") and Fachhochschulen (universities of applied sciences) in Brandenburg, Eberswalde, Potsdam, Senftenberg-Cottbus and Wildau, Brandenburg has also established non-university research centres. Each of Germany's major research organisations is represented in Brandenburg:

– 3 institutes of the Max Planck Society
– 4 centres of the Fraunhofer Society
– 4 centres of the Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF _ Hermann von Helmholtz Association of National Research Centres)

– 8 institutes of the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association).

These facilities exhibit a noticeable concentration around Berlin. Potsdam, Golm, Bergholz-Rehbrücke, Teltow and Großbeeren are located close to one another and form an "extended community" along Berlin's periphery. Other towns in Brandenburg (Zeuthen, Erkner, Müncheberg, Frankfurt/Oder, Cottbus) which are known for a concentration of scientific activity are firmly integrated into the region's transport infrastructure.

Geographical concentration is an important prerequisite for synergies. It will continue to progress, leading to areas with a high concentration of facilities. For example, the campus currently being set up in Potsdam is being organised in a way to produce what will probably be the greatest concentration of institutions to be found in Germany to date.

When you add Berlin's scientific expertise to that of Brandenburg (some of whose institutes already offer internationally recognised expertise), the result is an exemplary concentration of scientific infrastructure. A highly competitive research base is developing in this region – a good prerequisite for keeping pace with the international competition in the research arena and, as was the case during the late 19th and early 20th centuries, for representing the world's best science on a broad basis.

2. Universities and non-university research centres

Brandenburg's universities and Fachhochschulen (universities of applied sciences) are all quite new and were founded with an eye to present-day requirements. These higher education institutions were designed in such a way to allow them to respond to the times and effectively gear their organisational structure and infrastructure to specific fields of research. One of the principles on which these universities were founded is the principle of integrating education with research.

Brandenburg's universities and non-university research centres finished their founding phase in the last few years. They have become firmly established as they developed, thanks to organisational measures and considerable infrastructure investment. In the process, they have evolved into an important economic factor for their respective regions.

Consolidating and expanding these universities and increasing their attractiveness are some of the priority goals pursued by Brandenburg's science policy. Reaching these goals will entail developing distinct profiles for the individual universities, interlinking them with one another and ensuring their collaboration with non-university research centres. Co-operation agreements make it possible for universities and research centres to develop in a way that is geared to and complements one other's development. This strengthens the universities' research units and broadens the participating research centres' recruitment base.

The joint appointment procedures foreseen by co-operation agreements incorporate scientists from research centres into the university teaching system. Co-operation agreements also make the infrastructure resources of the respective research centre available to students. This is a very effective method for ensuring the proximity of education and training to ongoing research. It has also noticeably increased the performance level of the natural science programmes on offer at Brandenburg's universities. When seeking partners for their collaborative ventures, the *Land*'s non-university research centres look primarily to the universities in Brandenburg and Berlin.

The structure of Brandenburg's research scene is also determined by the overall profile of the disciplines it specialises in and by the precept that the purpose of research cannot be reduced to just usefulness and commercial success.

The humanities and basic research are highly relevant to society and have a long-term impact. The humanities and social sciences make an indispensable contribution to the way today's industrial, knowledge-driven society sees itself. They serve a number of functions in the areas of cognition, orientation and action-taking. Which is why Brandenburg systematically develops and promotes them.

Basic research in the natural sciences should also avoid focusing on short-term findings. Brandenburg has returned to the scientific tradition that evolved in this region over the years, and is now in the process of developing it further.

The promotion of application-related science is a research-policy paradigm in Brandenburg. Technology-oriented fields are particularly important for getting a head start in product and process innovation and for ensuring the existence of the technological conditions necessary for making the transition to a service and knowledge society.

Building on small fields and faculties, the *University of Potsdam* has developed a distinctive profile in several areas which are marked by pronounced interdisciplinary, cross-subject and cross-faculty collaboration and by co-operation with non-university facilities. Particular attention is assigned to the following areas:

– Mathematics and natural sciences
– Economics, institutions and administration
– Cognitive science.

The University of Potsdam's research achievements were recognised and acknowledged with the University's admission to the Deutsche Forschungsgemeinschaft.

The fields of research pursued at the *Brandenburg Technical University of Cottbus* are geared to long-term development priorities which are necessary for the *Land* and the surrounding region. These priorities include energy-efficient systems, the development of new materials, and transport systems engineering. The University has developed productive co-operation structures with research institutes. This interlinking of capability and resources lays the foundation for the emergence of centres of excellence in materials research, transport systems and environmental sciences.

Being located on one of Germany's borders, Brandenburg regards its geopolitical location as a responsibility and has made an important contribution toward building a bridge between western and eastern central Europe in the European integration programme by founding the *European University Viadrina* in Frankfurt an der Oder. Today, a third of the students attending Viadrina University come from Poland. The number of students from other east European countries such as Ukraine and Romania is also growing. Viadrina has concluded co-operation agreements with a number of scientific centres in Europe and elsewhere. One product of such co-operation agreements is the Collegium Polonium in Slubice, Poland, a neighbour of Frankfurt an der Oder. The Collegium Polonium is a cross-border teaching and research facility which is jointly operated by the European University Viadrina and the Adam Mickiewicz University in Poznan.

The *Film and Television Academy "Konrad Wolf" in Potsdam-Babelsberg* is an important player in shaping the Berlin-Brandenburg media landscape. Its Audiovisual Media Science degree programme provides the main framework for teaching and research at the Academy. The school's practical focus leads to ideas for basic research on media design, aesthetics and dramaturgy as well as content and product analyses for communications research.

The Berlin-Brandenburg region's special advantages – its concentration of research and development facilities, their close, practice-oriented relations with industrial enterprises, and its infrastructure – offer favourable conditions for the development of the research profiles of the *Land*'s five Fachhochschulen (universities of applied sciences).

Through their targeted contributions to teaching and research – e.g. with regard to deploying new information and communications technologies – Brandenburg's Fachhochschulen are helping to shape the transition from industrial society to information and knowledge society. In this context, particular attention is being given to the development and application of multimedia technologies, a pivotal field.

Application-oriented research and development have developed into an important profile-defining factor at Brandenburg's universities of applied sciences. Priority here is assigned to improving the conditions necessary to increase the number of start-ups by graduates from the Fachhochschulen. The technology transfer agencies at all the *Land*'s universities of applied sciences are to make a contribution toward this. Brandenburg's Fachhochschulen have built up collaborative relations with a number of institutes and SMEs in their respective areas. The technology and knowledge transfer that takes place when universities of applied sciences perform project contracts provides solutions to technical, technological and operational problems. As a consequence, this transfer has grown into an important stimulus for the development of the respective region.

The government of Brandenburg has vigorously supported the founding and expansion of *non-university research centres*. Some DM 550 million in funding from the *Land* government, the Federal Government and the European Union have been expended for the construction and outfitting of new institutes alone.

Local priorities have led to the development of campuses:

Three Max Planck institutes have been working on the campus of the Golm Science Centre since 1998. These are the Institut für Molekulare Pflanzenphysiologie (Max Planck Institute for Molecular Plant Physiology), the Institut für Kolloid- und Grenzflächenforschung (Max Planck Institute for Colloids and Interfaces) and the Institut für Gravitationsphysik Albert-Einstein-Institut (Max Planck Institute for Gravitational Physics – Albert Einstein Institute). The infrastructure for the Fraunhofer Society's Institut für angewandte Polymerforschung (Institute for Applied Polymer Research) is currently being set up and the University of Potsdam is building facilities for its Department of Mathematics and Sciences on the Centre's campus.

A technology park is being added to the Golm Science Centre.

Located on Potsdam's Telegrafenberg, the campus of the Albert Einstein Science Park is populated by the GeoResearchZentrum (GeoResearchCentre, a member of the HGF – Hermann von Helmholtz Association of National Research Centres), the Potsdam Research Unit of the Alfred Wegener Institute (also a member of the HGF), the Potsdam-Institut für Klimafolgenforschung (Potsdam Institute for Climate Impact Research, a member of the WGL – Gottfried Wilhelm Leibniz Science Association) and parts of the Astrophysikalisches Institut Potsdam (Astrophysical Institute of Potsdam, a member of the WGL). This campus has developed into a centre of excellence for earth system research that enjoys international standing.

A biotechnology campus with several institutions and numerous small and medium-sized biotech enterprises has sprung up at Potsdam-Hermannswerder.

A humanities campus is currently taking shape at Potsdam's New Market where the following facilities can already be found:

- The Einstein Forum which acts as a mediator between the natural sciences, engineering sciences and humanities;
- The Moses Mendelssohn Zentrum (Moses Mendelssohn Centre) for European-Judaic studies which conducts historical, philosophical, theological and sociological research on an interdisciplinary basis;
- Long-term projects in the humanities field being conducted by the Berlin-Brandenburg Academy of Sciences and Humanities.

The *thematic focus* in the natural and engineering sciences is on biotechnology, environmental technology and microelectronics.

The science strategies of the 21st century will be geared more than ever to protecting the natural resources that humanity depends on for survival. This will mean dealing with the issues nutrition and health, the environment as habitat, and information and communication.

By defining priority research fields for non-university research centres, the government of Brandenburg is helping to meet upcoming challenges with scientific means.

The Max Planck Institute for Molecular Plant Physiology in Golm explores the reactions and functional processes of plants, reaching all the way to the molecular level in the process. This work is expected to lead, among other things, to a man-made developmental advance in the plant world, an advance which will give mankind the raw material we know as "plants" – which serves as both food and material – in hitherto unknown forms, variety, quantity and quality.

The work of the Deutsches Institut für Ernährungsforschung (German Institute of Human Nutrition, a WGL member) at Bergholz-Rehbrücke draws upon the findings being produced in Golm and other facilities. This institute is developing into a life science centre. The basic research that it conducts on the links between nutrition and health will guarantee trade and industry, service-providers and law-makers the expertise they need on nutrition issues and for taking the decisions arising from these issues. Given the growing awareness that nutrition can have preventive and therapeutic benefits for human health, a new and very broad field of research is opening up for the Institute.

The Institut für Gemüse- und Zierpflanzenbau Großbeeren (Institute of Vegetable and Ornamental Crops in Großbeeren, a member of the WGL) examines relationships and processes involved in generating new knowledge all the way to developing practical uses for it in production operations. A major surge in knowledge is to be expected from the research on genetically modified plants that is currently being conducted around the world. This knowledge will also have an impact on production processes for vegetable and ornamental crops and must be studied.

The GeoForschungsZentrum Potsdam (Potsdam Geoscientific Research Centre) in Potsdam-Telegrafenberg is Germany's centre of excellence for geosciences. Research here focuses on exploring solutions and concepts for protecting and extracting resources, ensuring safer disposal sites for waste and hazardous materials, making provisions for natural disasters and lessening their after-math. It is also conducting very promising research on sources of geothermal energy that can be harnessed.

The Potsdam Institute for Climate Impact Research in Potsdam-Telegrafenberg is involved in research on the relationship between the ecosphere and the anthroposphere and on the mechanisms for controlling or steering this interrelationship. It is already clear today that its research findings will have a direct impact on political decision-making processes.

The Potsdam Research Unit of the Alfred-Wegener-Institut für Polar- und Meeresforschung (Alfred Wegener Institute for Polar and Marine Research, a member of the HGF) in Telegrafenberg works in a specialised environmental field. Polar research is important because it helps us understand the processes that occur during climate change. With the help of polar research, it is possible to make prognoses about how living conditions will change in the future as a result of anthropogenic intervention.

The work of the Zentrum für Agrarlandschafts- und Landnutzungsforschung (Centre for Agricultural Landscape and Land Use Research) in Müncheberg also revolves around environmental engineering, albeit with a focus on another critical area. This institute analyses, evaluates and forecasts processes and interactions in agricultural parts of the North German Lowlands. It also conducts analyses and sheds light on processes using landscape models which allow an appraisal of possible future changes. The Institut für Agrartechnik Bornim (Institute of Agricultural Engineering, a member of the WGL) in Potsdam-Bornim deals with the development of environmentally sound techniques for plant cultivation, animal husbandry and horticulture and for alternative forms of land use.

The Institut für Halbleiterphysik Frankfurt (Institute of Semiconductor Physics, a member of the WGL) in Frankfurt an der Oder has built up a chain of interlinked expertise in the fields of physics, materials science and system-specific technologies.

The research conducted at the institute is application-oriented and concerned with providing a bridge between research and the development of marketable products. The institute's work also includes close collaboration with the Brandenburg Technical University of Cottbus and with renowned industrial enterprises.

The founding of the Hasso-Plattner-Institut für Softwaresystemtechnik (Hasso Plattner Institute for Software Systems Engineering) could serve as a model for starting up other new institutes. The establishment of this institute was made possible by the generous financial assistance of a private donor – a good example of public-private partnership. The institute collaborates closely with the University of Potsdam.

The founding of the Berlin-Brandenburg Academy of Sciences and Humanities in 1992 added a new chapter to the earlier traditions that began with Leibniz and his academy. The Academy supervises 34 long-term projects with the help of (currently) 15 commissions. One of the Academy's special features is that it selects its members on a nation-wide basis.

Research at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) is endeavouring to develop a theory which – as a generalisation – is valid for both the general theory of relativity and the quantum field theory.

An independent programme for elementary particle research is being conducted at DESY Zeuthen (a branch institute of the Deutsches Elektronen-Synchrotron and a member of the HGF), in conjunction with DESY Hamburg (Deutsches Elektronen-Synchrotron, a national research centre for particle physics and synchrotron radiation research), the European Organization for Nuclear Research (CERN) and numerous German and foreign universities and research institutes. DESY Zeuthen is also involved in developing supercomputers.

The Astrophysical Institute of Potsdam (a member of the WGL) focuses its research efforts on structures and processes in both the near and distant universe. This work revolves around magnetic fields in the universe and the signs of activity that they cause. The institute also conducts research in the field of extragalactic astrophysics, including cosmology. Here, the focus is on distant objects and on how cosmic structures were formed during the early phases of the universe.

3. The promotion of technology

A hallmark of *key technologies* is that they take elements of knowledge which have been developed by science and make them marketable. A *Land* such as Brandenburg cannot foster all advanced technologies. It consequently focuses on selected areas of expertise.

Establishing favourable conditions for innovative scientific work and developing a transfer-friendly culture of co-operation

INFO-BOX
INNOREGIO – INNOVATIVE IMPETUS FOR THE REGION

The InnoRegio special funding programme which the BMBF launched for Germany's new Länder in 1999 takes into account the strengths and weaknesses of innovation activities in eastern Germany. In contrast to other programmes which require a certain level of innovation capability on the part of their participants, InnoRegio's focus is on developing innovation potential. InnoRegio targets the use of new forms of co-operation between educational institutions, research institutes, industry and government bodies to develop and boost regional innovation potential and in turn generate vital impetus for the development of marketable products and services and for the creation of new jobs. New partners are to give existing networks supplementary impetus. Close partnerships are particularly important for the innovation work pursued by small and medium-sized enterprises – the players who are shaping the economy in the new Länder.

Twenty-five InnoRegio projects were selected from the 444 regional initiatives that were entered in the competition which set no restrictions with regard to the topics or players. During the development phase, these "InnoRegios" are to develop detailed innovation plans for their particular region with the assistance of professional consultants. The implementation phase will then focus on setting up and developing self-sustaining initiatives and structures which will help improve real net output, competitive strength and employment in the region. The BMBF has earmarked a total of DM 500 million for InnoRegio activities in its budget.

Further information:
InnoRegio Project Office, Wallstr. 17-22, D-10179 Berlin
Tel.: +49-30-20 199-482, Fax: +49-30-20 199-470
E-mail: innoregio@innoregio.de, Internet: www.innoregio.de

between science and industry are crucial prerequisites for being able to make full use of efficient, high-quality research infrastructures and the transfer potential arising from them.

Brandenburg's universities will play a decisive role in the development of a culture of entrepreneurship. University curricula will attach ever-greater importance to teaching and fostering entrepreneurial skills. Innovative entrepreneurship is increasingly becoming a focus of attention at the *Land*'s universities – a trend which has met with a strong and positive response from students.

Innovative, technology-oriented collaborative projects between universities or non-university research centres and industrial enterprises are a decisive prerequisite for ensuring the competitive strength of Brandenburg's businesses in new and changing markets. Brandenburg has deliberately funded this type of collaborative project in the high-tech field and will continue to do so in the future so that science and research can bring the requisite infrastructure with them into these projects. This funding programme – which also constitutes the key departmental measure for implementing the *Land*'s job-creation strategy – makes a crucial contribution toward creating a favourable climate for scientific achievement and the successful transfer of technology.

The Brandenburg Patent Plan for University Facilities and Research Centres represents another important step towards better utilisation of this patent potential and, consequently, for the actual patenting and licensing of new developments.

The framework for technology funding in Brandenburg is provided primarily by the Brandenburg Technology Initiative which was launched back in 1991. Since then, it has been the source of DM 280 million in funding for some 3,150 projects. Approximately 700 of these projects were dedicated to product and process developments alone. This funding is effected using not only *Land* funds but also federal and EU funds. Besides providing funding in the form of straightforward grants, increased priority will be given in the future to funding financing instruments (loans, interest subsidies, etc.).

With an eye to supporting small and medium-sized technology-oriented enterprises in particular, Brandenburg has set up a network in which the Technologie- und Innovationsagentur Brandenburg GmbH (T.IN.A. – Brandenburg Technology and Innovation Agency) plays a pre-eminent role alongside the *Land*'s technology transfer and innovation consultancy agencies and its 21 technology parks and business incubators. Working through decentralised branch offices, T.IN.A. provides assistance with project implementation and follow-up, based on the particular company's needs.

At the same time, T.IN.A. – as well as Brandenburg's InvestitionsBank – is providing services on a paid-contract basis. T.IN.A is an independent private enterprise that has been assigned the task of fulfilling specific functions in the *Land*'s interest. As such, it is (for example) in charge of implementing the Placement of Innovation Assistants in the *Land* project which has placed approximately 500 innovation assistants in companies throughout Brandenburg to date.

The Technologiestiftung Brandenburg (Brandenburg Technology Foundation) was established in December 1998 for the purpose of increasing the flexibility of Brandenburg's response to changing challenges in the technology sector. Operating primarily along the interface between science and industry, this foundation serves as a moderator between all players in technology. One of its main tasks is to acquire private capital for the successful implementation of sophisticated technological projects.

5. Free Hanseatic City of Bremen

1. Underlying principles and priorities of research and technology policy

As part of Bremen's efforts to cope with structural change in the regional economy, its innovation policy assigns a leading role to the positive impact had by the *Land*'s science infrastructure. As a consequence, the Free Hanseatic City's science infrastructure enjoys special status in budget considerations in spite of current austerity measures.

The following were important for the development of Bremen's universities and of non-university research during the reporting period:

– On October 8, 1998, the Senate (state government) of the Free Hanseatic City of Bremen adopted a binding budget framework for science funding for the period 1998 through 2004. In return, the *Land*'s universities agreed to adhere to this framework – by raising their efficiency, reducing their expenses and increasing their revenues. In May 1999, the Senate passed the Third General Plan for Higher Education which remains within the limits of this financial framework and sets the clearly-defined objective of strengthening the natural science and engineering fields.
– The International University of Bremen (IUB, http://www.iu-bremen.de/) will make an important contribution toward this. Founded in February 1999, IUB is striking out in new directions in teaching, research and study programmes. Using liberal, character-shaping and occupation-oriented training, IUB will prepare students from throughout the world to be managers with global responsibilities and intercultural skills. Research at IUB will give priority to the natural and engineering sciences and be linked with international, multi-institutional associations and networks. Research and education will be closely geared to one another right from the start of a student's programme. Training at IUB will be application-oriented and consequently include periods of practical experience in international organisations and companies. IUB's extensive exchange activities with foreign universities and research centres – particularly in the United States – are a reflection of this new university's international profile.
– In 1998 and 1999, a total of DM 186 million in funding was made

available through Bremen's special investment programme which assigns science a pre-eminent position with a 21-per cent share of its funding. The expansion of Bremen's universities and research centres which was financed with this funding gave priority to strengthening the transfer of scientific findings to the region's industry, supporting the establishment of centres of excellence, modernising and supplementing the range of courses offered (particularly in areas of special importance for the region's economy), intensifying the international dimension and establishing the physical and organisational conditions necessary for these centres' work.

– To improve the industrial exploitation of scientific findings and step up the transfer of knowledge between science and industry, Bremen's universities have launched initiatives which have led to pilot schemes. Examples include the commercial exploitation of scientific know-how, patent initiatives, training programmes for entrepreneurs, the RITTS (Regional Innovation and Technology Transfer Strategy) follow-up project Transfer Orientation of University Institutes, the founding of the MicroFAB GmbH company for transferring university research findings in the microsystems technology field, the founding of the beos GmbH company for development work and regional co-operation between industry and science during the period in which the International Space Station is in operation, the founding of the Zentrum für Informations- und Kommunikationstechnik (IKOM – Centre for Information and Communications Technology) and the launch of the AMST initiative (Airbus Material and System Technology Centre Bremen) with its selective project-oriented interleaving of industry and research.
– Bremen's Senator of Education and Science commissioned Professor Pfähler from the University of Hamburg to draw up a report on "Education and Science as Economic Factors – The Importance of University, Educational and Scientific Institutions in Bremen for the Regional Economy". Using detailed figures, this report shows the impact the scientific infrastructure has on the economic and financial strength of the Bremen region and beyond. The analysis comes to the conclusion that direct, indirect and induced effects safeguard nearly 5,500 jobs in Bremen, another 5,000 in the surrounding *Land* of Lower Saxony and 8,100 in the rest of Germany. The report also goes into detail about the regional impact of the *Land*'s scientific institutes. This report was published in October 1999 by the publishing house Verlag Peter Land, Europäischer Verlag der Wissenschaften.

2. University research

In the Free Hanseatic City of Bremen, research in the higher education sector that receives institutional funding is conducted by the University of Bremen (http://www.uni-bremen.de/), the Hochschule für Künste (Bremen University of the Arts, http://www.hfk-bremen.de/), the Hochschule Bremen (Bremen University of Applied Sciences, http://www.hs-bremen.de/) und the Hochschule Bremerhaven (Bremerhaven University of Applied Sciences, http://www.hs-bremerhaven.de/).

Special mention is to be made of the following priority fields:

Work continues on setting up the Zentrum für Marine Umweltwissenschaften (MARUM – Centre for Marine Environmental Sciences) at the University of Bremen. MARUM is part of one of the largest internationally recognised, interdisciplinary research priority fields in Bremen's university and non-university research sector – namely, marine environmental sciences.

Expansion of an interdisciplinary R&D centre, the Zentrum für Umweltforschung und Umwelttechnologie (UFT – Centre for Environmental Research and Environmental Technology, http://www.uft.uni-bremen.de/) also continues.

The University of Bremen's Zentrum für Kognitionswissenschaften (Centre for Cognitive Sciences) and the collaborative research centre No. 517, Neuronal Fudamentals of Cognitive Performance, are working within an international context and in conjunction with the Hanse-Wissenschaftskolleg (Hanse Institute for Advanced Study) to further develop the cognitive sciences. The collaborative research centre (which is being conducted together with the University of Oldenburg) entered its second funding phase in 1998. This priority field was substantially enlarged once again with the addition of three new professorships.

The BMBF and the Free Hanseatic City of Bremen have been funding the Genetic Sensor Technology R&D alliance on a joint basis since September 1998. This alliance grew out of Bremen's entry for the BioRegio competition. Eight University of Bremen research units and the Bremer Institut für angewandte Strahltechnik GmbH (BIAS – Bremen Institute for Applied Beam Technology) are participating in the R&D alliance in the fields of (bio)computer science, biology, chemistry, microtechnology and systems development. This R&D alliance has set itself the goal of developing an integrated, fully automated genetic sensor system into a marketable product, using chip production, DANN analytics, DANN computing, microdosing, surface chemistry and systems development technologies.

In the field of materials research, an interdisciplinary research network that goes by the name MATEC (http://www.matec.uni-bremen.de/) has been established at the University of Bremen in conjunction with several non-university research centres. The focus of MATEC's work is on microstructured composite materials. This priority field is to be further supplemented by a centre of excellence in microengineering for which an application has been submitted and which the BMBF and Bremen are to fund jointly.

The precision engineering priority field was enlarged in 1999 with the completion of a new building for the Labor für Mikrozerpanung (LFM – Laboratory for Micromachining) at the University of Bremen.

The University's Technologiezentrum Informatik (TZI – Centre for Computing Technologies, http://www.tzi.uni-bremen.de/) views itself as a technology service provider for application-related problems in the region and collaborates with companies, associations and institutions. TZI's primary task is to develop and refine computing technologies and to transfer package software solutions to companies in the region. In response to the sharp increase in the amount of contract research TZI was conducting, TZI's acquisition and transfer-oriented infrastructure was expanded in 1999 at the recommendation of the TZI advisory board.

The Zentrum für Mikrosystemtechnik (MCB – Microsystems Centre Bremen, http://www.mcb.uni-bremen.de/) combines the Institut für Mikrosensoren, -aktuatoren und -systeme (Institute for Microsensors, Microactuators and Microsystems) and three other institutes with complementary specialities. As a partner to industrial manufacturers, MCB is able to develop microsystem solutions, from the initial idea all the way to small-lot production. The Micro-Fab-GmbH company was founded as a spin-off of MCB's activities in 1999.

Looking at health care research, Bremen is active in the areas of epidemiology, public health, nursing, rehabilitation, and health care system research. The most important institutes are the Bremer Institut für Präventionsforschung und Sozialmedizin (BIPS – Bremen Institute for Prevention Research and Social Medicine, http://www.bips.uni-bremen.de), the Zentrum für Rehabilitationsforschung (ZRF – Centre for Rehabilitation Research) and the Institut für angewandte Pflegeforschung (iap – Institute for Applied Nursing Research). These facilities teamed up with three other university research centres to form the University of Bremen's Forschungszentrum Public Health (Public Health Research Centre) in late 1998.

The Zentrum für Sozialpolitik (ZeS – Centre for Social Policy Research, http://www.zes.uni-bremen.de/) at the University of Bremen is also active in the field of health care research. The Centre's activities include analysing the health care reporting system on the basis of data provided by statutory health insurance companies. Issues of old-age provisions and long-term care insurance constitute other focal areas of the Centre's research and political advisory activities. In this field, the Centre for Social Policy Research is the leader in comparative international analyses of social security systems and in examining the evolution of social policy in Germany, including in the 'working world and social security' field.

The University of Bremen has four DFG-funded collaborative research centres (or SFB, their German acronym):

- SFB No. 186, Status Passages and Risks in Life Course, (since 1988)
- SFB No. 261, The South Atlantic in the Late Quaternary, (since 1989)
- SFB No. 372, Spray Compacting, (since 1994)
- SFB No. 517, Neuronal Fundamentals of Cognitive Performance, (together with the University of Oldenburg since 1996).

Bremen also has two DFG-funded postgraduate research groups and one DFG-funded research unit.

The Universities of Applied Sciences' practical orientation is being tapped to put the resources they offer for the development and application of new technologies to productive use for the region. Examples of this include the Bremerhaven University of Applied Sciences' Technologietransferzentrum (TTZ Bremerhaven – Bremerhaven Technology Transfer Centre, http://www.ttz-bremerhaven.de/) and the Institut für Aerospace-Technologie (AIT – Institute for Aerospace Technology) at the Bremen University of Applied Sciences.

In 1998, the University of Bremen's expenditure of external funding remained stable at the high level of 26 per cent of total spending.

3. Non-university research

Non-university research in Bremen is closely linked with the higher education sector. This is manifested by co-operation agreements with the University of Bremen and, in individual cases, with the *Land*'s Fachhochschulen (universities of applied sciences). As a result of joint appointment procedures, senior scientists at non-university research institutes are also professors at Bremen's universities.

Facilities that receive joint research funding from the Federal Government and *Länder* governments under Article 91b of the Basic Law (Germany's constitution) are:

- The Alfred Wegener Institute Foundation for Polar and Marine Research (AWI, http://www.awi-bremerhaven.de/), a member of the Hermann Helmholtz Association of National Research Centres. The Biologische Anstalt Helgoland (Biological Institute of Helgoland) has been part of the AWI since 1 January 1998. This addition substantially increased AWI's biological marine research activities. Over the course of 1998, AWI recast its scientific profile by reorganising its work into four specialised fields: climate systems, Pelagic ecosystems, Benthic ecosystems and geosystems;
- The Max-Planck-Institut für marine Mikrobiologie (MPI – Max Planck Institute for Marine Microbiology, http://www.mpi-bremen.de/);
- The Fraunhofer-Institut für Fertigungstechnik und angewandte Materialforschung (IFAM – Fraunhofer Institute for Production Technology and Applied Materials Research, http://www.ifam.fhg.de/);
- The Deutsches Schifffahrtsmuseum Bremerhaven (German Maritime Museum in Bremerhaven, a Blue List research museum).

One of the objectives pursued by the Zentrum für Medizinische Visualisierungs- und Diagnosesysteme (MeVis GmbH – Centre for Medical Diagnostic Systems and Visualisation, http://www.mevis.de) at the University of Bremen is to develop products to support clinical diagnostic activities. This centre was successful in recruiting a pilot project on mammography-based screening. The company MeVis Technology GmbH – a MeVis spin-off – markets software products and supplies MeVis with ideas for new products.

The ECO-Zentrum (ECO Centre) – a research and demonstration centre for environmentally-sound production processes – was set up at the Institut für Werkstofftechnik (IWT – Institute for Material Science, http://imperator.cip-iw1.uni-bremen.de/) to develop production processes, systems and machines for the environmentally-sound production of engineering components. It has firmly established itself. The initiator of the ECO Centre was awarded the Leibniz Prize for his work in 1999.

The laser demonstration centre at the Bremer Institut für angewandte Strahlenforschung (BIAS – Bremen Institute for Applied Beam Technology, http://www.bias.uni-bremen.de/) provides consultancy services to industrial partners in Germany and throughout Europe for the processing of laser applications. The centre was expanded by the addition of a metrological unit. A new laser-assisted microtechnology department is currently being set up.

The Bremer Institut für Betriebstechnik und angewandte Arbeitswissenschaften (BIBA – Bremen Institute for Industrial Technology and Applied Work Science, http://www.biba.uni-bremen.de/) has restructured its organisation into four divisions which work together with companies in the Bremen market to translate technologically sophisticated ideas into viable solutions. One of BIBA's priorities is the establishment of a centre of excellence for innovative and sustainable product and production process development.

The Fraunhofer-Institut für Fertigungstechnik und angewandte Materialforschung (IFAM – Fraunhofer Institute Applied Materials Research, http://www.ifam.fhg.de/) moved into its new building on the university campus in 1999 and is extensively involved in material science priority fields. A second phase of construction is in the planning.

The University of Bremen's Forschungsstelle Osteuropa (Research Centre for East European Studies, http://www.forschungsstelle.uni-bremen.de/) is devoted to the study of contemporary cultural and social developments in eastern Europe. The Science Council completed its evaluation of the Research Centre with positive results in 1998 and recommended that the *Länder* continue providing joint funding for it. This institute has a unique collection of written documents on alternative cultures and autonomy movements in Central and Eastern Europe. The exhibition to be shown in Berlin in the autumn of 2000 pays tribute to the special contribution that dissident and opposition movements have made to post-war European culture. The Research Centre was awarded Danzig's Erich Brost Prize in 1999 for its special efforts to bring about reconciliation between Poles and Germans in the cultural, economic, educational and political spheres.

Established together with Lower Saxony, the Stiftung Hanse-Wissenschaftskolleg (HWK – Hanse Institute for Advanced Study, http://www.h-w-k.de) moved into its new offices in Delmenhorst in 1998. Its work focuses on marine sciences, neuroscience, cognitive science and social sciences which it conducts in close co-operation primarily with the University of Bremen and the University of Oldenburg. During the period covered by this report, 51 fellows conducted research at the Institute. To date, it has organised 28 international scientific congresses.

4. The promotion and transfer of technology

The reorganisation of Bremen's economic development promotion system included a restructuring of the purview of technology funding in 1998. As of 1 January 1999, the management of nearly all innovation-related funding programmes was bundled together in the Bremer Innovations-Agentur GmbH (BIA – Bremen Innovation Agency, http://www.bia-bremen.de/start/programme/bia/home.html). BIA was also placed in charge of managing Bremen's *Land*-owned technology parks. This has markedly increased the efficiency and transparency of funding activities. The primary beneficiaries of these improvements are companies which profit from shorter processing times and the now more clear-cut organisation of Bremen's institutional landscape.

Bremen's innovation programme is also being continued, taking into account the *Land*'s reorganised innovation funding system. Particular attention has been given to the following recommendations. These recommendations were developed by the RITTS project which was conducted with international participation:

- To improve communication and collaboration between industry and science;
- To improve the infrastructures for the University of Bremen's technology park;
- To improve the conditions which Bremen's universities of applied sciences have for working on collaborative projects with industry;
- To encourage start-ups coming from the higher education sector in particular, improve young companies' access to venture capital and streamline processes where legally possible.

Some of these suggestions have already been put into action as new programme elements (fellowship model and the Initialfonds [Initial Fund]). Others have been dealt with in greater detail in exploratory projects which were evaluated by external experts. The experience gained through this has been integrated into the BIA's working methods.

Already launched as a pilot project, the Fellowship Model for Preparing Start-Ups by University Graduates encompasses the components Ensuring a Livelihood for One Year and Opportunities for Using University Resources plus technical guidance and company-specific training measures. The project was launched with 14 participants and led to the founding of six new companies by the end of its first year in 1998/1999. For its second year, it will have 13 fellows participating with ten business concepts.

The Initialfonds (Initial Fund) – which has DM 2 million a year at its disposal – assists innovation-oriented start-ups by providing loans with a minimum of red tape. Since its establishment in 1998, this fund has provided funding for eight start-ups.

The following additional measures are currently being implemented:

- Measures to foster greater transfer-orientedness at Bremen's universities of applied sciences;
- The Bremen Special Investment Programme to Intensify Technology Transfer which is being conducted in selected fields of technology for the purpose of strengthening scientific institutions;
- A training programme for students and university graduates on starting up a business;
- Pilot projects to provide inventor consultancy services and to exploit patents, with Bremen providing part of the funding for the acquisition of industrial property rights and/or their exploitation;
- Organisational planning for the commercial exploitation of scientific know-how from the science sector, including funding for individual exploitation measures.

5. International activities

At DM 23 million, the amount of project funding which Bremen's universities and non-university research centres were able to recruit from the European Union's research and mobility programmes remained stable at a high level in 1998.

The cross-border co-operation being pursued by the Netherlands Institute for Sea Research (NIOZ) and Bremen's marine research centres in the joint NEtherlands BRemen OCeanography (NEBROC) project has developed positively. Medium-term plans foresee the establishment of a centre of excellence in the marine sciences field as a hub within a European network.

The bilateral co-operation between the Netherlands' Ministry of Economics and Bremen's Senator of Education and Science is part of Bremen's cross-border co-operation which also includes the neighbours Flanders, Lower Saxony and North Rhine-Westphalia. This co-operation sets clear priorities in research and instruction, fosters mobility among students and university lecturers, and supports the effective, cross-border use of resources. Its objective is to create a joint science area.

One of Bremen's first priorities in regard to this co-operation was to establish the Hanse Law School together with the University of Groningen. For the first time ever, professors from Bremen, Oldenburg and Groningen will hold a joint seminar course on comparative administrative procedural law beginning with the 1999 summer semester.

The interregional R&D co-operation which Bremen pursues with the Netherlands' northern provinces and Lower Saxony within the New Hanse InterRegio is being pushed ahead primarily with an eye to further strengthening the science network that has been put together in recent years.

The Free Hanseatic City of Bremen has a long tradition of giving priority to co-operation within international networks. Bremen has taken its very successful involvement in the European and Global Bangemann Challenges – which revolved around the benefits that information and communications technologies offer mankind, society, the economy and the environment – and incorporated it into a network of cities. This Global Cities Dialogue will actively guide and accompany Bremen along its way to becoming a member of the information society in coming years. Other networks such as the Maritime Cities Network address specific issues facing cities – and seaports in particular – that are in the midst of structural change. In the area of cutting-edge research, the newly founded International University of Bremen will, in conjunction with the city-state's public higher education institutions and research centres, strengthen Bremen's international ties through its outstanding partnerships.

Literature See references in the text.

6. Free and Hanseatic City of Hamburg

1. Underlying principles and priorities of research and technology policy

The Free and Hanseatic City of Hamburg's research and technology policy is guided by the fundamental insight that science, research and the development of technology play a key role in shaping living conditions in modern society.

Accordingly, the object of this policy is to ensure that the *Land*'s scientific institutes are manned by highly qualified personnel and to establish conditions which will allow innovative research capability to develop. This particularly includes interlinking basic research with applied and technology-oriented R&D to an ever greater degree in order to put attractive capabilities and resources at the region's disposal for its sustained economic, ecological, social and cultural development. The technical breadth and diversity of the research spectrum to be found at Hamburg's universities and non-university research centres have been and continue to be the basis for establishing and expanding priority research fields with international attraction and spillover.

In tandem with this, Hamburg's research and technology policy focuses on developing and honing structures and instruments which optimise research findings and technological developments, particularly with regard to their translation into marketable products.

Target and performance agreements between Hamburg's universities and the authorities responsible for science and research have developed into an instrument for realising the above-mentioned research and technology policy objectives. These agreements – which are to be updated on a yearly basis –also lay down, in a spirit of reciprocal obligation, what each side is to do in terms of performance and financing. Of special importance in this connection is the fact that the Senate (state government) and Parliament of the Free and Hanseatic City of Hamburg have established financial planning security for the next several years for Hamburg's institutions of higher education. In return, Hamburg's universities are required to develop within this financial framework instruments and procedures for funding priority research fields on a performance basis and, in the process, to specifically foster young scientists.

Outstanding research expertise in the fields of
- Materials sciences
- Climate, marine and environmental research
- Molecular biology and medical biotechnology
- Information and communications technologies (multimedia) and
- Socio-cultural and humanities research

has defined the greater Hamburg metropolitan area's characteristic research and development profile. At present, particular effort is going into intensifying media research and inter-university research involving the ecology and sustainable development fields.

Germany's northern *Länder* are working on a joint presentation of these fields of research. A CD-ROM on northern Germany's science profile is currently being put together.

2. University research and non-university research

Since the 1996 Report of the Federal Government on Research and the 1998 Facts and Figures report have already outlined Hamburg's priorities in the above-mentioned research fields, this section will limit itself to new developments.

The establishment of collaborative research centres (or SFB, the German acronym) is an important structural factor for the higher education sector and for the building of long-term priority research fields. There are currently ten collaborative research centres operating at the University of Hamburg and the Hamburg-Harburg University of Applied Sciences; two of them at the University of Hamburg are new:
- SFB No. 520, Dealing with Social Transformation in African Societies,
- SFB No. 538, Multilingualism.

High priority continues to be assigned to bringing together at one location the institutes belonging to the University of Hamburg's Zentrum für Meeres- und Klimaforschung (Centre for Marine and Climate Research) with the Max-Planck-Institut für Meteorologie (Max Planck Institute for Meteorology) and the Deutsches Klimarechenzentrum (DKRZ – German Climate Computer Centre) and developing them into a Zentrum für Marine und Atmosphärische Wissenschaften (Centre for Marine and Atmospheric Sciences). This undertaking is aimed at expanding marine and climate research activities into integrated global change research. This approach is being taken in response to the realisation that studies must take into account not only the climate system's physical, biological and chemical components (which have been researched on a priority basis to date) but also the socio-economic components, if science is to come to an integrated understanding of changes in the global system.

The Michael-Otto-Stiftung (Michael Otto Foundation) made a vital contribution to intensifying the research on socio-economic global change being conducted at the University of Hamburg by establishing a chair for *global change and sustainability*. This chair will also be a catalyst for the *Hamburg Science Agenda* in which inter-university research alliances will be set up to study issues involving the environmentally sound, socially just and economically viable development of metropolitan areas. The Senate and Parliament of the Free and Hanseatic City of Hamburg have set up a fund to facilitate and assist these Agenda 21 research activities.

In the materials research field, the Zentrum für Mikrostrukturforschung (Centre for Microstructure Research) at the University of Hamburg has developed into a priority research institute of national standing. As part of the BMBF competition for establishing centres of excellence in the nanotechnology field, the University of Hamburg, in conjunction with the University of Münster and the University of Munich, is co-ordinating the work of the Kompetenzzentrum für Nanoanalytik (Centre of Excellence in Nanoanalysis) where 40 project partners from universities, research centres, SMEs and groups of affiliated companies collaborate. The founding of this centre of excellence promises the establishment of a structure for the sustained transfer of knowledge and technology that will bring together training, basic research and the development, production, marketing and end use of innovative nanoanalytical techniques at both regional and national level. In addition, a Norddeutsches Service- und Ausbildungszentrum für Nanoanalytik (North German Service and Training Centre for Nanoanalytics) is to be established to strengthen the regional elements.

Non-university research centres make a vital contribution to the high scientific standards maintained by Hamburg's research system. This has been again confirmed in an evaluation of the *Hans-Bredow-Institut für Medienforschung an der Universität Hamburg (HBI – Hans Bredow Institute for Media Research at the University of Hamburg)*, which the Science Council conducted as a pilot project at the request of the Free and Hanseatic City of Hamburg. The HBI does not belong to that group of institutes which is jointly financed by Germany's Federal and *Länder* governments. It is supported by the media industry and the Free and Hanseatic City of Hamburg which provided DM 1.1 million in funding in 1999. The Science Council observed in its evaluation that the HBI is one of Germany's oldest and most renowned specialised institutes. Its work revolves around the analysis, interpretation and evaluation of media developments and is highly regarded both at home and abroad.

Hamburg will make use of the opportunity offered by the Science Council's recommendations to give the Institute's work a broader foundation and to intensify its links with other institutes, first and foremost with the University of Hamburg.

In response to the Science Council's evaluation, the *Hamburgische Welt-Wirtschafts-Archiv (HWWA – Hamburg Institute of International Economics)* was given a new research profile and reorganised into a service facility for the research community. Hamburg has also set up a three-year visiting researcher programme with a total of DM 3 million in special funding which will be used as knock-on financing. Work on modernising the IT systems in the library and documentation area is almost completed. As a result, the library catalogue for the years 1945 through 1987 – 700,000 documents – is now available on the Internet, making it possible to access and search the catalogue and order documents on-line. Co-operation with the press archive of the Institute of International Economics was institutionalised as of January 1, 1999. This necessitated a restructuring of the source programme in the press documentation area and the development of a uniform classification system. The Institute of International Economics assumed the overall responsibility for press documentation at that time as well.

The *Heinrich-Pette-Institut für Experimentelle Virologie und Immunologie an der Universität Hamburg (HPI – Heinrich Pette Institute for Experimental Virology and Immunology at the University of Hamburg)* has also undergone extensive structural change. As a result, it can now set up research units comprised of young scientists on a temporary basis. The Institute is currently organising its second such research unit.

The *Deutsches Elektronen-Synchrotron (DESY – German Electron Synchrotron)*, a national research centre for particle physics and synchrotron radiation research, will present the development of the world's first 300 metre-long free electron laser to the public at its exhibition "Light of the Future" at EXPO 2000. This project is the pilot facility for the 33 kilometre-long TESLA Linear Collider which is in the planning.

3. The promotion and transfer of technology

In the years since the issue of the last Report of the Federal Government on Research in 1996 and the update provided by the Facts and Figures report in1998, the following priorities have been established in Hamburg's innovation and knowledge transfer field:

- The reorganisation of the University of Hamburg's entire transfer structure was initiated in 1998 with the establishment of the Research-Based Transfer of Innovation and Technology (FIT) system. This reorganisation was stepped up by the creation of FIT centres of excellence. The *Kooperationsstelle DGB/Hochschulen Hamburg (DGB/Hamburg Universities Co-operation Agency)* is also to be included in this reorganisation with the objective of creating a joint institution that will make participating scientists' research findings available for exploitation as marketable products in ways that are geared to employee interests and to demand from trade and industry;
- An initiative on the part of Hamburg's institutions of higher education and their partners in the research, industrial and political spheres, the *Hamburg Start-Up Programme (hep)* has the job of stimulating and actively supporting start-up activities originating in universities and research centres. The focus here is on start-ups in the service and product fields. With its *Start-up Jobs and*

BusinessPlanCompetition elements, the Hamburg Start-Up Programme endeavours to directly acquaint people with ideas with the actual founding of a new company and accompany them on the path to entrepreneurship. The programme will also improve conditions for ensuring the physical proximity of these young firms to their respective university or research institute;
- The TU Technologie GmbH company has set up a *StarterZentrum (Start-Up Centre)* to help new start-ups and spin-offs from the Hamburg-Harburg University of Applied Sciences;
- The *Centrum für Innovative Medizin (CIM – Centre for Innovative Medicine)* is being established on a private basis with the help of Hamburg government agencies. The centre will likewise provide office and laboratory space on favourable terms to new start-ups in the medical field;
- Together with banks and the medical technology industry, the Free and Hanseatic City of Hamburg founded the *Medizintechnisches Anwendungszentrum Hamburg GmbH (MTZ GmbH – Medical Technology Application Centre of Hamburg)* to promote the exploitation of projects and inventions in the medical technology field. The establishment of MTZ GmbH was Hamburg's submission for the BMBF competition Centres of Excellence in Medical Technology;
- Hamburg's institutions of higher education will be teaming up to form an alliance for the exploitation of research findings produced by the higher education sector and research institutes (R&D Exploitation Alliance). Plans foresee the establishment of a joint office and an exploitation fund on the basis of an agreement with various partners.

4. International co-operation

Today, the participation of higher education institutions in collaborative cross-border research ventures conducted within the framework of European Union funding programmes has developed into an integral part of Hamburg's research landscape and research funding system.

The percentage share that EU funds represent out of total external revenue varies from university to university. All in all however, there has been an increase in recent years with the result that the EU ranks third following the Deutsche Forschungsgesellschaft and the Federal Government as the most important source of external funding at all of Hamburg's universities.

Measured by the number of projects being conducted by the various institutes, EU research funding covers a broad spectrum of focal areas.

The already good co-operation between Hamburg's universities and Scandinavia was put on a sound foundation as a result of the joint EU funding which became possible following Sweden and Finland's accession to the European Union. The opening of the Fifth Framework Programme to candidates for EU accession will also facilitate co-operation with the countries of Central and Eastern Europe.

The INTERREG II C Community initiative of the European Regional Fund (EFRE) also constitutes an important instrument for expanding supraregional and cross-border contacts between institutions of higher education.

In addition to a number of collaborative ventures which because of their focus (the environment, sea transport chains, regional air traffic) involve the Baltic Sea region as a whole, another focal area for co-operation – the *Öresund Technology Region* which includes the city of Hamburg – is also emerging.

7. Hesse

1. Underlying principles and priorities of research and technology policy

The government of Hesse views the promotion of science, research and education as one of its primary responsibilities. It also holds that the government sector has to establish the conditions necessary to empower institutions in the science and education sectors to fulfil their duties. All expenditure made in this area constitutes an investment in the future, an investment which safeguards not only the individual's prospects for development but also the innovative abilities of society as a whole.

Hesse's research and technology policy aims to establish within society a new awareness of Hesse as a location for research, an awareness which examines not only the risks that new projects entail but which also sees the opportunities that promising developments have to offer. Basic research and applied research are to be similarly safeguarded. A concerted effort on the part of lawmakers, industry and science is necessary for translating research findings into technology and consequently into fast-growing fields that generate new jobs – and to accomplish all of this more quickly and more efficiently than in the past.

The government of Hesse sees areas that have the potential for rapid growth in the information industry, among telecommunications firms, in biotechnology and genetic engineering, materials science and telematics – in other words, not only in industry but also and most importantly among know-how-intensive service enterprises. To reach these goals, publicly funded research spending is to be secured, and increased if possible. Targeted, flanking measures are being taken to encourage and support young scientists, improve and intensify the transfer of knowledge and technology, and finance spin-offs from universities and research institutes.

The relationship between the government and higher education sectors in Hesse will have to be redefined in conjunction with plans for the extensive overhaul of the *Land*'s entire public administration. The government will withdraw from micromanaging public finance and instead be allocating university funding in the form of general budgets in the future. These budgets will be calculated on the basis of performance-linked indicators. Hesse's universities will be free to operate and make their own decisions within the framework of their respective budget. At the same time, the precepts underpinning Hesse's science policy will provide a framework which is to be implemented via agreements on targets that the government concludes with the *Land*'s universities. The budget will reward a university's success in the research field or in training young scientists, as measured in terms of operationalised performance parameters such as external funding volumes, the number of collaborative research centres and postgraduate research groups, and the number of doctorates granted. As a consequence, Hesse's universities will be able to draw a direct connection in the future between their performance and the size of their respective budget. This will provide the *Land*'s universities another strong incentive for developing a distinctive profile of their own in their education and research activities, most importantly by establishing priority fields and selectively strengthening productive teaching and research units. The same precepts and objectives will apply to publicly financed non-university research centres as well.

2. University research

Now as before, the filling of professorships – in conjunction with structural measures which improve general conditions – represents a particularly effective means of stimulating innovation in the research field. New appointments resulting from the "changing of the generational guard" among professors have given rise to new approaches in many disciplines and have led to a substantially greater need for reinvestment funds. Hesse increased its allocation for research funding – which is also used to supplement the universities' own funds for covering the reinvestment requirements arising from the appointment of new professors – to a total of DM 10 million for the 2000 fiscal year.

However, well-equipped premises are also a fundamental prerequisite for productive research. Since the financial base for the building and extension of institutions of higher education, according to the constitution a joint responsibility of the Federal and *Länder* governments, was inadequate, the government of Hesse provided advance financing for a number of important construction projects of relevance to research, projects worth a total of DM 350 million. The last of these projects – the Interdisziplinäres Forschungszentrum für Umweltwissenschaften (Interdisciplinary Research Centre for Environmental Sciences) at the University of Gießen – will go into full operation in the year 2000 (DM 120 million, start of construction: 1997).

The government of Hesse is making enormous efforts to create, on a priority basis, a sufficient amount of separate area for medical research during the reorganisation of the University of Frankfurt's Medical Centre (DM 430 million in total cost) and the expansion of the University of Marburg's Medical Centre (DM 240 million). The winners of the planning competitions being held for the envisaged research buildings for both projects will be decided in early 2000.

The University of Frankfurt's entire physics department is to be moved to the Niederurseler Hang campus addition. The first phase of construction which revolves primarily around the nuclear physics facilities is to be completed by the end of 2004. Plans also foresee enlarging the area reserved for developing a university centre for structural biology and bioinformatics by the end of 2001. The Max Planck Society will also be constructing a new building on the Niederurseler Hang addition for its Institute for Biophysics which is currently located in another part of Frankfurt.

A *Land*'s collaborative research centres provide a yardstick for measuring the special productivity of the research being conducted at its universities. As of 1999, Hesse's universities are in charge of 21 DFG-funded collaborative research centres. The humanities account for four of them, biology/medicine for 11, the natural sciences for three and the engineering sciences for three. Scientists from Hesse are involved in other collaborative research centres as well.

Well-targeted measures to foster young scientists continue to be a provision for the future of research. The government of Hesse has set up 50 additional postgraduate fellowships using funds from the Third Special Funding Programme for Higher Education and Research (or HSP III, the German acronym). The individual university decides on the awarding of these fellowships which benefit all disciplines. HSP III funds are also used to finance the establishment of postgraduate research groups, following application to the Deutsche Forschungsgesellschaft. Today (1999), Hesse's universities host 34 such groups.

3. Non-university research

Looking at the promotion of non-university research centres, special note is to be made of the following developments:

The scope for experimental work at the Fraunhofer Institut für Betriebsfestigkeit (Institute for Structural Durability) in Darmstadt is to be substantially enlarged during its reorganisation. Hesse will bear half the cost of the DM 31.8 million investment that this will require. At the same time, a corresponding priority field is to be developed at the Department of Mechanical Engineering at the Technical University of Darmstadt. The head of the new institute will be jointly appointed.

The Federal Government and the government of Hesse are increasing their funding for the Stiftung Chemotherapeutisches Forschungsinstitut Georg-Speyer-Haus (Chemotherapy Research Institute Georg Speyer House) which focuses on tumour research and infection biology. Following an extensive renovation of the building in which the institute is housed, allocations for operating costs and investments will be raised by more than 50 per cent. The Science Council is to be asked in 2002 for an official opinion on whether the institute meets the criteria for receiving funding as a Blue List research institution.

With the same goal in mind, allocations for the Hessische Stiftung für Friedens- und Konfliktforschung (Peace Research Institute Frankfurt) are also being increased by approximately 50 per cent. Based on current plans, the Science Council will be requested in 2003 for an assessment.

4. The promotion and transfer of technology

Hesse's *technology promotion activities* are aimed at mastering structural change in the region's economy through modernisation. Key tasks in this connection are putting innovation to use to ensure competitive strength, creating and safeguarding jobs that are able to survive the changes of the future, and protecting natural resources. Hesse wants to strengthen its standing as a location for technology. To achieve this, it will be necessary to step up the pace of innovation. For this reason, innovative ideas must be translated quickly into marketable products and brought together with investment-seeking capital.

With this in mind, Hesse is creating a new innovation architecture on the basis of the following pillars which contain individual components of their own:
– The establishment of innovation-friendly conditions;
– The promotion of the transfer of technology and the provision of innovation guidance while developing an industry-related technology infrastructure;
– The promotion of advanced technologies via lines of action and model projects;
– The establishment of a system for financing innovation.

Further, the length of necessary approval processes could be shortened considerably without sacrificing quality. Compared to other *Länder*, Hesse has the shortest processing periods for approvals pursuant to the Federal Immission (Environmental Quality) Control Act and the Genetic Engineering Act.

The provision of funding for technology parks, business incubators and innovation centres is still a rather new area of activity for Hesse's Ministry of Economics. Such facilities have been launched in the meantime in Kassel, Marburg, Hanau, Bad Hersfeld and Gießen with the help of the *Land* government. The technology parks and business incubators have the primary task of improving the starting conditions for entrepreneurs and new innovative firms by providing affordable premises, extensive guidance and an infrastructure for joint use. In the process, these centres draw upon regional resources.

The government of Hesse started the Hessen-media initiative to foster information and communications (I&C) technologies. In addition to promoting pilot projects for SMEs with a view to pushing forward the use of modern I&C technologies, the Hessen-media initiative also focuses on establishing and expanding centres of excellence and technology service centres whose work revolves around technology transfer, training, consultancy services and support for co-operations. At the same time, efforts are being made to strengthen existing institutions with the objective of building competence networks. Hessen-media provides funding for, among other things, pilot applications in the following fields: education and research, telemedicine, telematics in environmental protection, telematics in transport, telematics services for SMEs (introducing small and medium-sized enterprises to electronic services), teleworking, multimedia, and new technologies in public administration.

The government of Hesse continues to pursue the goal of developing the *Land* as a centre for biotechnology. All industry-related measures for promoting Hesse as a location for biotechnology will be pooled for the first time in the economics ministry's Hessen-biotech line of action. Launched by the government of Hesse and Hoechst AG in collaboration with the German chemical industry association VCI and the non-profit scientific and technical association DECHEMA, Science4Life was the first nationally publicised start-up competition for the life sciences and chemistry fields. Science4Life is intended to generate a surge of start-ups. The first round elicited such a strong response – 250 participants submitted 80 plans for start-ups – that the sponsors have decided to continue the competition.

The government of Hesse supports a variety of innovation financing options for start-ups and for the development and market launch of new products. These include the DM 80-million Hesse Innovation Fund under the lead management of the Landesbank Hessen-Thüringen (*Land* bank of Hesse and Thuringia), the innovation investment programmes of the Mittelständische Beteiligungsgesellschaft, an SME equity investment company, the offerings of the TFH-Technologiefinanzierungsgesellschaft Hessen mbH, a technology financing company, the venture capital funds offered by the Kassel Sparkasse savings bank and, most importantly, Future Capital AG – Hessen Life-Sciences Chemie. The latter is a joint venture between the government of Hesse and the Hoechst AG company. With DM 125 million, it is the largest German venture capital fund in the life sciences and chemistry field today.

All of Hesse's institutions of higher education have had know-how and *technology transfer* agencies for some time now. A joint information system provides information on the transfer offerings available at all the *Land*'s universities and Fachhochschulen (universities of applied sciences). Chambers of industry and commerce, chambers of handicrafts, unions, federations and other institutions have also set up transfer agencies or offer innovation consultancy services. The government of Hesse supports many of these agencies. The same applies to the patent information offices in Kassel, Gießen and Darmstadt.

Hesse's newly elected government aims to re-organise the transfer of knowledge and technology. The *Land*'s existing technology transfer agencies are to strengthen the transfer of technology via more effective co-ordination and clearly defined tasks. A network of transfer agencies will be set up for this purpose. Its central point of contact at the Hessische Technologiestiftung GmbH (Hessian Technology Foundation) will serve as a gatekeeper and guide. Funding for entry-level consultancy services is to be improved in order to promote the initiation and development of co-operation between businesses and universities.

The new Fraunhofer-Anwenderzentrum für Graphische Datenverarbeitung in der Chemischen und Pharmzeutischen Industrie (Fraunhofer Application Centre for Graphic Data Processing in the Chemical and Pharmaceutical Industry) which is being established in co-operation with the University of Frankfurt as a "branch" of the Darmstadt-based Fraunhofer Institut für Graphische Datenverarbeitung (Institute for Computer Graphics Research) is unmistakably geared to industries that are strong in the Rhine-Main area.

5. International activities

Hesse's higher education institutions cultivate a large number of international partnerships which include both research co-operation and research scholar and student exchanges with nearly all parts of the world. In past years, separate funding was allocated to support this co-operation. It was used to foster the following activities in particular:
– Co-operation was intensified within the framework of European partnerships, particularly as part of interregional activities with EU regions (Emilia Romagna, Aquitaine);

- Hesse's universities have been directly and intensively involved in the funding programmes offered by the European Social Fund. The activities that were launched during the current funding period which runs through 1999 – activities such as the ADAPT Community initiative and the concomitant establishment of transnational partnerships – will be continued in the Structural Fund's new programme period as well, as a focal area within its structural policy measures. By directly transferring the findings they obtain through their research and teaching activities and incorporating experience from the European area, universities have the opportunity to help solve the social problems that structural change brings;
- As in years past, east-west relations were once again a priority field in Hesse's higher education sector. Special mention is to be made of the activities that were undertaken to foster young scientists in eastern Europe and to develop an existing east-west database so that it can be used on an interactive basis by persons seeking sources of financial assistance for their studies or research work or in connection with the non-university area, such as for collaborative ventures with business;
- Assistance was also provided to promote university co-operation with the USA. This assistance involved not only the exchange programmes offered by the respective university but also the individual university's inclusion in *Länder*-level activities or participation in national conferences. With a view to increasing the number of student exchanges, funding was also provided for developing English-language mini-courses and, particularly, a joint summer school that is organised by Hesse's universities;
- The universities' north-south activities were stepped up. University co-operations were initiated and developed as part of the development policy priorities being pursued by the government of Hesse. Information about the activities being conducted by Hesse's universities in the development aid field has been made available to a broad public through the Internet page "Hessian Universities in a North-South Context".

Info-Box

Promoting doctoral candidates in postgraduate research groups

– The Deutsche Forschungsgesellschaft's Federal/Länder programme –

Graduiertenkollegs – known in English as postgraduate research groups – are university programmes that have been set up on a longer-term (but not permanent) basis to foster young postgraduate scientists. These topic-based programmes offer doctoral candidates the opportunity to develop and write their dissertation in a comprehensive research framework. This makes postgraduate research groups an important new structural tool for fostering young scientists and, at the same time, strengthening university research. The primary objective is to go beyond providing individual guidance and include doctoral candidates in the collaborative research work being done by the scientific institutes involved in the particular postgraduate research group. Another objective followed by postgraduate research groups is to counter the tendency of doctoral candidates to specialise in the subject of their dissertation. This is done by offering research-oriented programmes of study that are as interdisciplinary as possible.

The Federal/Länder programme has already reached its goal of setting up 300 postgraduate research groups with approximately ten per cent of all doctoral candidates in Germany. Launched as a prototype for structured, interdisciplinary, three-year doctoral programmes that offer intensive guidance, it has now reached a size that allows it to serve as a model and provide exemplary impetus for modern doctoral training.

At the same time, postgraduate research groups are also to increase mobility among young scientists by offering the most suitable training options available for doctoral projects involving specific topics (through calls for applications).

A further step towards greater mobility and international research co-operation has been taken more recently with European postgraduate research groups. This type of postgraduate research group involves research scholars from two or more universities who work on a cross-border basis within a system of integrated doctoral training and funding. Funding is already being provided for nine European groups and one transatlantic group, the latter in philosophy at two German and two American universities.

These activities are financed through a joint Federal/Länder funding programme which largely follows the recommendations made by the Science Council and draws upon previous experience gathered during a pilot phase. The Deutsche Forschungsgesellschaft has been charged with implementing this programme.

At present, there are approximately 330 postgraduate research groups with a total of some 8,000 postgraduate researchers. About 4,000 of these researchers receive a fellowship through the corresponding DFG funding programme. These fellowships presently amount to DM 1,600 or DM 1,550 a month (to be increased to DM 1,800 and DM 1,750 beginning April 2000) plus a DM 200 research allowance and possible family and child care allowances.

Part IV

8. Mecklenburg-Western Pomerania

1. Underlying principles and priorities of research and technology policy

Research and technology policy is a priority focus in the work of the government of Mecklenburg-Western Pomerania. Its objective is to structure the existing research system efficiently and to set the kind of priorities which will enable Mecklenburg-Western Pomerania – a *Land* that has been structurally weak for centuries – to compete successfully at national and international level in science and research. In addition to continuing its systematic expansion of the *Land*'s research structure, Mecklenburg-Western Pomerania also selectively promotes special priority research fields such as plasma physics, biotechnology, information and communications technology, environmental research, sensor engineering, medical research, maritime technology and materials research. Mecklenburg-Western Pomerania is using these special priority research fields – which go beyond its "traditional" profile – to open up new technological and economic options. This also includes strengthening application-related research on a targeted basis. Competitive research institutions and technology-transfer centres have been established in Mecklenburg-Western Pomerania in the comparatively short time since German unification. The *Land* is home to two universities, three Fachhochschulen (universities of applied sciences), one academy of music and theatre, four Blue List institutes, two Max Planck Institutes, two work units of the Fraunhofer Society, one branch office of the Hermann von Helmholtz Association of National Research Centres, four *Land* institutes and two projects under the Academy of Sciences and the Humanities.

Land-level research policy activities revolve primarily around university research and research conducted at non-university institutes. In the years since 1992, it has been possible to increase the basic funding which Mecklenburg-Western Pomerania has spent on science and research. As a result, basic funding expenditure for science and research represented approximately 1.6 per cent of GDP in 1998.

Mecklenburg-Western Pomerania additionally provides funding instruments for science and research policy that are specific to the *Land*. One such instrument is the currently DM 8.8-million funding programme which was set up specifically for *Land*-level research activities.

Ongoing attention must be given to the *Land*'s priority research fields and to expanding its research system. During the development of Mecklenburg-Western Pomerania's first general plan for higher education, the following development objectives were laid down following consultations with experts:

- To use the resources available at the *Land*'s universities to foster particularly promising, high-quality research;
- To refine and, in some cases, top up Mecklenburg-Western Pomerania's research funding instruments;
- To increase basic research fundingfor institutions;
- To establish incentives for recruiting external funding, including EU funding.

Initiatives to develop the fields of *plasma physics* and *biotechnology* are to be introduced as special priorities. Research into plasma physics being done in Greifswald will constitute a special priority field in the future. Work on setting up the Wendelstein 7-X nuclear fusion experiment that is based on the stellator principle will be completed by the end of 2006. The construction of a new generation of optimised stellators will make it possible to conclude research work that was begun in the early 1980s. The Wendelstein 7-X in Greifswald will confine plasma in an improved magnetic field cage which is generated by a new type of non-planar magnetic field coils. This design principle offers considerable advantages for future fusion power plants, such as suitability for steady-state operation. The German government, the European Union and the government of Mecklenburg-Western Pomerania are providing substantial funding to realise this project. Building the stellator will place Mecklenburg-Western Pomerania at the forefront of international cutting-edge research.

The development and deepening of research activities in the area of low-temperature plasma physics directly helps to safeguard industrial jobs. Research work at the Institut für Niedertemperatur-Plasmaphysik e. V. Greifswald (Institute for Low Temperature Plasma Physics) in Greifswald currently focuses on the areas of plant and equipment engineering, finishing of wool, natural fibres and polymers, exhaust and air purification, medical technology and light sources. Estimates place the economic value of the market for the broad field of plasma-based technological applications at far more than DM 100 billion a year. The sustained funding that the Federal Government and the government of Mecklenburg-Western Pomerania are providing for the work being done at this facility would indicate that Greifswald will become Germany's centre of excellence in low-temperature plasma research.

Given its research structure and extensive agricultural activities, Mecklenburg-Western Pomerania offers favourable conditions for biotechnology to develop into an important field. In light of this, it has actively participated in the Federal Government's BioRegio competition and set up a biotechnology research centre (BioTechnikum) in Greifswald. The biotechnology research being conducted in Mecklenburg-Western Pomerania is aimed at finding practical applications for agriculture, medicine, and marine biotechnology. More efficient approval procedures, high levels of acceptance and the rapid launch of innovative products and processes in the marketplace are also targeted.

2. University research and non-university research

Mecklenburg-Western Pomerania promotes innovative research and technology at its universities and corresponding non-university research institutes with the objective of fostering scientific progress on an economically and ecologically sustainable basis. These efforts are guided by the vision of developing, as a start, technologies that are environmentally friendly or as non-damaging as possible to natural resources in those areas in which the *Land* already has a lead in know-how or experience. These areas are to be found primarily in the agricultural and maritime fields. Mecklenburg-Western Pomerania's universities cultivate specialised fields of research which they have co-ordinated with one other.

The *Ernst Moritz Arndt University of Greifswald* has established priority research fields in plasma physics, community medicine/dentistry, molecular biology/molecular medicine, biotechnology, landscape ecology/Bodden landscape, north European and Baltic studies, the culture of the Middle Ages and computer philology. As part of its community medicine/community dentistry activities, the medical faculty is conducting a regional study to collect basic health data about the people living in Western Pomerania. Eight other projects are being conducted in conjunction with this study. These activities entail substantial financial, time and manpower investments and are being largely funded by the BMBF. In addition to this, research being conducted at the medical faculty focuses on the study of causal relationships between the endogenous opioid system and monocyte/granulocyte activation in trauma, septicemia and shock. The postgraduate research group on the Structural and Functional Characterisation of Prokaryotic and Eukaryotic Genes focuses on molecular medicine which also falls under the purview of the medical faculty. The University added a biochemistry department to its science faculty, signalling its commitment to substantially expanding its expertise in biochemistry.

The DFG's collaborative research centre No. 198 – Kinetics of Partially Ionised Plasmas – conducts basic research and is in the process of developing a time-resolution-based optical emission computer tomography system for the diagnosis of technically relevant and chemically active low-pressure plasmas.

Research work being done in the field of coastal zone management covers the Baltic Sea region, its development and various historical, geoscientific, biological, economic and political aspects. In the geosciences field, a survey of the pollutant situation in stagnant and flowing waters is also being conducted.

Looking at the history field, a special role is played by research being conducted on the Hanseatic League, the elucidation and incidence of Slavic names for towns and fields in Mecklenburg-Western Pomerania, and on foreignness and integration.

At the *University of Rostock*, priority research areas include Baltic Sea research, artificial organs and biomaterials, transplantation medicine, proteome research, materials research, multimedia, the production, processing and biorelevant modification of renewable resources, the automation of technical systems, the study of dynamic processes, finite and asymptotic methods and structures in mathematics, molecular biology, linguistics, international law, and economic infrastructure and integration.

Medical research includes questions involving the development of capsulated liver cells, studies on infertility and subfertility (EC study), on pancreatic tissue, on monoclonal anti-CD4 antibodies in the rejection of allogenic kidney transplants and on oligosaccharides in human breast milk.

Also worth mentioning is the work being done on laser research, gas metabolism analysis und sensory analysis of generation and deterioration processes. In the humanities and social sciences fields, work is being conducted on regional planning, the transformation of economic systems, comparative political systems, the formation of political elites, and linguistics.

Special research activities revolve around the study of brackish water ecosystems, research on exchange processes in Bodden waters, and the development of waste avoidance strategies. Work is currently also being done on phase-oriented software ergonomics, the engineering strength of welded seams on ships, propulsion systems for sea-going and river-going ships, and basic studies to identify the dynamic movements of ships. Special mention is also to be made of the work being done on high-frequency sediment echo depth sounding and on developing seismoacoustic systems in the Baltic Sea.

The *Hochschule für Musik und Theater (Academy of Music and Theatre)* in Rostock has built its artistic profile around its drama department and its broad offering in music disciplines and music education. The Academy has anchored the especially innovative collaboration between its Institute for Music Education and Institute for Drama in its curriculum with a degree programme in acting. Musical training at the Academy is provided through the usual range of courses and through artistic collaboration with partner academies in north-eastern Europe. This collaboration is embodied in the Association of Baltic Academies of Music (ABAM) and is especially manifest at the Academy's annual summer school.

Research activities at the *Hochschule Wismar (*Wismar University of Applied Sciences, Fachhochschule for Technology, Business and Design) give centre stage to the use of modern information and communications technologies, including multimedia systems, the processing and study of construction methods, the application of modern thin-film technologies, joining technology, issues of ship handling and operation, and environmentally sound product design.

The *Fachhochschule Neubrandenburg (Neubrandenburg University of Applied Sciences)* is regarded as Mecklenburg-Western Pomerania's "green university of applied sciences". Its work focuses particularly on issues involved in an environmentally-oriented agro-industry and food industry, building renovation, metrology, social accounting and health research. The *Fachhochschule Stralsund (Stralsund University of Applied Sciences)* has a strong technology and business profile. It studies issues involved in the development of so-called alternative energies, including hydrogen technologies. It is also involved in research on corporate development, software development, tourism strategies and in the development of application-specific machine elements and optical components.

In addition to the priority research fields that have been established at Mecklenburg-Western Pomerania's institutions of higher education, the *Land*'s non-university research centres give priority to work in the following fields:

– Nuclear fusion at the Max-Planck-Teilinstitut für Plasmaphysik Greifswald (Greifswald Branch Institute of the Max Planck Institute for Plasma Physics) in co-operation primarily with the Max-Planck-Institut für Plasmaphysik (Max Planck Institute for Plasma Physics) in Garching and the University of Greifswald;
– The Institute for Low Temperature Plasma Physics in Greifswald moved into its new home in March 1999. The new building features a surface area of 3,700 m_ and state-of-the-art laboratory facilities. The Institute can now conduct contract research for industry without having restrictions being placed on its work by its premises or equipment. The increase in external funding enables the Institute to employ a staff of 110. Work on functional thin-film coatings in optics, tribology, heterogeneous catalysis, and protective film technology, in biotechnology and for radiation sources can be conducted in the new building. The Institute also upscales industrial facilities and conducts plasma diagnostics studies;

– Breeding research at the Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere (Research Institute for the Biology of Farm Animals) in Dummerstorf;
– Baltic Sea research that makes use of European research programmes being conducted at the Institut für Ostseeforschung (Baltic Sea Research Institute) in Warnemünde. The Institute will be building a 1,000 m_ addition in the next few years. The Federal Government and the government of Mecklenburg-Western Pomerania – which are providing the funding for the addition – are aiming for a functional, attractive building that conveys the national and international importance of Baltic Sea research;
– Atmospheric research that is conducted at the Institut für Atmosphärenphysik (Institute for Atmospheric Physics) in Kühlungsborn in close co-operation with research centres in northern Norway;
– Molecular catalysis research at the Institut für Organische Katalyseforschung (Institute for Organic Catalysis Research) in Rostock;
– Use of remote sensing at the German Aerospace Centre's Fernerkundungsdatenzentrum (Remote Sensing Data Centre) in Neustrelitz;
– Computer graphics at the Rostock branch of the Darmstadt-based Institute for Computer Graphics Research.

In addition to this, non-university research centres specialising in agroecology, diabetes research and demographic research are currently being established or expanded.

3. The promotion and transfer of technology

Mecklenburg-Western Pomerania's development into a modern location for research and technology demands creativity and competence. The government of Mecklenburg-Western Pomerania promotes the development of a correspondingly innovative, science and technology-friendly climate by providing target-specific funding and suitable conditions. The development of new, innovative and technologically sophisticated products, services and materials boosts the sales prospects and competitiveness of existing businesses. The funding being provided will also play a decisive role in ensuring the founding of new, competitive companies and the creation of high-skill, future-proof jobs.

The Ministry of Economic Affairs' technology policy is geared to the following priorities:
– To continue developing a technology infrastructure that is tailored to the needs of the market;
– To support efficient forms of technology transfer;
– To promote technology-oriented start-ups and the relocation of technology-oriented firms to Brandenburg-Western Pomerania;
– To foster new, trend-setting technological developments in products, processes and services and their marketing;
– To promote industry-related research in the higher education sector and at non-university research centres.

In the years since 1991, Mecklenburg-Western Pomerania's Ministry of Economic Affairs has allocated a total of DM 232.3 million in technology funding for implementing development projects in companies and for technology transfer measures. With its TEAM programme, the Ministry of Education, Culture and Science supports pre-competitive research projects with businesses. A total of DM 220 million was granted for the establishment and expansion of technology and research centres.

A funding programme was set up to help businesses and independent inventors acquire patents and licenses. The establishment of a venture capital fund in 1998 to provide start-up assistance for technology-oriented companies and its subsequent conversion into a revolving fund this year has brought a decisive improvement in this group of companies' equity position and in the provision of management support for them.

These specialised funding instruments and infrastructure measures are intended to step up the application and use of scientific findings and shorten the time it takes to translate them into marketable products, processes and services. The interlocking quality and complexity of Mecklenburg-Western Pomerania's funding instruments make it possible to accompany the entire innovation process, from the initial product idea all the way to marketing and sales.

The universities' transfer agents, the 12 research associations at the university-industry research and competence centres at technology parks or specialised centres, the Fraunhofer Institute for Computer Graphics Research in Rostock and the nine specialised working groups of the Innovationsagentur MV e.V. (Innovation Agency of Mecklenburg-Western Pomerania) all serve to foster the rapid transfer of research findings and technology to industry. In addition, nine Steinbeis Centres have been set up at the Universities of Rostock, Wismar and Stralsund in the last two years. Construction of a Fraunhofer Anwendungszentrum Großstrukturen in der Produktionstechnik (Fraunhofer Institute for Manufacturing Engineering and Automation) on the campus of the University of Rostock began in January 2000.

Information and communications technology, biotechnology, biomedicine and medical technology, telemedicine, renewable energies and environmental engineering, maritime technologies and food technology are among the areas which offer potential for development.

Great importance is attached to start-ups – especially new technology-oriented businesses – for economic and labour market policy reasons. Mecklenburg-Western Pomerania consciously fosters start-ups, particularly from the higher education sector, in order to keep experts and know-how in the *Land*. The Spin-Off pilot project being implemented by the Mecklenburg-Western Pomerania Research Alliance is a good example of this. With help from Spin-Off, 52 start-ups from a university or non-university research centre have either been launched or are being prepared for their launch. Start-ups of this type in particular can generate interesting, high-skill jobs that can survive the changes of the future.

Mecklenburg-Western Pomerania's technology centres have evolved into a tried and tested infrastructure for young firms and entrepreneurs. With the opening of the Stralsunder Innovations- und Gründerzentrum (Stralsund Centre for Entrepreneurship and Innovation) in late 1998 and the Biomedizinisches Technikum Teterow (Teterow Biomedical Centre) in early 1999, the *Land* now has six interdisciplinary and four industry-specific technology centres.

Today, 320 firms with 1,558 employees have located at one of these ten technology centres. The number of applications for admission to a centre has steadily increased thanks to the favourable conditions they offer, such as low-cost leases for attractive office, laboratory and workshop space and the provision of effective consultancy and other services. At present, the technology centres themselves are giving priority to expanding the amount of leasable space, increasing their range of services and setting up technology parks in their immediate vicinity. These parks offer companies opportunities to expand and invest.

4. International co-operation

Following German unification, it became increasingly important to integrate eastern Germany's research capabilities and capacities into the country's national and international science and research system. Mecklenburg-Western Pomerania has responded by purposefully promoting international contacts, giving particular emphasis to those within Europe. In the process, the government of Mecklenburg-Western Pomerania also aims to include eastern Europe and those countries that are candidates for accession to the EU (countries bordering the Baltic Sea) to a greater degree.

Mecklenburg-Western Pomerania's research centres have participated in the EU's Fifth Framework Programme for Research with numerous submissions.

The Ernst Moritz Arndt University of Greifswald was able to increase its involvement in the ERASMUS programme alone from five international co-operations in 1991 to 22 in 1995/1996. The University of Rostock is currently integrated into 23 ERASMUS networks. It is also participating in four TEMPUS programmes and in one TEMPUS/TACIS project. In addition, 54 partnership agreements are being used to strengthen international co-operation, with special focus being placed on Szczecin, Debrecen, Riga, Gdansk, Torun, Varna and Moscow. Further partnerships exist with the University of Georgia, East Tennessee State University and the University of Nantes. Rostock's Academy of Music and Drama is a member of the Association of Baltic Academies of Music (ABAM). Collaborative ventures are also being undertaken with the Israel Rubin Academy and the Conservatoire Superieur de Musique de Paris.

Brandenburg-Western Pomerania's Fachhochschulen (universities of applied sciences) are also extensively involved in international teaching and research activities. For example, the Neubrandenburg University of Applied Sciences is participating in two TEMPUS projects and one ERASMUS project with 11 partners. The Stralsund University of Applied Sciences has established an international degree programme – Baltic Management Studies. It is participating in five ERASMUS projects and one LINGUA project. The Wismar University of Applied Sciences cultivates working relations with 30 European countries. It serves as the project manager for the Computer Science in Economics degree programme at the University of Szczecin and is, together with Stralsund, the project partner for cross-border co-operation between western, eastern and northern Europe in the "Pomerania" EU region.

5. Other programmes and measures sponsored by Mecklenburg-Western Pomerania

Mecklenburg-Western Pomerania has given priority to sponsoring a *Land* research promotion programme in recent years, increasing the programme's funding volume fourfold to DM 8.8 million today, in contrast to the trend exhibited by the *Land* budget. This programme provides funding assistance for projects involving the humanities or natural sciences and for industry-related research. The efficacy of these funds makes it possible to enhance co-operation between science and the business enterprise sector, strengthen the region's business infrastructure and quickly provide companies with the training and skills they need for using new technologies. Emphasis should be given to the following two examples which are taken from of a wealth of individual activities:

- The University of Rostock, the Wismar University of Applied Sciences and the Stralsund University of Applied Sciences are collaborating in a *Land*-level venture to develop the latest aspects of multimedia research in ways that would benefit a sparsely populated *Land* such as Mecklenburg-Western Pomerania. Through the sustained efforts of the government of Mecklenburg-Western Pomerania, a university network could be established for this purpose in recent years – a network which is also the most modern university network in Germany today. Its structures and technologies (ATM networks) are some of the world's best in the multimedia field and offer unique opportunities for optimising teaching and research and for collaborating with industry;
- The advancement of women is another area in Brandenburg-Western Pomerania which has developed extremely well in comparison to the national average. Women account for 54.74 per cent of all students in Mecklenburg-Western Pomerania, compared to 40.5 per cent on national average. At 48.73 per cent, the share of women among university graduates is also markedly higher than the national average (38.96%). This trend can also be seen in the share of women acquiring a doctoral degree. In this case, women represent 41.42 per cent of all persons receiving a doctorate in Brandenburg-Western Pomerania, as opposed to 30.6 per cent on national average. Women also hold 7.94 per cent of all university professorships in the *Land*, considerably more than the national average. Only when it comes to doing independent research and writing a pertinent thesis to obtain a professorship ("*Habilitation*") does the share of women fall below the national average (9% in Brandenburg-Western Pomerania compared to 13.6% for Germany as a whole).

Mecklenburg-Western Pomerania's funding of basic research at universities and non-university research institutes and its targeted stimulation of applied research at Fachhochschulen, research centres and centres of excellence are part of a long-term research and technology policy that is aimed at optimising necessary structural change in the *Land*. One objective of this policy is to enable qualified research to be conducted in all parts of the *Land*. A focus on priority research fields will ensure that limited public resources continue to be employed in the best, most beneficial way in the future. The government of Mecklenburg-Western Pomerania also plans to put the *Land*'s universities and non-university research centres in a position to better participate in the European Union's mobility and research programmes than they have in the past. Corresponding funds have been included in the *Land* budget especially for this purpose.

9. Lower Saxony

1. Underlying principles and priorities of research and technology policy

Important in and of itself, research and science policy pursues independent objectives. Like cultural and educational policy, it is not part of any general economic policy whose primary interest lies in increasing the economic strength of the respective *Land* or region. Nevertheless, it is evident and has been frequently proven that science and research policy can, to a very large degree, set structural priorities and have an impact. The financial resources that government and industry invest today in the area of research and development lay the foundation for an economy's prosperity in future years. In the process, this investment also helps safeguard jobs.

Research policy must ensure the development of science. This means establishing a foundation for the entire spectrum of science, from pure research to application-oriented research all the way to applied research.

The government of Lower Saxony attaches particular importance to fostering key and advanced technologies in the university and non-university sectors. This is also reflected by the *Land*'s programme of work for the current legislative period, which cites the following areas as special examples: information technology and underwater technology at the University of Hanover, microtechnology and biotechnology in Brunswick, molecular biosciences in Göttingen, environmental technology in Clausthal, renewable electrical energy systems in Oldenburg and cell research in Osnabrück.

Using its newly established innovation fund, the government of Lower Saxony will be granting priority funding to collaborative research projects which are geared to developing new and innovative products, processes and services and are conducted on a joint basis by universities, non-university research centres and business enterprises. This policy was designed to help interleave science and industry more closely with one another in order to improve the transfer of technology on a lasting basis and concomitantly create value added for all involved. It also concerns itself with promoting technology-oriented start-ups from universities and non-university research centres – because companies from the high-tech field are particularly suited to generating new impetus for the labour market.

To support this research policy, the government of Lower Saxony pursues project alliances in which a number of Lower Saxony's universities and in some cases non-university research institutes collaborate with industry. Examples include "Measurement Valley", acoustics research in connection with motor vehicles, and biomedical technology.

Further structural measures such as the Europäisches Neurowissenschaftliches Institut (European Neuroscience Institute) in Göttingen, the DLR-Institut für Verkehrstechnik (DLR Institute for Traffic Engineering) and the Research Airport in Brunswick, will help strengthen the region's innovation capabilities on a sustainable basis.

Today more than ever before, it is vital for the individual university to develop a specialised profile because not every university can conduct research in all fields with equal intensity or quality. It is also very important to bring together outstanding research activities on the most interdisciplinary basis possible and enter into collaborative ventures with other universities, non-university research centres and industry. The internationalisation of university research also plays an important role in building profiles and in ensuring quality assurance at universities. However, the ability of a *Land*'s universities to compete in the research arena can be ensured over the medium term only when the funding at hand is also used to enter into new territory. Gone are the days when government was able to provide additional funding to develop new fields of science. Today, cuts have to be made in those areas that are not competitive in order to make room for new areas of research.

In order to make research policy cuts of this type, it is absolutely necessary to have a reliable picture of how efficient the *Land*'s universities and non-university institutes are. Aware that a *Land*'s competitiveness and ability to meet the challenges of the future depend in large part upon the performance of its science, the government of Lower Saxony appointed a science commission consisting of high-ranking representatives from the scientific community in October 1997. Set up as a permanent body, this commission advises the government of Lower Saxony and its scientific institutions on an ongoing basis using expert opinions. Its advice focuses primarily on the following key tasks:
– The progressive development of the structure of Lower Saxony's university and research systems,
– The development and review of priority research fields,
– The development and organisation of research evaluation procedures.

The science commission is currently developing a plan for structuring the natural sciences in Lower Saxony, taking all the *Land*'s universities into consideration. This is to be followed shortly by a plan for the engineering sciences. Particular attention is being given to future priorities and concentrations of expertise.

In March 1999, the science commission adopted a plan for the Evaluation of Research at Lower Saxony's Universities and Research Centres which is aimed at helping universities develop and plan a clearly defined research profile of their own that offers prospects for the future. The commission's plan also helps ensure the allocation of investments that are necessary for priority research fields and facilitate performance-oriented appointment processes.

The chemistry and history fields are currently undergoing an evaluation. They will be followed by economics, biology, civil engineering/architecture and the disciplines involved in teacher training, probably in the autumn of 2000.

Among its specialised policies, Lower Saxony assigns technology policy high standing alongside science policy. Technology policy is an essential component of the *Land*'s economic and industrial policies and establishes fundamental conditions necessary for the latter's implementation.

The general objectives targeted by Lower Saxony's technology policy are:
– To promote the use of key technologies;
– To maintain and improve the *Land*'s industry-related research and technology infrastructure;

– To intensify co-operation and transfer activities between research institutes and businesses;
– To assist primarily small and medium-sized enterprises with the development and introduction of new technologies;
– To support technology-oriented start-ups and the relocation of existing technology-oriented companies to Lower Saxony.

Technology policy gives priority to the fields of microelectronics, information and communications technologies, biotechnology, medical technology, production engineering, new materials, traffic engineering and environmental technology. Important technology policy activities in priority fields include the SICAN project (a strategic centre of excellence in microelectronics, a key technology) and Lower Saxony's Information and Communications Industry and New Materials for Lower Saxony initiatives.

2. University research and non-university research

The principles outlined at the start of this section give rise to a number of priority fields, such as the following examples:

Lower Saxony presently has 26 collaborative research centres which received a total of DM 56.8 million in funding from the Deutsche Forschungsgemeinschaft (DFG) in 1998. The primary focus of these activities is on the biosciences which account for ten collaborative research centres and on the engineering sciences with nine cllaborative research centres. Approximately 13 per cent of all collaborative research centres in the engineering field in Germany are set up at universities in Lower Saxony. Research activities in the bioscience field are concentrated in Göttingen with its university, the Max-Planck-Institut für biophysikalische Chemie (Max Planck Institute for Biophysical Chemistry), the Max-Planck-Institut für experimentelle Medizin (Max Planck Institute for Experimental Medicine) and the Deutsches Primatenzentrum (German Primate Centre).

Project alliances at the *Land*'s universities are used to fund for limited periods of time the following research activities which are conducted jointly by various universities and, in some cases, with the involvement of non-university research centres:
– Applied media research
– Peace and conflict research
– Sociological technology research
– Women's studies
– "Measurement Valley"
– Marine biotechnology
– Agricultural biotechnology.

Lower Saxony has allocated DM 9 million for an animal laboratory which is to be jointly used by the Max Planck Institute for Experimental Medicine and facilities of the University of Göttingen. This laboratory allows the keeping of transgenic animals and will consequently serve as the cornerstone for developing a bioscience priority research field in Göttingen. This concentration of expertise can be expected to generate very valuable scientific information and provide a platform where the institutes of the Max Planck Society and the University of Göttingen can collaborate in exemplary ways.

The establishment of the Göttingen Zentrum für Molekulare Biowissenschaften (GZMB – Centre for Molecular Biosciences) will create another concentration of expertise in the bioscience field. Some DM 65 million in special funding will be allocated for this interdepartmental facility over the next five years.

The Federal Government will allocate DM 11.3 million for the third funding phase (1999 through 2003) of the Forschungszentrum Waldökosysteme (FZW – Forest Ecosystems Research Centre) which was established at the University of Göttingen back in 1984 to study the dynamics of change in forest ecosystems. Lower Saxony is providing funding totalling some DM 24 million.

In the area of energy research, the University of Oldenburg has been provided DM 7.1 million in funding for its research priority *Systems research: renewable electrical energy systems*. This funding will be used to explore economically and ecologically tenable uses of renewable sources of energy in the future and to markedly increase the reliability of and improve the economic conditions underlying the solar-wind systems that are currently in use.

The Institut für Solarenergieforschung (Institute for Solar Energy Research) was set up in Emmerthal, near Hameln, in recent years with an investment of some DM 30 million.

Being a key technology, microtechnology research at the Technical University of Brunswick was allocated DM 14.5 million in special funding. This field of research was also set up at the University of Hanover with approximately DM 3 million.

Based on recommendations made by the Science Council, an underwater technology research centre was established at the University of Hanover in 1996 and 1997 with an investment of DM 25 million. The work on underwater techniques at the centre revolves around research on methods for dismantling nuclear power plants, controlling damage to nautical vessels and offshore structures, and on the filtering and absorption behaviour of water processes for reducing the environmental impact of toxic and carcinogenic gases, noise, radiation and respirable solids.

The new Zentrum für Luft- und Raumfahrttechnik (ZLR – Centre for Aviation and Aerospace Engineering) at the Technical University of Brunswick – which has been allocated some DM 24 million in funding – was established to improve the quality of teaching and research in this field and to foster vital interdisciplinary co-operation with the aviation and aerospace facilities that are relevant to teaching and research and are already sited in the vicinity of the Brunswick airport. These include the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre), Luftfahrtbundesamt (federal supervisory agency for civil aviation in Germany), Deutsche Flugmessgesellschaft, Deutsche FlugsicherungsAG (German Air Traffic Services, successor to the former Federal Administration of Air Navigation Services), Aerodata and the Avionikzentrum (Avionics Centre).

In Lower Saxony, practical research and development work is viewed as an obligatory activity for Fachhochschulen (universities of applied sciences). In this connection, the following new priority research fields were set up in mid-1997 for a period of five years with a total funding volume of DM 9.65 million:
– The employment of women in the health and social welfare field (University of Applied Sciences in north-east Lower Saxony),
– Plastics recycling (University of Applied Sciences Brunswick/Wolfenbüttel),
– Applied microsystems for small and medium-sized industries (University of Applied Sciences and Arts in Hanover),

- The supply of energy using small, decentralised power plants in limited-capacity supply grids (University of Applied Sciences Wilhelmshaven),
- Intelligent sensor systems (University of Applied Sciences Osnabrück) and
- Raum-Rohr-Boden which focuses on ascertaining, inspecting and eliminating flaws and defects in existing pipe systems (University of Applied Sciences Oldenburg).

The Hanse-Wissenschaftskolleg (Hanse Institute for Advanced Study) began operation as a private foundation in Delmenhorst in the autumn of 1997. Working together with the Universities of Oldenburg and Bremen, it fosters national, international and interdisciplinary co-operation on the part of highly qualified und usually younger research scholars. The foundation has DM 4.5 million in funding at its disposal each year. A total of DM 8 million in special funding was provided on a one-off basis for the construction of suitable facilities for the Institute. Fellows from the national and international spheres who have been invited to the Institute deal with topics in the neurocognitive sciences, marine research and social sciences fields.

The Hanse Institute for Advanced Study is in charge of co-ordinating the training alliance that is part of the NeuroNord research and training alliance. This alliance has set itself the goal of intensifying outstanding research activities, training young scientists, and strengthening university teaching in the neurosciences and cognitive sciences via collaborative ventures, the allocation of tasks, and the pooling and joint use of resources.

The Deutsches Zentrum für marine Biodiversitätsforschung (DZMB – German Centre for Marine Biodiversity Research) in Wilhelmshaven will be established as a branch of the Forschungsinstitut Senckenberg (Research Institute Senckenberg) in early 2000.

In conjunction with the appointment of a professor of physics at the University of Hanover, Lower Saxony succeeded in recruiting a Max Planck Society working group which conducts experimental research on gravitational waves. This working group is endeavouring to furnish proof of gravitational waves through its experiments. Lower Saxony has allocated a total of DM 3.7 million in funding for the development of a gravitational wave detector.

Lower Saxony also provides some DM 40 million a year in core funding for the *Land*'s 16 regionally financed research institutes which include the Clausthaler-Umwelttechnik-Institut (Clausthal Environmental Technology Institute) in Clausthal-Zellerfeld, the Oldenburger Forschungs- und Entwicklungsinstitut für Informatik-Werkzeuge und -Systeme (Oldenburg Research and Development Institute for Computer Science Tools and Systems), the Laser-Laboratorium Göttingen (Laser Laboratorium Göttingen), the Kriminologisches Forschungsinstitut Niedersachsen (Criminological Research Institute of Lower Saxony) in Hanover and the Forschungszentrum TERRAMARE (TERRAMARE Research Centre) in Wilhelmshaven.

3. The promotion and transfer of technology

Lower Saxony's research, structural and economic policies continue to give priority attention to the funding and transfer of technology. The *Land*'s primary objective here is to boost the innovation capabilities and competitive capacity of small and medium-sized enterprises by fostering co-operative ventures between science and industry, remedying the lack of information about new technologies, encouraging research activities, and clearing financial bottlenecks which impede innovation in enterprises.

One of the most important technology policy instruments that active economic and industrial policy deploys is the promotion of larger-scale collaborative research initiatives. As a result of the many diverse types of know-how brought to the table by the companies and research centres that collaborate with one another, such initiatives substantially help increase synergies.

The government of Lower Saxony will also continue to promote the transfer of technology between science and industry and to fund the facilities established for this purpose. Special mention is to be made here of the *Land*'s various industry-related research institutes which work in key fields of technology such as laser technology, production engineering, environmental technology, solar energy research, rubber technology and food technology. These institutes make an important contribution toward putting innovative research and development findings to commercial use and concomitantly help increase the competitive strength of Lower Saxony's economy.

The Science and Industry for New Jobs joint action programme which was developed by the Ministry for Science and Culture and the Ministry of Economic Affairs, Technology and Transport provides the framework for realising projects which range from intensifying co-operation between universities and business enterprises to co-ordinating departmental funding instruments and programmes all the way to using Lower Saxony's cultural resources to increase the *Land*'s attractiveness as a location for trade and industry. Particular mention is to be made of the proposal to establish "innovation companies" (as profit-oriented limited liability companies) to improve the transfer of technology at Lower Saxony's universities. The first of these companies – the Innovationsgesellschaft Universität Hannover mbH – began operation on August 1, 1999. Plans foresee the establishment of further university innovation companies in the coming months.

Since the Patent Consultation and Exploitation pilot project which was launched at the University of Hanover on January 1, 1996, produced such positive results, the activities covered by the project will be developed into a standing task in the higher education sector of Lower Saxony and the Innovationsgesellschaft Universität Hannover mbH will be placed in charge of it. The Patent Campaign at Lower Saxony's Universities will give the *Land*'s universities the financial wherewithal necessary for exploiting marketable inventions and filing patents on them.

The Start-Ups from Universities pilot project which was conducted in the university towns of Hanover and Osnabrück was successfully concluded. The measures that were tested during the project are now to be implemented throughout Lower Saxony.

In an effort to boost innovation activity, Lower Saxony grants low-interest loans and subsidies to help individual companies – and small and medium-sized enterprises in particular – carry out research and development projects. Mention is to be made in this connection of the Programme for Consultancy Services between Science and Industry in Lower Saxony which was recently extended. This programme subsidises the provision of short-term scientific consultancy services for SMEs in the manufacturing sector and processing trades.

In the area of technology transfer, the government of Lower

Saxony attaches particular importance to promoting the transfer of personnel. Promotion measures revolve around the hiring and practice-oriented deployment of university graduates who have an engineering, science or economics degree and will be working for the first time as a graduate in certain areas of the respective company.

The government of Lower Saxony also pursues the declared goal of developing existing technology parks into regional innovation service providers. The Virtual Technology Centre of Lower Saxony database (VTN) which was set up in 1998 is an important factor in achieving this goal. This database presents the products and services of the some 250 firms operating in Lower Saxony's 16 technology parks and the services that these parks provide. This platform also offers access to Lower Saxony's research and development infrastructure. The Lower Saxony Technology Server project also serves this goal. This project is developing an interactive navigation and information system for any and all questions regarding research and development or innovation and the transfer of technology.

4. International co-operation

During the second half of the 1990s, EU research funding became even more important for Lower Saxony's universities, non-university research institutes and firms. These bodies and enterprises attracted nearly ECU 139 million in funding from Brussels during the Fourth EU Framework Programme on Research which ran from 1994 through 1998. This was nearly double the share of EU funding that Lower Saxony received during the foregoing Third Framework Programme. A break-down of these funds by year also reveals a pronounced increase: In 1995, the EU approved ECU 19.8 million in research funds. By 1998, this figure had increased to ECU 36.5 million.

Lower Saxony's industry, non-university research institutes and universities received approximately equal amounts of funding from the Fourth Framework Programme on Research. The *Land*'s universities and Fachhochschulen received ECU 44 million or approximately 32 per cent of the funding allocated, while its non-university research institutes attracted ECU 47 million or some 34 per cent, followed by large-scale enterprises with ECU 28 million (approximately 20 per cent) and small and medium-sized enterprises with ECU 18 million (some 13 per cent).

The European Union's structural funds offer another route for obtaining EU funding. Lower Saxony availed itself of funding from the European Regional Development Fund (ERDF) and the European Social Fund (ESF) for the first time during the 1994 – 1999 funding period. The funds it received were used to finance measures conducted by universities and research institutes which are located in the 2 and 5b target areas. Some DM 20 million in funding went to Lower Saxony during this period.

ERDF funds are used in various ways, such as to finance practical R&D, step up activities to introduce SMEs in particular to co-operation with universities and research institutes, and expand research centres which provide R&D services for industry. ESF funds are deployed to provide continuing scientific training for university graduates to improve their prospects on the labour market and to qualify experts and managers from trade and industry.

Lower Saxony helps its scientists participate in EU research programmes by providing human, physical and transportation resources in preparation of projects with international partners.

10. North Rhine-Westphalia

1. Underlying principles and priorities of research and technology policy

North Rhine-Westphalia has continued to systematically transform itself into a location for trade and industry that offers a high level of know-how in key and advanced technologies. As part of the *Land*'s economic and industrial policies, North Rhine-Westphalia's technology policy continues to promote this development and offers small and medium-sized enterprises in particular extensive assistance for strengthening their technology base.

This is further supported by the *Land*'s research policy which is aimed at helping to broaden and deepen scientific knowledge, reinforce the social and cultural foundations of democratic society, and gear science to application-related solutions for the individual, society and industry. Through its research policy, North Rhine-Westphalia establishes the conditions that put researchers in a position to provide answers to pressing ecological, economic and cultural issues.

Not only has globalisation led to tougher competition on the markets for goods and services, it has also exposed labour markets to international competition in hitherto unknown ways. It has become largely impossible to protect these markets through national policies. New growth markets in the information, environmental protection, health, food and cultural fields are developing throughout the world. Demand for new products is springing up. The ability to satisfy this demand in innovative ways is a prerequisite for creating jobs with a future. This requires the help of science and research in particular. For this reason, the co-ordination of research (production and knowledge base), initial and continuing training, mobility, the dissemination of knowledge, and the ability of firms – particularly SMEs – to absorb new technologies and new know-how are of vital importance for innovation.

The object of North Rhine-Westphalia's research policy is to promote applied research and basic research in the right balance. Longer-term and higher-risk pre-competitive research in the area of basic research is absolutely essential.

The challenges facing modern industrial and information societies cannot be solved with scientific and technological means alone; they must also be dealt with at social and cultural level. For this reason, environmental research, social acceptability, and technology impact assessments are integral parts of North Rhine-Westphalia's research and technology policy.

2. University research and non-university research

Research funding instruments
North Rhine-Westphalia's science budget was increased again in 1999 to approximately DM 8.6 billion. Over the last ten years, the *Land* has increased its funding for science and research by 50 per cent.

In recent years, North Rhine-Westphalia has regularly increased not only its funding for the fundamental outfitting of research and teaching facilities at the *Land*'s universities, but its other research funding as well. The so-called core funding for research which the science ministry uses to fund particular research projects at North Rhine-Westphalia's universities totalled DM 88.5 million in 1999, more than twice the amount allocated eight years ago.

North Rhine-Westphalia's Ministry of Schools and Continuing Education, Science and Research does not limit its efforts to foster research to subsidising individual research projects. It also aims to:
– Prompt and flank the development and expansion of concentrations of research expertise at the *Land*'s universities;
– Initiate the siting of new facilities and the development of existing facilities of regional and national standing;
– Work toward inter-university collaboration in the research field and, in the process, progressively interlink research in North Rhine-Westphalia on a cross-university and interdisciplinary plane;
– Work toward intensive co-operation between universities, non-university research institutes and industry and concomitantly toward the prompt and practical implementation of research findings;
– Further develop and improve conditions that will foster efficient research.

In general, North Rhine-Westphalia budgets its research funding in two programmes. The so-called special measures for promoting research and technology are meant primarily for expanding the *Land*'s research infrastructure on a pin-pointed basis. These funds are to be used to foster promising, new, alternative research initiatives in the fields of basic research and key technologies. They are also used to flank national research funding, support and interlink existing priority research fields, and enable individual projects to be implemented. These funds are supplemented by the Research Innovation programme which was established in 1996 to bring science's contribution to structural change more in line with actual conditions in North Rhine-Westphalia and to step up development of the *Land*'s science system. This programme is expressly used to foster scientific work and technological development in key areas. It presently encompasses the following focal areas:
– Shape the information society at social and technological level
  This area deals with the social and technical implications of the coming information society. The areas working world, telematics, art and leisure time will be organised taking economic, cultural and organisational aspects of information, communication and media into account.
– Safe and efficient energy production
  This area focuses on developing renewable sources of energy, the safe and efficient production of energy, and the use of ecological methods for closed-loop systems.
– Better protection of the climate and the environment
  Work here concentrates on thematic areas involving climate change and issues of environmental protection and environmental education.
– Medical progress and prevention
  As part of this focal area, the conditions for internationally competitive research in the service of health will be optimised on a pin-pointed basis. At the same time, the opportunities offered by modern molecular biology will be incorporated and used in a responsible manner.

Social change and cultural orientation
This programme focus deals with areas which currently have potential for social and cultural conflict and with the public dialogue on science and technology. The humanities and their future direction (cultural studies) constitute one area of focus. Other areas of focus include issues of science and ethics, Jewish studies and regional studies.

In the social sciences field, North Rhine-Westphalia fosters in particular the areas technology assessment, migration and poverty research, peace and conflict research and issues regarding the future of cities.

Mobility and transport in the future
Here the focus is on finding ways to organise transport and traffic more efficiently while ensuring mobility for all strata of society and for trade processes. On the one hand, mobility – which is necessary for economic development and is desired by the individual – must be preserved. At the same time, the burdens and stresses that transport and traffic place on people and the environment, towns and cities, and on the economy are to be reduced to a minimum.

Future-oriented product and process innovation
One important prerequisite for many innovative developments is the availability and mastery of suitable new materials. Numerous fields help ensure that this prerequisite is met. Materials science – which integrates various specialised areas – is especially important in this regard. Nanotechnology is to be particularly emphasised here. Mention is also to be made in this connection of microsensor engineering, basic research in plasma technology, and production and process engineering.

Priority research fields at Fachhochschulen (universities of applied sciences)
Application-related research is the acknowledged strength of universities of applied sciences. Pooling these activities on an interdisciplinary level to form priority R&D fields further strengthens this special expertise, puts these institutions in a position to handle complex issues, generates synergies and, in the process, gives small and medium-sized enterprises in particular valuable stimulus for product and process innovation.

North Rhine-Westphalia's higher education sector takes part in shaping and honing the *Land*'s innovation programme through a scientific programme advisory council. The innovation programme funded a total of 65 projects in 1999 alone. In addition, it supports 24 priority research fields at the *Land*'s Fachhochschulen (universities of applied sciences). Calls for applications are to be issued for at least one project a year in each of the programme's priority fields. Efforts to strengthen the programme's competitive character on an ongoing basis began in 1998.

North Rhine-Westphalia has also had continued success in recruiting collaborative research centres, increasing its total to 62 as of 1 January 2000. Ten of these centres work in the humanities and social sciences, 15 in biology/medicine, 16 in the natural sciences, 18 in engineering and three in the computer science field.

Non-university research

The following institutes which are funded under Basic Agreements on Research Funding are located in North Rhine-Westphalia:

– 6 Fraunhofer Institutes
– 11 Max Planck Institutes
– 9 research centres and facilities which provide services for research being done in conjunction with the Blue List
– 3 Helmholtz Centres:
– Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR – German Aerospace Centre) in Cologne-Porz
– Forschungszentrum Jülich (FZH – Research Centre Jülich)
– GMD – Forschungszentrum Informationstechnik GmbH (GMD – GMD National Research Centre for Information Technology) in Sankt Augustin.

The Deutsche Forschungsgesellschaft, the above-mentioned institutes and other non-university research centres had DM 639.4 million in funding at their disposal in 1999, 40 per cent more than in 1990.

A co-ordinating interface between university research and non-university research is provided by the *Land*'s more than 90 independent research centres, most of which are affiliated with a university.

The following institutes (which are headed by professors) provide a sample of the facilities that have been set up to date using restructuring aid from the Federal Government and the *Land* government:

– Institut für Umwelttechnik und Umweltanalytik (IUTA – Institute for Environmental Technology and Environmental Analysis) in Duisburg
– Dortmunder Initiative zur rechnerintegrierten Fertigung (RIF – Dortmund Initiative for Computer-Integrated Production)
– Zentrum für Expertensysteme Dortmund (ZEDO – Dortmund Centre for Expert Systems)
– Informatik Centrum Dortmund (ICD – Dortmund Computer Science Centre)
– Europäisches Zentrum für Mechatronik (European Centre for Mechatronics) in Aachen
– Institut für Instandhaltung (IFIN – Institute for Maintenance) in Iserlohn
– Institut für Entsorgung und Umwelttechnik (IFEU – Institute for Waste Disposal and Environmental Engineering) in Iserlohn
– Institut für Umwelt- und Sicherheitstechnik (UMSICHT – Institute for Environmental, Safety and Energy Technology) in Oberhausen (now a Fraunhofer Institute)
– Institut für Chemo- und Biosensorik (ICB – Institute for Chemical Sensors and Biosensors) in Münster
– Zentrum für Neuroinformatik (Centre for Neuroinformatics) in Bochum
– Institut für Mikroeletronik (AMICA – Institute for Microelectronics) in Aachen
– Institut für Mobil- und Satellitenfunktechnik (IMST – Institute for Mobile and Satellite Communications Technology) in Kamp-Lintfort
– Zentrum für innovative Energieumwandlung und -speicherung (EUS – Centre for Innovative Energy Conversion and Storage) in Gelsenkirchen
– Institut für Mechatronik (IMECH – Institute for Mechatronics) in Moers.

These institutes are important contributors to North Rhine-Westphalia's ecological and economic renewal.

3. The promotion and transfer of technology

The timely setting of goals and intensive co-operation between science and industry are prerequisites for shortening the time it takes to translate the latest knowledge into new products, processes and services, and for concomitantly safeguarding existing jobs and creating new, competitive jobs.

Parallel to this, the priority task facing business enterprises is to gear their production structures to the requirements and opportunities that the future will bring. The government offers pin-pointed help toward self-help in this connection, particularly for small and medium-sized enterprises.

Technology promotion measures are bundled in the *Land*'s North Rhine-Westphalia Trade and Industry technology programme.

This programme focuses its activities on the one hand on the need for a technological modernisation of the structure of the region's industry and associated services that has evolved over the years. This need arises from the fact that industries such as chemicals, engineering, car-making, electronics, construction and other traditional branches of industry have long constituted the *Land*'s most important economic pillars, generating the greatest value added and providing the most jobs.

For this reason, advancing innovation in these branches continues to be an important task for the *Land*'s policies. Temporary so-called *Land* initiatives such as the Verbundinitiative Automobil NRW (VIA NRW, a collaborative initiative for the automobile industry of North Rhine Westphalia) and Zukunftsinitiative Textil (ZiTex, an initiative for the textile industry) are considered to be politically important areas for priority action.

In the high-tech field – with its potential for future growth and an image that is useful for marketing a location – the focus is first and foremost on generating new knowledge and/or acquiring such on the world market and subsequently translating it into new products and processes in North Rhine-Westphalia. This requires the fostering of high-tech research and the founding of corresponding companies in fields of technology that offer strong development potential.

Technology initiatives have proven themselves to be particularly suited to this. They provide an appropriate framework for inducing leading individuals in flexible and synergy-releasing ways to collaborate with one another. Examples of this include the Bio- und Gentechnikinitiative NRW (NRW Biotechnology and Genetic Engineering Initiative) and the Mikrostrukturinitiative NRW (NRW Microstructure Initiative).

In addition to this, small and medium-sized enterprises can draw upon a diversified network which, as part of North Rhine-Westphalia's technological infrastructure, provides transfer, information and training services – in some cases, over the Internet (www.mwmtv.nrw.de). This network is made up of technology parks and business incubators, technology agencies, research and development facilities and – extending beyond the above-mentioned initiatives – Media NRW, the Initiative Qualitätssicherung NRW (NRW Quality Assurance Initiative), the Bahninitiative NRW (NRW Railway Initiative) and the Landesinitiative Zukunftsenergien (Energies of the Future *Land* initiative) to name just a few examples.

In other areas, the government of North Rhine-Westphalia also pursues not only the goal of conducting extensive basic research but also the goal of organising and/or intensifying an open exchange between science and industry via applied transfer-oriented research. In light of this, the Ministry of Economic Affairs and Small Industry, Technology and Transportation and the Ministry of Schools und Continuing Education, Science und Research have agreed upon a set of measures to improve co-operation between science and research.

These measures include the Programme to Provide Financial Security for Start-Ups from Universities (or PFAU, its German acronym) which is an independent component of the Go! Start-Up Campaign In NRW and the Programme to Promote the Submission of Applications for Industrial Property Rights on Research Findings from Universities (or SAFE, its German acronym).

The PFAU programme assists young entrepreneurs by providing them a part-time position as an academic employee in teaching or research for a two-year period at a university or university of applied sciences. During this time, they are to develop their innovative ideas into marketable products or services which could provide the basis for a business. In addition to ensuring the individual's livelihood for this period, the PFAU programme also provides prospective entrepreneurs consultancy services regarding their risks, costs and market prospects.

This programme has provided funding for 83 of the 220 start-up ideas that it has assessed since it was launched in the autumn of 1996.

As part of the SAFE programme, North Rhine-Westphalia assumes up to 75 per cent of the costs arising in connection with applying for and exploiting patents. In doing this, SAFE goes far beyond just promoting patent applications. Its prime objective is the commercial exploitation of inventions – in other words, granting licences to other companies or starting up a new company on the basis of the particular invention. The SAFE programme assists inventors to this end. Inventions are assessed to determine whether they can be patented. Utilisation strategies are developed and active support is provided during the search for licensees. It has been possible to assist approximately 50 inventors in this way to date.

4. International co-operation

North Rhine-Westphalia's Ministry of Schools and Continuing Education, Science and Research began at an early stage to put the *Land*'s universities in a better position to participate in EU programmes. For this purpose, it launched the following initiatives:

– An initiative to establish consultancy capacity for research and technological development at individual institutions of higher education which are responsible at *Land* level for looking after the respective EU research and mobility programmes and which serve as the point of contact for collaboration of the higher education sector with industry and business enterprises (European Competence Network at North Rhine-Westphalia's Universities);
– An initiative for the provision of financial support for research scholars in North Rhine-Westphalia when applying to European Union funding programmes (incentive financing).

These initiatives have had a positive impact. North Rhine-Westphalia's research and development capabilities make it a high-tech region. As such, it also sets the pace among the European regions. Looking at levels of success in acquiring EU projects, North Rhine-Westphalia is to be found among the top ranks in both national and European comparisons of all EU regions.

In light of increasing globalisation, North Rhine-Westphalia is strongly interested in collaborating with all countries on research and development. The Ministry of Schools and Continuing Education, Science and Research accordingly promotes international collaborative research ventures to an increased extent.

International co-operative ventures are based on agreements which the *Land* of North Rhine-Westphalia concludes with other nations or organisations; they also come about as a result of North Rhine-Westphalia's accession to the agreement on the Federal Republic of Germany's science and technology co-operation. North Rhine-Westphalia currently has 30 agreements, whereby special mention is to be made of the agreements with North Carolina in the USA and the Chinese provinces Sichuan and Jiangsu. In addition to this, North Rhine-Westphalia's universities and research institutes also independently pursue co-operative ventures within the framework provided by university partnerships and by international contacts between professors and institutes.

Plans for the future target further involvement in collaborative research ventures with the countries of Central and Eastern Europe, America and Asia.

5. Other Land-level programmes and measures

Fostering young researchers

Young research scientists who offer expertise and quality are a guarantee for high-quality science not only today but in the future as well. For this reason, young scientists in North Rhine-Westphalia are given the opportunity to recruit funding for their research projects on an independent basis – in addition to the funding provided through the *Land*'s existing research funding system. The purpose of this system is to facilitate subsequent access to existing funding sources and concomitantly help qualify young scientists and bind young, top-flight research scholars to North Rhine-Westphalia.

Several paths are being taken to accomplish this.

Opportunities for young, top-flight scientists were opened up for the first time in 1999 with the establishment of career development groups – first in medicine and subsequently in other fields – following a public call for applications.

In addition to this, the Ministry of Schools and Continuing Education, Science and Research also promotes young researchers across the entire range of scientific disciplines on a pin-pointed basis through its Bennigsen-Foerder Prize.

The Bennigsen-Foerder Prize is awarded annually. Each year approximately DM 1 million in prize money can be awarded for a total of ten projects.

The Bennigsen-Foerder Prize has developed into North Rhine-Westphalia's most coveted science award. Over the years, 1,610 young scientists have taken part in the competition and 162 projects have been chosen for the award. Approximately DM 15 million in project funding has been allocated for the prize winners. The prize was awarded for the twelfth time in 1999.

Women's Studies Network

Unique for its size, North Rhine-Westphalia's Women's Studies Network was expanded to include 38 professorships in the early 1990s using funding from the Second Special Funding Programme for Higher Education and Research. It was subsequently enlarged by another six for a total of 44 chairs in 1996 with the help of *Land* funding. In addition, the Marie Jahoda Professorship – a visiting professorship for international women's studies – was established in 1994. These activities are aimed at building a productive and – for the Federal Republic of Germany – unique network of professorships in women's studies, particularly in fields where there has been little or no women's studies research to date. Professorships for women's studies have been established not only in the social sciences, education and linguistics, but also in architecture, design, musicology, history, law, medicine, business administration, theology, drama, film and television studies, urban planning and ergonomics.

Literature

Further information about North Rhine-Westphalia's research and technology policy can be found at the web sites sponsored by the Ministry of Economics Affairs and Small Industry, Technology and Transport and the Ministry of Schools and Continuing Education, Science and Research:

– http://www.mwmtv.nrw.de
– http://www.mswwf.nrw.de

Info-Box

Fostering young university lecturers

The Deutsche Forschungsgesellschaft's Emmy Noether Programme

The Emmy Noether Programme is a new type of funding that is provided for young and highly trained university lecturers. This programme follows the principle of promoting "creativity through early responsibility" and is geared to the "assistant professor" model found at American universities. For the first time in North Rhine-Westphalia's funding history, outstanding young scientists can apply for personnel and material assistance for themselves and for research projects for which they are responsible. Over a period of approximately five years, these participants are to gain enough experience and expertise that they are able to compete against formally qualified persons for appointments as university lecturers – despite not having gone through the traditional, protracted qualification procedure for a professorship themselves. As a rule, these young scientists begin their research at an institute abroad (for a two-year period, post-doctoral fellowship of approximately DM 2,700 a month). Following their return, they are offered for a further three years a temporary, grade BAT Ib or Ia position (BAT – Federal Collective Agreement for Public Service Employees) and funds to set up a scientific working group that they head. Thus, the Emmy Noether Programme constitutes an important milestone on the road to a new post-doctorate culture.

The Deutsche Forschungsgesellschaft first invited applications for the programme in the spring of 1999; 63 of the 167 applications that were subsequently submitted were approved. Fifteen of the approved applications were from women. A total of DM 14 million has been provided for 1999, the programme's first year. This amount is to be increased to DM 110 million annually in coming years through equal financing by the Federal and *Länder* governments.

11. Rhineland-Palatinate

1. Underlying principles and priorities of research and technology policy

The government of Rhineland-Palatinate views science, continuing education and the transfer of technology as vital cornerstones for the future. Research and development work being done within and outside the higher education sector is the basis for competitive strength, social security and prosperity in a modern economy.

In this area, Rhineland-Palatinate is guided by the following policy goals:

The plurality of the *Land*'s science system must be fostered and developed. The quality of research and the ability and productivity of the persons conducting it are the decisive criteria for funding. Additional funding is provided for those priority research fields which are set up to be interdisciplinary in nature and whose development plans have undergone external evaluation in the last two years.

In response to ever-growing challenges, Rhineland-Palatinate has built new research structures and facilities and expanded existing ones. Specifically targeted funding programmes and the construction of new buildings for research activities are putting the *Land*'s universities in a position to play their part in meeting these challenges. The non-university research system is being supplemented and expanded on a targeted basis, particularly in highly promising areas.

Application-oriented research centres were set up at locations which already offered the requisite structural conditions. These facilities were established to satisfy the demand for research and development services in important fields of technology, encourage the relocation of existing companies and the founding of new companies in these fields through their selective development of key technologies, and open up established companies to these new technologies.

In order to foster research, the transfer of knowledge and technology, and co-operative ventures at structural level, Rhineland-Palatinate set up an *Education Network* in 1997 as part of a *Land*-wide network. The Education Network links all institutions of higher education in Rhineland-Palatinate with one another. It has also been contractually agreed that it will serve as a feeder to the German Research Net's gigabit network in the future. It will be upgraded to 155 megabits for this purpose. Rhineland-Palatinate also continues to observe the rule that its scientific institutions should have more than sufficient bandwidth at their disposal in order to avoid capacity bottlenecks.

One important priority in Rhineland-Palatinate's technology promotion plan is to *foster the broad-based transfer of knowledge* between the *Land*'s universities, research centres and companies – a fundamental prerequisite for translating scientific findings into innovative products, processes and services. The knowledge and know-how that the experts at the *Land*'s universities and research institutes have to offer must be teamed up with the practical experience found at enterprises and then put to use to develop marketable solutions. The technology exchanges that have been set up at all of Rhineland-Palatinate's universities and chambers constitute an important link between university research and development facilities and enterprises. In addition to the activities of these agencies, the Innovation Relay Centres in Mainz and Trier and the Euro Info Centre in Trier offer similar services, particularly in connection with EU schemes.

2. University and non-university research

Rhineland-Palatinate's universities have developed distinct profiles and specialised priorities in individual fields of science. The following examples taken from this wealth of important research activities revolve primarily around technology-oriented priorities.

Special priorities at the *University of Kaiserslautern* include computer science, solid-state physics, food chemistry, environmental toxicology, laser development and application, technomathematics, recycling, biotechnology, medical physics and engineering, and industrial engineering.

At the *Johannes Gutenberg University of Mainz*, a special role is played not only by atomic physics, nuclear physics and chemistry but also by materials research, interdisciplinary scientific-medical research, research into forest damage and ecosystems, research into the mechanisms of tumour defence and its therapeutic implications, cardiovascular and transplantation research, allergy research and research into inflammatory processes. Looking at the humanities and social sciences, special mention is to be made of economic theory and policy, Kantian studies, media impact research, psychological anxiety and stress research, the drama and theatre fields, and research on cultural contacts.

One of the hallmarks of the *University of Trier's* science profile is its Europe-oriented research which involves several research institutes, professorships for European law and economic policy and a collaborative research centre entitled Between the Rivers Maas and Rhine. A new collaborative research centre which looks into the issue of Environment and Region has been set up at the University, validation of its special interdisciplinary approach to environmental research. Further areas of focus include information and communication, women's and gender studies, health research and contemporary East Asia studies.

The *University of Koblenz-Landau* directs special attention to the areas of computer science, education and psychology. Topical priority research fields include software engineering, artificial intelligence, image recognition, computer linguistics, computer science in the social sciences and economics, education research, evaluation research, intercultural education, communications psychology and media didactics.

Rhineland-Palatinate's *Fachhochschulen (universities of applied sciences)* are developing and expanding their programme and development priorities in technical subjects, with laser and fibre optics technology, biotechnology, waste disposal technology, microelectronics, data technology, special materials (glass and ceramics) and polymer technology playing an important role, to cite just a few examples. Existing centres such as the telecommunications centre at the Worms University of Applied Sciences, the Institut für Mediengestaltung und Medientechnologie (Institute for Media Design and Media Technology) at the Mainz University of Applied Sciences and the Ostasieninstitut (East Asia Institute) at the Ludwigshafen University of Applied Sciences and the recently founded Transatlantik-Institut (Transatlantic Institute) at the Ludwigshafen und Worms Universities of Applied Sciences are of particular importance.

The *Wissenschaftliche Hochschule fur Unternehmensfuhrung Koblenz (Otto Beisheim Graduate School of Management)*, a private, state-accredited institution with university status in Vallendar, has broadly ramified research expertise in the SME field.

The *Akademie der Wissenschaften und der Literatur (Academy of Sciences and Literature) in Mainz* gives special priority to long-term, interdisciplinary basic research activities. Fields range from researching cuneiform script to producing major musicological dictionaries and editions all the way to climate impact research. The Academy's activities are jointly funded by the Federal Government, *Länder* governments and external sources.

The *Deutsches Forschungszentrum für Künstliche Intelligenz GmbH Kaiserslautern/Saarbrücken (German Research Centre for Artificial Intelligence)* in Kaiserslautern and Saarbrücken focuses on properties of the human mind that involve intelligence and cognitive abilities. This centre is working on new types of computer programmes with problem-solving abilities that are patterned after humans.

The Federal Government, the governments of Rhineland-Palatinate and Saarland, and the companies involved have established the material conditions necessary for this work.

The *Institut für Verbundwerkstoffe GmbH (Institute for Composite Materials)* has the task of researching and developing technical and potential applications for composite materials. Focal areas include component dimensioning, processing and joining with other materials, fracture behaviour, the development of new and the refinement of known testing methods, and parameter identification and optimisation.

Established in 1996 and still overseen by the Fraunhofer Management GmbH, the *Institut für Techno- und Wirtschaftsmathe-*

matik (Institute for Industrial Mathematics) focuses on mathematics as a technology for solving technical, organisational and economic problems. The Institute was evaluated in 1999 by an external review group whose members included representatives from the science community and the business enterprise sector.

Also established in 1996, the new *Institut für Experimentelles Software-Engineering (Institute for Experimental Software Engineering)* became the first Fraunhofer Institute located in Rhineland-Palatinate when the Fraunhofer Society's Senate voted to admit the Institute to its organisation in October 1999. It will be jointly financed by the Federal Government and the *Länder* governments beginning January 1, 2001. The Institute's objective is to help companies in all sectors set up certifiable software development processes.

The *Europäische Akademie zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen Bad Neuenahr-Ahrweiler (European Academy for Research into the Effects of Scientific/ Technical Developments Bad Neuenahr-Ahrweiler)* – also founded in 1996 – studies the effects that future scientific and technological developments will have in Europe and conveys the knowledge and know-how from this area to interested parties in the political, business and scientific communities. The Academy is funded by Rhineland-Palatinate and the German Aerospace Centre.

Founded in late 1997, the *Institut für Telematik e.V. (Institute for Telematics)* in *Trier* has dedicated itself to oriented basic research and to providing consultancy services in all areas of telematics.

The *Institut für Biotechnologie und Wirkstoff-Forschung* e.V. (*Institute for Biotechnology and Drug Research*) in *Kaiserslautern* was established in 1998 and continues to be operated by the Fraunhofer Management GmbH. This institute focuses on fostering oriented basic research in the areas of biotechnology and drug research.

The *Forschungsinstitut für Anorganische Werkstoffe – Glas/ Keramik GmbH* (*Research Institute for Inorganic Materials – Glass/ Ceramics)* in *Höhr-Grenzhausen* gives special attention to assisting companies belonging to the ceramics industry in Rhineland-Palatinate's Westerwald area. Another example of collaboration between industry and science is the *Forschungsinstitut für Mineralische und Metallische Werkstoffe – Edelsteine/Edelmetalle* (*Research Institute for Mineral and Metallic Materials – Precious Stones/Precious Metals)* in *Idar-Oberstein*.

The *Institut für Oberflächen- und Schichtanalytik (IFOS – Institute for Surface and Thin Film Analysis)* in *Kaiserslautern* works in the field of materials and surface engineering while the *Institut für Mikrotechnik (IMM – Institute for Microtechnology)* in Mainz focuses on the innovative field of microtechnology. Both institutes have developed into important partners for enterprises that want to become involved in these new fields of technology.

By establishing the *Zentrum Grüne Gentechnik (Centre for Green Gene Technology*) at the government's Lehr- und Forschungsanstalt (Teaching and Research Institute) in *Neustadt an der Weinstraße*, Rhineland-Palatinate has made a contribution to fostering the use of the opportunities that this advanced technology has to offer in the agricultural field, using collaborative ventures between science and industry which will contribute to the positive development of Rhineland-Palatinate and regions beyond its borders.

Established in response to an initiative on the part of the industry, the *Zentralinstitut der Arzneimittelhersteller GmbH (Central Institute of Drug Manufacturers)* in *Sinzig* augments existing institutes.

3. The promotion and transfer of technology

Rhineland-Palatinate's Ministry of Economics, Transport, Agriculture and Viticulture focuses its efforts in the technology funding area primarily on supporting innovation processes that aim at enhancing the competitive strength of SMEs in particular. With this objective in mind, the government of Rhineland-Palatinate has developed the following four priorities:

- Building up and expanding an application-oriented research infrastructure;
- Supporting the transfer of knowledge between Rhineland-Palatinate's universities, research centres and commercial enterprises;
- Promoting the founding of innovation-oriented companies;
- Assisting small and medium-sized enterprises with the development of new products, processes and services and with their introduction into the market.

Twenty specialised, application-oriented transfer agencies have been set up at Rhineland-Palatinate's universities and Fachhochschulen to increase the transfer of knowledge. The services they offer range from the provision of consultancy services for contract research all the way to tasks which would be comparable to those performed by spin-out research and development departments. These agencies could be described as marketing platforms for the research work being done by the *Land*'s universities.

Rhineland-Palatinate has special instruments at its disposal for fostering collaboration between research centres and companies. These are the Industry-Related Research programme (which is aimed at supporting collaborative projects between research institutes and enterprises), the Innovation Assistant personnel transfer programme and the comprehensive Technology Consultancy programme.

One important pillar in *Rhineland-Palatinate's conceptual plan for fostering innovation-oriented start-ups* is a network consisting of four technology centres and a Business and Innovation Centre (BIC). This is augmented by special instruction offered for entrepreneurs in several of the *Land*'s university towns, such as the Institute-Supported Start-Ups pilot project which was specifically designed to prompt the hiving off of new companies from university and non-university research institutes. The Federal Ministry of Economics and Technology bears half the cost of this project which helps not only the particular entrepreneur starting up the new company that has been hived off but also the efforts the respective research institute makes in its capacity as consultancy agency.

And lastly, as part of its fourth priority – that of *assisting small and medium-sized enterprises with the development and launch of new products, processes and service*s – Rhineland-Palatinate's Ministry of Economics, Transport, Agriculture and Viticulture has developed a set of programmes that include funding measures which start during the definition phase and extend to industrial research through pre-competitive development all the way to pilot and demonstration projects.

These measures specifically target six fields of technology – key technologies – which have good chances of developing well in Rhineland-Palatinate, such as

- Biotechnology and genetic engineering
- Microtechnology and precision engineering

– Materials engineering and surface technology
– Information and communications technology
– New production techniques and
– Energy technology and environmental engineering.

Based on the structures that already exist in the *Land*, the government of Rhineland-Palatinate is pooling and implementing measures in each of these individual fields of technology.

In light of the fact that telecommunications markets are among the fastest-growing segments of the economy, the government of Rhineland-Palatinate launched a *Land*-wide multimedia initiative called Rhineland-Palatinate Inform which merged the *Land*'s broad range of multimedia projects, facilities and services. Together with companies, organised interest groups, educational institutions and research facilities, it has been possible to build a network of competent partners for innovation in this area in Rhineland-Palatinate.

Similar initiatives are currently being implemented in the fields of biotechnology, microtechnology, materials engineering and surface technology.

4. International co-operation

All of Rhineland-Palatinate's institutions of higher education are involved in cross-border co-operation with the neighbouring countries France and Luxembourg. One example of this co-operation in its institutionalised form is the Charte de Co-opération Universitaire in which 12 universities in the Saar-Lor-Lux-Trier-Western Palatinate region are involved. On Rhineland-Palatinate's side, these institutions are the University of Trier, the University of Kaiserslautern, the Trier University of Applied Sciences and the Kaiserslautern University of Applied Sciences. Rhineland-Palatinate finances a LEONARDO contact office which looks after and implements projects under the European Union's LEONARDO programme.

Initiatives launched by research institutes such as the Institut für Mikrotechnik Mainz (Mainz Institute for Microtechnology) have led to a number of measures aimed at incorporating small and medium-sized enterprises into the transfer of knowledge in Europe. The Investitions- und Strukturbank Rheinland-Pfalz (ISB – Investment and Structural Development Bank of Rhineland-Palatinate) and the Institute for Microtechnology are also helping set up EU liaison offices.

5. Other programmes and measures implemented by the government of Rhineland-Palatinate

Various priority fields are being funded at Rhineland-Palatinate's higher education institutions through the two budget chapters *New Technologies and the Environment* and *Interdisciplinary Research in the Humanities and Social Sciences*. The research centres and priority research fields that have been established with the help of this long-term targeted funding were evaluated on an external basis in order to examine these centres' particular specialisation, evaluate the quality of the research being conducted there and obtain recommendations for their future work.

The *Stiftung Rheinland-Pfalz für Innovation (Rhineland-Palatinate Foundation for Innovation)* which the government of Rhineland-Palatinate founded in late 1991 also works to promote scientific and technological development in the *Land*. The funding provided by this Foundation focuses on basic and application-oriented research projects, new technologies and the transfer of scientific findings to industry in Rhineland-Palatinate. To date, the Foundation has been able to selectively assist a large number of projects in areas which are particularly in the *Land*'s interest. Its funding measures concentrate on fields which are considered to have good chances of doing well in Rhineland-Palatinate.

In the years since 1994, all funding for research and teaching has been apportioned among the *Land*'s universities on the basis of set criteria. Thirty per cent of this funding is granted according to the individual university's relative share of external funding. This method is an effective incentive for universities to raise external funds for their research activities. Staffing positions are also allotted according to criteria which take into account teaching load on the one hand and special accomplishments in research work on the other (collaborative research centres, research priorities, attracting external funding, etc.).

The *Klinikum der Johannes-Gutenberg-Universität (University Hospital at the Johannes Gutenberg University of Mainz)* will be converted into an institution under public law as of January 1, 1998 pursuant to a *Land* law from January 1, 1997. This legislation is aimed at separating the financing of research and instruction from the financing of health care services because of their funding sources. The University Hospital will be assigned not only financial but also personnel, planning and construction responsibility. This move will strengthen the School of Medicine and its dean. It will also make it possible to avoid with certainty any undue mixing of financial resources in the future and consequently ensure the economic foundation for clinical research and teaching.

Literature

– Research database:
httpp//ww.mnww.rlp.de/Wissenschaft/Hschul.Html
– Brochure "Forschung, Technologietransfer und Innovation in Rheinland-Pfalz", January 1999, published by the Minister of Economics, Transport, Agriculture and Viticulture of Rhineland-Palatinate and the Minister of Education, Science and Continuing Education of Rhineland-Palatinate
– Brochure "Wirtschafts- und Agrarförderung 99", 17th edition, April 1999, published by the Minister of Economics, Transport, Agriculture and Viticulture of Rhineland-Palatinate
– The Ministry of Economics, Transport, Agriculture and Viticulture of Rhineland-Palatinate on the Internet: http//mwvlw-sms1/start/index.asp
IMG: http//www.img-mainz.de
Multimediainitiative Rheinland-Pfalz inform: www.rlp-inform.rlp.de.

12. Saarland

1. Underlying principles and priorities of research and technology policy

Research, development and the use of new technologies are decisive factors in Saarland's continued transition to being a competitive location for science and industry. One of Saarland's primary objectives is to foster close collaboration between science and industry so that research findings are promptly and continuously put to use in the development of new products, processes and services and so that new jobs are created in future-oriented fields.

By *building and expanding an application-oriented research infrastructure*, Saarland has laid the *foundation for the modernisation of its economy* within the course of ten years. The government's *integrated science and industry policy* fosters – with the involvement of all forces of society – the *systematic use of this research capacity* via an intensive, broad-based transfer of knowledge and technology to enterprises.

Further plans for Saarland's research and technology policies are based on recommendations issued by the *second Expert Commission on Research, Technology Transfer and Jobs* in its final report dated March 1996 and the *Saar Memorandum* which was adopted as part of a joint initiative in September 1997. The Saar Memorandum's structural concept for the research and technology transfer fields draws upon and moves forward from the report published by the Expert Commission and the research and development priorities cited therein. The *objective* behind this work is to develop Saarland into a *modern location for industry and services which is oriented to Europe and technology*.

Priority research fields are concentrated primarily in the areas *materials science, computer science, information and communications technology, electrical engineering, microelectronics, medical technology, environmentally compatible process engineering, and innovative product and production technologies*. In its funding of future-oriented priority fields, Saarland's focus is on pooling expertise in selected fields of research in the *biotechnology* arena, particularly in the areas of biohybrid systems and biologically composed materials.

Particular attention is paid to stepping up the establishment and expansion of collaborative science and research structures in the *Greater Saar-Lor-Lux-Trier/Western Palatinate Region*. Priority goals include regional, cross-border information and communications structures and the *pooling of resources* via joint study programmes, research projects and technology developments, all pursued with a view to *forming a European core region.*

Saarland's long-standing relations with its neighbour France have given rise to what could be called "*expertise in matters relating to France*" which has become one of the *Land*'s hallmarks. This is evidenced by a number of binational study programmes and degrees offered by the Universität des Saarlandes (Saarland University), the only German university to be a member of the Association of French-Speaking Universities (AUPELF). Established back in 1978, the *Deutsch-Französisches Hochschulinstitut für Technik, Wirtschaft und Wissenschaft (DFHI/ISFATES – Franco-German Institute of Higher Education)* is jointly run by the Université de Metz (University of Metz) and the Hochschule für Technik und Wirtschaft des Saarlandes (Saarbrücken University of Applied Science). Thanks to its newly revamped programme structure, DFHI continues to be a model for Franco-German university co-operation. This co-operation is manifested by the Charte de Co-opération which bands together all universities in the Saar-Lor-Lux region and the Trier/Western Palatinate area.

Saarbrücken's selection as the administrative headquarters of the *Deutsch-Französische Hochschule (DFH – Franco-German University)* confirmed the special role that Saarland plays in Germany's bilateral university co-operation with France. The Franco-German University is a modern service facility which is sponsored by French and German institutions of higher education. It offers a variety of programmes in teaching, research and training of young scientists. Future graduates will be able to earn a binational degree from a participating partner university or a degree from the DFH itself.

2. University research

Saarland has eight universities that offer an extensive range of high-quality scientific, technical and art-related courses of study: the Saarland University, the Hochschule für Musik und Theater Saar (College of Music and Drama), the Hochschule der Bildenden Künste Saar (Academy of Arts Saarbrücken), the Hochschule für Technik und Wirtschaft des Saarlandes (University of Applied Sciences Saarbrücken), the Franco-German University that is currently being set up, and three other universities of applied sciences. The *Land*'s higher education institutions employed a total of 9,218 persons (3,604 in science or arts fields) in 1998. University medical centres accounted for 5,456 of this number (including 1,243 in the science field).

An overview of *research activities at Saarland University* is available at the Internet address http://www.uni-sb.de/ Forschung.html. The Saarbrücken University of Applied Science offers information at its homepage http://www.htw-saarland.de. For further information on the *range of research activities pursued by non-university research institutes* see section 3 below or the Internet address http://www.uni-sb.de/Sonstige.html. Information on Saarland's research infrastructure can be found in the German-language *brochure "Innovatives Saarland"* (5th edition 1999, available through the Zentrale für Produktivität und Technologie Saar e.V., Franz-Josef-Röder-Straße 9, 66119 Saarbrücken, Germany, Tel.: +49-681-9520 470, Fax: +49-681-584 6125) or the *Abschlussbericht der Sachverständigenkommission Forschung, Technologietransfer, Arbeit (Final Report of the Expert Commission for Research, Technology Transfer, and Labour)* which was issued in March 1996 (available through the Ministry of Education, Cultural Affairs and Science, Hohenzollernstr. 60, D-66117 Saarbrücken, Germany, Tel.: +49-681-5030, Fax: +49-681-503 291). This report contains an assessment of Saarland's research infrastructure and recommendations for its further development.

At present, Saarland University has *four collaborative research* *centres* which are conducting work in the fields social and environmental sciences, materials science and theoretical medicine. A collaborative research centre looking into Spatio-Temporal Interactions of Cellular Signalling Molecules (theoretical medicine) was established in 1999. The University also has *six postgraduate research groups* working in the areas of computer science, cognitive science, materials science, and modern linguistics and literary studies. First-time approval was also granted for postgraduate research groups on Cellular Regulation and Growth (medicine) and Physical Methods (especially Mass Spectroscopic) in the Structural Research of Novel Materials (materials science, a European postgraduate research group in which Germany, France and Luxembourg participate).

Saarland enjoys a *special concentration of expertise* in the computer science field with Saarland University's department of computer science, the Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI – German Research Centre for Artificial Intelligence), the Max-Planck-Institut für Informatik (MPI – Max Planck Institute for Computer Science), the Institut für Wirtschaftsinformatik (IWI – Institute for Information Systems) , the Institut der Gesellschaft zur Förderung der angewandten Informationsforschung e.V. (IAI – Institute of the Society for the Promotion of Applied Information Sciences), the Internationales Begegnungs- und Forschungszentrum für Informatik Schloß Dagstuhl GmbH (IBFI – International Conference and Research Centre for Computer Science), a transfer centre dealing with Runtime Guarantees for Modern Architectures by Abstract Interpretation (which developed out of the collaborative research centre looking into Very Large Scale Integration (VLSI) – Design Methods and Parallelism), the Computer Science postgraduate research group plus an interdisciplinary collaborative research centre and another postgraduate research group in the area of cognitive science in conjunction with computer science.

Looking at the field of *materials science*, the School of Materials Science and Production Engineering at the department of technology which Saarland University established in 1990, and the Institute für Neue Materialien (INM – Institute for New Materials), the Anwendungszentrum Neue Materialien für die Oberflächentechnik (NMO – Application Centre New Materials for Surface Engineering) and the collaborative research centre stuying Materials Determined by Boundary Effects, the postgraduate research group looking into the Fundamentals and Technology of New High-Performance Materials and the European postgraduate group on Physical Methods in the Structural Research of Novel Materials constitute a further *concentration of core expertise*. This focus is further strengthened by the participation of scientists and research centres from Saarland in three of the six Nanotechnology for New Materials centres of excellence which the BMBF funds.

Saarland's universities and research institutes *raise external funding* to augment research funding provided by the government of Saarland. Great importance is attached to the raising of external funding which is considered to be an important component in the transfer of innovation and technology and a major factor in science and industry's efforts to develop solutions on a joint basis. The external funding recruited by *Saarland University* in 1998 totalled some DM 53 million (please refer to section 3 below for further information on non-university research institutes).

In its 1998 report, an expert commission set up by Rhineland-Palatinate and Saarland outlined sources of vital impetus for the *further development of the region's universities*. Following up on this report, Saarland passed the *Act to Reform Saarland's Legislation Governing Its Higher Education Sector* in 1999. This new law focuses on *developing concentrations of expertise, strengthening the profiles* of Saarland's universities and *stepping up co-operation* in the region. *New features of this law which are of relevance to research* include, most importantly, that it has elevated the task of putting scientific findings to practical use to the status of a legally mandated task for the *Land*'s universities. Further, it introduced performance agreements, evaluation procedures and the allocation of funding on the basis of actual or predicted performance in research, and has established centres of excellence to serve as fora for the development and promotion of multidisciplinary research projects.

Arrangements for increased co-operation and the establishment of a regional network for courses of study and research were laid out in a framework agreement signed by the Universities of Kaiserslautern, Koblenz-Landau, Saarbrücken and Trier in July 1999. Plans to establish and expand a range of disciplines and courses offered via the Internet (virtual university) will also play a major role in the future.

3. Non-university research

The Internet pages at http://www.uni-sb.de/Sonstige.html offer an overview of the *range of research being conducted by non-university research institutes in Saarland*.

In the area of non-university research institutes, Saarland particularly links its research and technology policy to the *objectives associated with the modernisation of the regional economy as a location for industry and business* and to the actual shaping of structural change. *Generating impetus through research* – with the goal of developing a diversified, innovation-oriented corporate landscape – is of key importance. Saarland's non-university research facilities raised some DM 64 million in external funding in 1998.

The establishment of *demonstration and application centres* is a fundamental part of a plan to *build seamless research and development chains* to close existing gaps between basic research and the translation of research findings into marketable industrial products and to ensure the *broad use of the basic technologies that are already available at the Land's universities and research institutes.* These centres have the tasks of honing and developing these technologies with a view to potential applications and of developing necessary production technologies to the point where they can be put to use under practical conditions. This is accomplished by adapting the particular technology to the individual needs and requirements of the contracting enterprise and by training its employees in the use of these new technologies. Work on setting up a development and demonstration centre at the German Research Centre for Artificial Intelligence (DFKI) which targets the deployment of intelligent software technologies at SMEs was begun by these application centres (which were presented in the 1998 Facts and Figures report) in 1999. This new centre will focus its attention on the areas of logistics, environmental information systems, telework and teleco-operation, call centre automation, electronic commerce and Internet information services.

The development of the *Science Park* with its direct link to Saarland University also serves to further strengthen the transfer of technology in Saarland. The goal here is to offer attractive working conditions near the university for new R&D companies or the development departments of established companies and to intensify the dialogue between science and industry. Scheduled for completion in 2000, the first stage of construction at the Science Park has already attracted strong demand and given rise to plans to expand it. The concept behind the Science Park is being augmented and supported by an increase in the assistance being provided for *entrepreneurs from universities*. As a first step, this expanded assistance provides requisite infrastructure, services and guidance at the respective university. Following the start-up phase, participating entrepreneurs have the option of moving to the Science Park.

4. The promotion and transfer of technology

Trade and industry in Saarland have an *efficient network of technology transfer and consultancy agencies* with a wide range of quality services at their disposal with the Zentrale für Produktivität und Technologie e.V. (ZPT – Office for Productivity and Technology), the Kontaktstelle für Wissens- und Technologietransfer (KWT – Contact Office for Science and Technology Transfer) at Saarland University, the Institut für Technologietransfer (FITT – Polytechnic Institute for Technology Transfer) at the Saarbrücken University of Applied Science, the Technologietransfer-, Innovations- und Technologieberatungsdienst (T.IT. – Consultancy Service for Technology Transfer, Innovation and Technology) of the Saarland Chamber of Craft Trades and the Beratungsstelle für sozial-verträgliche Technologiegestaltung e.V. (BEST – Advisory Office for the Socially Acceptable Use of Technology). Saarland's *technology programmes* offer innovative small and medium-sized enterprises a wide variety of assistance options to help them boost their productivity and competitiveness. These include the Innovation Promotion programme which subsidises feasibility studies and research contracts, the Research and Technology programme, the Product Launch programme and the Innovation Assistant programme. In addition to this, Saarland has a special action programme to foster the founding of technology-oriented companies. The range of promotion activities is rounded out by grants for consultancy services for start-ups and for general business consultancy services and by a pilot scheme to increase patenting activities in Saarland. The *Starterzentren (Start-Up Centres) at the University* and the *Science Park* which is currently being set up are particularly important for the transfer of technology. One of the core areas of expertise at the *Science Park will be the biotechnology sector*. Saarland has implemented adjunctive action programmes to help step up the pace of this area's development. Further information on the promotion of technology in Saarland can be obtained from the *Ministry of Economic Affairs and Finance,* Am Stadtgraben 6 – 8, D-66111 Saarbrücken, Germany. Tel.: +49-681-501-00, fax: +49-681-501-1590. A variety of detailed information on policies, research and industry is also available on the Internet at http://www.saarland.de.

The *Land* Research Promotion programme is also aimed at increasing the transfer of technology from Saarland's universities and research institutes. Launched in 1998, this programme offers a framework for funding application-oriented research projects that are conducted in co-operation with – primarily small and medium-sized – enterprises. Information can be requested from the *Ministry of Education, Cultural Affairs and Science*, Hohenzollernstr. 60, D66117 Saarbrücken, Germany. Tel.: +49-681-5030, fax: +49-681-503 291.

5. International activities

The opening and interpenetration of markets that is part of the globalisation of science and industry increasingly necessitates the *establishment of research partnerships at international level*. For the government of Saarland, co-operative ventures between its universities and research centres on the one hand and foreign universities and research centres on the other offer important prospects for development which must be fostered and expanded with an eye to *integrating Saarland into new structures and networks* at both scientific and industrial level.

In addition to the developments presented in the 1998 Facts and Figures report, mention should also be made of the *European Centre for Product Innovation and Coatings* (EPC) which was established in 1999 as a joint venture between the Institute for New Materials (INM) and the Dutch research society TNO. The Centre's objective is to pool know-how and offer to industry a comprehensive range of services for innovations involving new coatings. This new service enterprise combines INM's international leadership in material development with TNO's broad technology resources to give industrial customers tailor-made integrated solutions for their innovations, solutions which range from the development of new high-tech materials all the way to actual production applications and the requisite production technology.

The Fraunhofer-Institut für Biomedizinische Technik (IBMT – Fraunhofer Institute for Biomedical Engineering) has collaborated with the Institute for Microelectronics in Barcelona, Spain, since 1998 in sponsoring the *Europäisches Kompetenzzentrum für biomedizinische Mikrokomponenten, -instrument und -techniken (MEDICS – Competence Centre for Biomedical Microsystems)*. Working together in a network, these two institutes help small and medium-sized enterprises in Europe translate microtechnology-based product ideas into medical products. The IBMT's increasingly globalised activities are also manifested by the establishment of the Fraunhofer Technology Centre China (FteCC) in Shenzhen, China.

Saarland's universities and research institutes are internationally active in a growing number of research projects with both European and non-European partners. The homepages of the various institutions offer a survey of the co-operative ventures being pursued (see sections 2 and 3 above for Internet addresses).

Literature

Cited in the above text.

13. Free State of Saxony

1. Underlying principles and priorities of research and technology policy

Economic growth and the creation of jobs that will be able to survive the changes of the future are increasingly founded on the rapid introduction of new products and technologies. Only international-quality science can generate these products and technologies, and only highly trained people can produce them and put them to use. Science and research also make an indispensable contribution to social stability and the cultural foundations of society. They have a very strong impact on the quality of a location and consequently constitute a decisive factor in safeguarding economic viability on a lasting basis. The government of Saxony acts on the basis of this premise, drawing on a solid tradition and on the results of the research and technology policies it has pursued to date. The Free State of Saxony already has a productive and diverse science system. The *Land*'s universities and non-university research centres are home to some of Saxony's most important innovation capability. The primary goal of Saxony's science and research policy in the future will be to safeguard and stabilise the successful work done to date towards building up science and research in the *Land*. Moreover, it will be important to further develop Saxony's science structures by setting regional and sectoral priorities, interlinking them with one another and with industry, and by supplementing them with new, innovative research structures. The government of Saxony is taking the following steps to reach these goals:

– Fostering outstanding achievement in the area of basic research;
– Supporting close collaboration between universities, non-university research institutes and industry;
– Fostering local centres of excellence;
– Fostering competition within the science system;
– Boosting the competitiveness of the Free State's universities and facilities on the external funding market;
– Building up a modern research infrastructure.

Saxony's universities are the primary players in a research process which is based on a division of labour. Ever shorter innovation cycles are bringing basic research, applied research and development closer to one another and are leading to an increased overlapping of the research fields occupied by the Free State's universities and non-university research institutes. This brings not only more intensive competition, but also opportunities for productive co-operation. One of the fundamental goals of Saxony's science policy is to steer and guide this process through the use of suitable infrastructure and personnel measures.

Saxony's universities and non-university research institutes are linked at staffing level through more than 30 appointments which they have made jointly. Large research networks – particularly in the areas of materials research, environmental engineering, biotechnology and medicine – provide another cornerstone for collaborative research activities.

The government of Saxony is also endeavouring to further improve the general conditions for industrial and industry-related research through its technology policy. In this connection, a focus on key fields of technology will not only generate impetus for the creation of new, future-proof jobs in high-tech fields, it will also increase on a long-term basis the competitive strength of industries which have traditionally been located in Saxony. The research capabilities of the companies in Saxony are to be closely and yet flexibly interleaved with the Free State's entire research and development infrastructure in order to facilitate the exploitation of scientific findings. Measures in the following areas have been planned on the basis of the Guidelines for Technology Policy in the Free State of Saxony (see also the report "Wirtschaft und Arbeit in Sachsen 1997" [Economy and Labour in Saxony 1997] and the "FuE-Handbuch Sachsen 1996" [R&D Handbook for Saxony] published by the Saxon Ministry of Economic Affairs and Labour):

– Taking steps to further organise and develop the industry-related research and development infrastructure;
– Fostering the development of new products and processes;
– Supporting the transfer of technology.

2. University research

The 14 universities falling under the purview of the Free State's Ministry of Science and the Arts and the Internationales Hochschulinstitut Zittau (IHI – International University Institute Zittau) are the main planks in Saxony's research system. They are also the most important places for basic research in Saxony. The universities' 18,870 budgeted posts and the some 3,800 externally-funded employees at the Free State's universities and the medical schools at the Technical University of Dresden and the University of Leipzig form a solid foundation for productive education and research. The Free State of Saxony allocated approximately DM 1.6 billion in *Land* funding to finance its universities and university medical centres in 1998. The tasks that university research is to fulfil have changed over the past several years and are increasingly defined by industry and society. As a result, the spectrum of university research being conducted in the Free State of Saxony has become more ramified and now ranges from areas of basic research all the way to applied research and the performance of research and development contracts for industry. In response to this situation, the government of Saxony made the transfer of knowledge and technology and the provision of continuing education one of the primary responsibilities of the universities in the amended Act on Higher Education of June 11, 1999.

Priorities and guidelines for university research in Saxony were laid down in a university development plan in 1997; they were subsequently evaluated and updated by the University Development Commission which the government of Saxony set up in 1999.

Saxony's universities are increasingly successful in attracting external funding – which is not only an additional source of revenue but also evidence of their competitive strength. The amount of funding received from the Deutsche Forschungsgemeinschaft (DFG) in particular provides a yardstick for comparing the performance of the various players in the German research arena. Today, Saxony's universities host 12 collaborative research Ccentres, 22 postgraduate research groups and six DFG-funded centres of excellence. External funding for the Free State's universities totalled some DM 286 million in 1998.

Saxony's Fachhochschulen (universities of applied sciences) are also required by law to conduct applied research that is geared to actual practice. This does not however challenge the primacyof teaching. This type of applied research particularly serves to ensure quality training, progress in generating findings in various areas of applied science, and the transfer of knowledge and technology to industry. The findings generated by this work will particularly benefit the region's innovative SMEs. Section 104 of the Act on Higher Education requires Saxony's universities of applied sciences to pursue their research tasks primarily at the research centres they have established.

Saxony fosters the research work being conducted at its institutions of higher education by providing additional financing for priority fields and by granting its own financial assistance for projects. The additional funding concentrates on strengthening the basic funding and outfitting of collaborative research centres and postgraduate research groups and on fostering special structures for research in areas which determine the respective university's individual profile. Project funding serves to boost co-operation between universities, non-university research centres and enterprises, foster the creation of additional jobs which are financed with external funds, improve university endowment with equipment, and increase the individual university's competitiveness in attracting external funding. In the years since 1992, the Ministry of Science and the Arts has authorised a total of 130 basic research projects with an aggregate funding volume of DM 29.3 million. These projects dealt primarily with materials research, environmental research and microelectronics. Saxony also provided project funding for scientific conferences and visits from East European scientists. In the applied sciences field, the Ministry grants project funding for "Innovative Research" and has authorised a total of 78 projects in the higher education sector with an aggregate funding volume of some DM 21.7 million since 1997.

3. Non-university research

In addition to the core research being conducted at its universities, Saxony also has a non-university research system whose individual elements handle a variety of different tasks.

The Ministry of Science and the Arts presently oversees more than 50 non-university research institutes, including 20 institutes which are jointly funded by the Federal Government and the government of Saxony. Together, these institutes had some 2,700 posts and nearly 1,300 externally-financed employees in 1998. Saxony provided DM 222 million in core funding in 1998, while the Federal Government allocated approximately DM 263 million. All in all, these institutes raised some DM 127 million in external funding. With its Umweltforschungszentrum Leipzig-Halle GmbH (UFZ – UFZ Centre for Environmental Research Leipzig-Halle) – a member institute of the Hermann von Helmholtz Association of German Research Centres – Saxony now has six Max Planck Institutes, ten Fraunhofer institutes and seven Blue List institutions. These institutes that are financed jointly with the Federal government and other *Länder* governments are described in greater detail in Part VI – Funding Organisations, Research Organisations and Research Institutions in Germany. They are augmented by 11 institutes (which are funded solely by Saxony or jointly with the Federal Government) and by a diversified network of non-university structures which efficiently strengthen the ties between science and industry. These bodies include in particular the five research centres at Saxony's universities of applied sciences and 16 institutes that are affiliated with a university (so-called affiliated institutes). In 1997 and 1998, the Ministry of Science and the Arts allocated a total of some DM 19 million in funding for these five research centres and the Free State's seven industry-related affiliated institutes alone.

In addition, there are the institutions, agencies and research facilities which are the responsibility of Saxony's Ministry for the Environment and Agriculture and Ministry for Social Affairs, Family, Youth and Health. These include the Forschungsinstitut für Balneologie und Kurortwissenschaften (Balneology and Spa Medicine Research Institute) which employs 15 people and has a budget of approximately DM 1.8 million.

A fundamental part of the industry-related research and development infrastructure that falls under the purview of Saxony's Ministry of Economics and Labour is a group of 40 research companies with limited liability. Through 1998, these facilities received a total of some DM 137.5 million in funding from this ministry (allocations for the period 1991 through 2001). The 16 non-profit research companies with limited liability were evaluated in 1999. The findings of these evaluations will contain information regarding the effectiveness of current and future funding measures.

Saxony has completed its establishment of non-university research facilities in the humanities field. In addition to the Sächsische Akademie der Wissenschaften zu Leipzig (Saxon Academy of Arts and Sciences in Leipzig), Saxony is home to the Hannah-Arendt-Institut für Totalitarismusforschung e. V. (Hannah Arendt Institute for the Study of Totalitarianism) which is affiliated with the Technical University of Dresden, the Institut für Sächsische Geschichte und Volkskunde e. V. (Institute for Saxon History and Folklore), the Simon-Dubnow-Institut für jüdische Geschichte und Kultur e.V. (Simon Dubnow Institute for Jewish History and Culture), the Sorbisches Institut e.V./Serbski institut (Sorbian Institute) in Bautzen, the Tanzarchiv Leipzig (Leipzig Dance Archive) and the Geisteswissenschaftliches Zentrum für Geschichte und Kultur Ostmitteleuropas e.V. (Centre for the History and Culture of Central Europe). Saxony allocated approximately DM 10 million for these institutions in 1998. A further DM 5 million in external funding was also raised (appropriations for the period 1991–2001).

The 97 posts that are financed with budget funds are supplemented by 74 employees whose positions are financed through external funds. Being of national-level scientific interest, the programme of the Saxon Academy of Arts and Sciences in Leipzig (with currently 17 long-term projects) is jointly funded by the Federal and *Länder* governments. The close co-operation that has developed between the Academy and the Free State's universities is ensured by the joint appointment of an individual to serve concurrently as a university teacher and as the director of a research institute.

Saxony has been using funds from the European Union's Structural Fund since 1995 to further improve the Free State's research infrastructure. In 1994, Saxony's cabinet established the conditions necessary for this by partially de-coupling Structural Fund financing from the funds allocated to implement the Federal and *Länder* governments' joint task – as prescribed by the constitution – of improving regional economic structures. The objective of this move was to build up concentrations of research and technology in various areas. The Ministry of Science and the Arts had a total of DM 155 million at its disposal for these funding measures for the period 1995 through 1999.

Saxony's non-university research centres also make intensive use of the Ministry of Science and the Arts' options for project funding. To date, the Ministry has provided some DM 62.4 million in funding for a total of 223 research projects involving basic research. In the area of Innovative Research, it has approved a total of 52 projects at non-university research centres with an aggregate financing volume of approximately DM 14.4 million.

4. The promotion and transfer of technology

Drastic personnel cuts between 1989 and 1994 reduced the number of persons conducting research in the industrial sector to some 17 per cent of the pre-1989 level. It can now be assumed that a consolidation process has set in. The degree to which this process moves forward depends largely upon the stability and collaborative ability of the Free State's industrial structure which is primarily shaped by its SMEs. Saxony accounted for some 3.5 per cent of Germany's aggregate industrial research capacity in 1995.

Funding for the development of new products and processes focuses on the advanced technologies outlined in the Guidelines for Technology Policy in the Free State of Saxony. This funding is viewed as a supplement to the funding measures provided by the German government and the European Union. Research and development projects are funded as projects that are conducted by individual companies or as joint projects that are implemented by non-university research centres, commercial enterprises and university-based research groups. The government of Saxony approved a total of DM 410.6 million in funding for 619 projects at individual companies and DM 285.1 million for 321 collaborative projects through the end of 1998. Further incentives for collaborative projects are to be created as part of the Centre for Development and Innovation (CDI) initiative. Under these projects, companies are to make equipment available for collaborative ventures between SMEs and research institutes and possibly participate themselves in the research and development work being conducted.

Located throughout the Free State of Saxony, the 42 technology parks that fall under the purview of the Ministry of Economics and Labour support the transfer of technical knowledge and expertise that has been acquired by the Free State's universities and research institutes to commercial enterprises. A total of some DM 69.6 million was approved over the period 1992 through 1998 for the work of these facilities.

The Patent Information Centres at the Chemnitz University of Technology and the Dresden University of Technology are jointly funded by Saxony's Ministry of Science and Ministry of Economics (with the latter approving DM 636,000 through the end of 1998). In addition, the Technologieagentur für Innovationsförderung und Technologietransfer GmbH AGIL (AGIL – Technology Agency for the Promotion of Innovation and Transfer of Technology) which is funded by Saxony's economics ministry and the Federal Ministry of Economics will also be operating a patent information office in Leipzig.

Other funding measures in the technology field facilitate the hiring of innovation assistants, the application for patents in other countries and the introduction of new technologies. The Innovation Assistant programme with a total of DM 15.5 million in approved funding for the years 1996 through 1998 constitutes the main focus here. Saxony's Ministry of Economics has been funding the *Business Development Centre Sachsen* (BDCS) – a joint venture founded by six technology parks and business incubators in Saxony and by Daimler Chrysler Aerospace AG – with an eye to assisting technology-oriented entrepreneurs. By early 1999, the BDCS procedure (whose hallmarks are selection, qualification, guidance and assistance with financing) had resulted in the founding of 31 innovative companies with a total of 212 employees. These measures are further supplemented by a project which the Seed Capital Brandenburg GmbH launched to strengthen the start-up-phase financing of technology-oriented companies in Saxony. Within the framework of this project, Seed Capital Brandenburg is now offering seed-phase investments in the technology field and providing management support through its branch office in Dresden.

5. International co-operation

Saxony's strong interest in international collaborative research activities is evidenced by the more than 400 international partnerships cultivated by Saxony's universities and the many international collaborative ventures and research contacts which the Free State's individual scientists pursue, also in the non-university research field. Saxony's good links to scientists in the countries of Central and Eastern Europe and the Commonwealth of Independent States makes the Free State of Saxony a kind of hub between these countries and Western Europe, a role that brings both opportunities and responsibilities. In this connection, Saxony makes intensive use of the funding opportunities offered by the various European research funding programmes. During the Fourth Framework Programme on Research which ran from 1994 through 1998, it was possible to attract DM 44 million for work being done under the purview of the Ministry of Science and the Arts. The first call for applications to the Fifth RTD Framework Programme led to DM 24 million in external funding. Saxony also has four EU co-ordinators who are financed by the Ministry of Science and the Arts. Within the framework of four working groups, these co-ordinators assist and advise Saxon scientists when applying for EU research funding.

In the province of the Free State's Ministry of Economics and Labour, four government agencies which deal with the transfer of technology and the promotion of innovation help Saxon companies in their efforts to participate in the EU's Fifth RTD Framework Programme. Three other agencies are integrated into the European innovation network through the AGIL agency in Leipzig which serves as an Innovation Relay Centre. Besides offering consultancy services, these agencies provide competent help, particularly with the filing of applications, the search for partners and project management. As a result of these activities, 58 companies in Saxony have participated in a total of 78 European research or innovation projects to date. The projects which have been completed represent a total of € 31 million in funding (including the funding provided by the respective European partners and the participants; these figures do not include the Fifth RTD Framework Programme).

In the technology field, regular contact is maintained with numerous companies, institutions and/or regions in France, the UK, Hungary and California.

6. Other funding programmes and measures

In 1995, the Ministry of Science and the Arts set up on a pilot basis the two funding programmes *Land Innovation Research Groups for Technology* and *Industry* and *Land Innovation Fellowships* for Saxony's universities. Both programmes were designed to foster young scientists and translate the findings of basic research into innovative products that are ready for use. These two programmes have received a total of DM 10.3 million in funding.

14. Saxony-Anhalt

1. Underlying principles and priorities of research and technology policy

Like other policy fields, Saxony's research and technology policy is currently facing many new kinds of economic, social and ecological challenges at both local and global level. Priority tasks for the future revolve around developing business practices which ensure jobs and do not harm the environment. The need for sustainable economic and social development is particularly highlighted by the global environmental threats facing the earth's natural resources.

In this age of global competition of products and services and the accelerated structural change in the industrial and service sectors that this competition brings, research and innovation play an increasingly important role.

Rather than being organised according to industrial sectors or oriented to technology, research policies and funding must be substantially more cross-sectoral in nature and geared to social and environmental problems. Research and technology policy's practice of focusing on technical solutions which frequently lead to a situation in which problems are (physically or temporarily) moved elsewhere or aggravated must be changed in favour of integrated strategies which combine alternative routes for social action combined with innovative technologies. In particular, forms of research funding which actually enable multi-disciplinary, problem-oriented scientific work are being developed for this purpose.

By expanding the *Land*'s institutions of higher education and research institutes receiving statutory funding, Saxony-Anhalt and the Federal Government have laid the foundation for publicly financed research.

Saxony-Anhalt's higher education institutions are its most important vehicles for publicly funded research. The *Land* has two universities, one art academy and four Fachhochschulen (universities of applied sciences). While basic research is conducted primarily at universities, the research being done at the *Land*'s universities of applied sciences is application-oriented and closely linked to the transfer of technology.

Saxony-Anhalt is home to five Blue List research institutes, two Max Planck Institutes, two Fraunhofer facilities and a Helmholtz Centre. Another Max Planck Institute is currently in the process of being set up.

In addition to these non-university research centres, Saxony-Anhalt's manufacturing sector also has research capacity. This capacity constitutes the greatest potential for industrial research and for industry-related research and development in the *Land*. It is either part of a particular company or takes the form of private, external R&D service companies.

2. University research and non-university research

Saxony-Anhalt's higher education sector combines teaching, research and the promotion of young scientists. Research is part of each university's mission. It serves the acquisition of scientific findings and helps lay and develop the scientific foundation that underpins teaching and study.

The fostering and funding of research that is externally evaluated gives rise to opportunities for building priority research fields, opportunities which are a major factor in developing national profiles for the *Land*'s universities. The policy pursued by Saxony-Anhalt is geared to strengthening basic research at its universities. Conducted primarily in DFG-funded collaborative research centres, centres of excellence and postgraduate research groups, the basic research being done in Saxony-Anhalt makes an outstanding contribution – in both quantitative and qualitative terms – toward this goal.

Five collaborative research centres, three centres of excellence and nine postgraduate research groups have been established at the *Land*'s universities to date.

The *Martin Luther University of Halle-Wittenberg* offers an extensive range of subjects which encompass all relevant areas of the arts and sciences. The university is divided into 18 schools or departments. Its research profile is shaped by the biosciences, materials sciences, Enlightenment and pietism studies, school research, Oriental studies, ethnology, educational sciences, environmental sciences, cardiovascular research, oncology, environmental medicine, social research and agricultural research.

One important focus of research at the Martin Luther University is the interdisciplinary co-operation between the biology, biochemistry and biotechnology fields and the pharmacy, medicine and agricultural sciences fields. Characteristic elements of this focus are the University's diverse collaborative relations with non-university research institutes, and its (presently) eight Interdisziplinäre Wissenschaftliche Zentren (IWZ – Interdisciplinary Science Centres) and affiliated institutes.

The University's Interdisciplinary Science Centres raise new cross-disciplinary issues by combining the scientific output of various specialised disciplines. These Centres give the University new impetus not only for research and the promotion of young scientists but also for developing new subject combinations and courses of study. The University's 11 affiliated institutes are dedicated to applied research.

A fundamental hallmark of the *Otto von Guericke University of Magdeburg* is the close collaboration between engineering, the natural and life sciences, economics, the social sciences, and the humanities. The life sciences take their place alongside engineering as a special priority field which helps shape the University's research profile. All six of these basic disciplines have an integrative function and are being developed to compete in the international arena. The engineering field is broken down into the engineering, process and systems engineering, and electrical engineering departments.

At the Otto von Guericke University, computer science is considered to be part of the engineering department, while the focus of mathematics, physics and chemistry is geared closely to the technological disciplines. Biology and psychology have a neuroscience profile and combine medical science, the engineering sciences and the humanities. Their own intrinsic value notwithstanding, economics, social sciences and the humanities are geared in special ways – share, focus and degree programmes – to the engineering and life sciences.

As an art academy, the *Hochschule für Kunst und Design, Burg Giebichenstein, Halle*, *(Burg Giebichenstein, Academy for Art and Design)* contributes to research and artistic development projects in the liberal arts, applied art, design, interior design, aesthetics and art history fields.

Saxony-Anhalt has largely completed the establishment and expansion of its *Fachhochschulen* (*universities of applied sciences)*. In addition to providing education and training, the *Land*'s universities of applied sciences also have a growing research component to which the government of Saxony-Anhalt assigns high priority. Research conducted at the *Land*'s universities of applied sciences is application-oriented and closely linked to the transfer of technology.

The following research fields typify the research being done at Saxony-Anhalt's universities of applied sciences:
- Mechanical engineering/industrial engineering, design/industrial design, process and environmental engineering, food technology and biotechnology, electrical engineering, computer science and specialised communication, the social services and health care systems, and
- Agriculture, landscape management, ecotrophology and architecture, civil engineering and geodesy, water resource management and waste management.

Saxony-Anhalt is home to the following universities of applied sciences:
- Hochschule Anhalt, HS für angewandte Wissenschaften (Anhalt University of Applied Sciences)
- Fachhochschule Merseburg (Merseburg University of Applied Sciences)
- Hochschule Harz, Hochschule für angewandte Wissenschaften (Harz University of Applied Sciences)
- Fachhochschule Magdeburg-Stendal (Magdeburg-Stendal University of Applied Sciences).

A competitive system of *non-university research institutes* effectively supports and supplements the research being conducted at Saxony-Anhalt's universities. Institutes which receive joint statutory funding from Saxony-Anhalt, the Federal Government and all the other *Länder* and represent a significant portion of the *Land*'s research capacity include not only Blue List institutes which in Saxony-Anhalt all belong to the Gottfried Wilhelm Leibniz Science Association, but also Max Planck Institutes, Fraunhofer Institutes and one Helmholtz Centre.

These institutes conduct not only basic research aimed at self-defined objectives. In certain focal areas their research work also involves application-oriented subjects. A balanced relationship between basic research and applied research and their application in trade and industry are targeted.

Non-university research is dominated by the following priority research fields:
- Plant research
- Brain research
- Materials research
- Technology research
- Economics research.

Regular evaluations are conducted using quality assurance procedures to determine and ensure the efficiency and productivity of non-university research.

Saxony-Anhalt's non-university research institutes are involved in a variety of ways in the collaborative research centres, centres of excellence and postgraduate research groups to be found at the *Land*'s universities.

The following non-university research institutes are located in Saxony-Anhalt:

Blue List research institutes
- Institut für Pflanzenbiochemie Halle/Saale (Institute of Plant Biology)
- Institut für Pflanzengenetik und Kulturpflanzenforschung Gatersleben (IPK Gatersleben – Institute for Plant Genetics and Crop Plant Research)
- Institut für Neurobiologie Magdeburg (Leibniz Institute for Neurobiology)
- Institut für Agrarentwicklung in Mittel- und Osteuropa Halle/Saale (Institute of Agricultural Development in Central and Eastern Europe)
- Institut für Wirtschaftsforschung Halle/Saale (Halle Institute for Economic Research)

Max Planck Institutes
- Max-Planck-Institut für Mikrostrukturphysik Halle/Saale (Max Planck Institute of Microstructure Physics)
- Max-Planck-Institut für Dynamik komplexer technischer Systeme Magdeburg (Max Planck Institute for Dynamics of Complex Technical Systems)

– Max-Planck-Institut für ethnologische Forschung Halle/Saale (Max Planck Institute for Social Anthropology)
– Forschungsstelle für Enzymologie der Proteinfaltung der Max-Planck-Gesellschaft Halle/Saale (Max Planck Enzymology of Protein Folding Research Unit)

Fraunhofer Institutes
– Fraunhofer-Institut für Fabrikbetrieb und -automatisierung Magdeburg (Fraunhofer Institute for Factory Operations and Automation)
– Fraunhofer-Einrichtung für Mikrostruktur von Werkstoffen und Systemen, Halle/Saale -Außenstelle des Fraunhofer-Institutes für Werkstoffmechanik Freiburg (Fraunhofer Facility for Microstructures of Materials and Systems, a Halle-based branch of the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg)

Helmholtz Centres
– UFZ/Umweltforschungszentrum Leipzig-Halle GmbH (UFZ Centre for Environmental Research Leipzig-Halle) with offices in Halle/Salle, Bad Lauchstädt and Magdeburg

Research facilities operated by trade and industry
In addition to the above-listed research institutes, Saxony-Anhalt's manufacturing sector also has research capacity. This capacity constitutes the chief capability for industrial research and industry-related R&D in the *Land*. It is primarily maintained by:
– Industrial enterprises which have their own R&D capability and
– Private, external R&D service providers (limited liability companies which were formed when industrial combines created spin-out R&D firms or universities hived off affiliated institutes, or innovative start-ups).

Industrial research provides jobs for some 3,500 persons in Saxony-Anhalt. Of this number, 860 work in external research facilities which have built a reputation for themselves as R&D service providers for industry, among other things, by:
– Providing industry-oriented R&D services for particular technologies and/or products;
– Serving as a broker between basic research, pre-competitive research and industrial enterprises;
– Providing R&D services (expert opinions, testing, certification, etc.) and sales and support services.

The following priority research fields determine the type of research work being done at research facilities operated by the manufacturing industry:
– R&D in the area of beam technologies in welding engineering and surface treatment;
– Development of raw materials (binding agents, pigments, extenders, additives) and testing to determine their suitability for particular applications, paint analysis, environmental analysis, and the development of paint formulas;
– R&D in the area of extracting and processing vegetable oils and fats;
– Food and environmental analysis, quality management systems and eco-auditing;
– R&D in the area of system solutions for motor and mechanical engineering;
– Process automation, image processing, special-purpose electronics, pollution control technology;
– R&D in the area of sensor engineering and microsystems technology, the area of communications systems in the Fieldbus system field (Profibus, FIP, ISP) and the field of base stations for mobile telephony systems;
– R&D for control engineering systems in the area of sewage treatment automation, traffic control technology and for in-house transport, process engineering and mechanical engineering;
– R&D in the area of environmental technologies for cleaning up the air, water and soil;
– R&D on the recycling of inorganic residual materials and plastics recycling;
– Innovative solutions for combining conventional chemistry with biotechnology for the production of optically pure compounds;
– Scientific studies to open up new applications for photographic materials;
– The development of coating processes and equipment.

3. The promotion and transfer of technology

Application-orientedness and a 'transdisciplinary' approach are the hallmarks of the efforts being taken to foster research and technology with an eye to creating an innovative climate as Saxony-Anhalt moves towards becoming a knowledge-based society. A re-orientation of government funding entails turning away from the current practice of categorising research as either basic research or applied research and moving towards the funding of networking, flexibility and rapid application.

Since the early 1990s, the technology policy pursued by the government of Saxony-Anhalt has attached growing importance to the transfer of technology between research centres and companies.

A network of transfer offices has developed in Saxony-Anhalt, consisting of the transfer agencies operated by the *Land*'s universities (research-related technology agents), pre-competitive transfer offices (independent technology agents) and competition-stage transfer agencies.

The following guidelines and measures have been developed for Saxony-Anhalt:
– Intensifying the direct transfer of knowledge and technology;
– Decentralising responsibility for transferring knowledge and technology in the *Land*'s research centres;
– Creating incentives for the transfer of knowledge and technology;
– Integrating universities of applied sciences to a greater degree;
– Increasing the ability and willingness of commercial enterprises to participate in the transfer of knowledge and technology;
– Fostering the founding of new companies.

The focus of transfer funding in Saxony-Anhalt is on:
– Continuing the technology management programme,
– Building up a technology database and
– Establishing an innovation fund.

Additional technology programmes:
Saxony-Anhalt provides grants to foster the development of new products and processes at SMEs (innovation funding). This policy targets product and process innovations which will maintain and improve competitiveness in Saxony-Anhalt.

This funding is geared to specific sectors of industry and gives special consideration to industrial research, whereby core funding does not preclude concurrent project funding.

A total of DM 56.2 million (DM 17.2 million for research infrastructure, DM 39 million for R&D project funding) was allocated during the years 1998/99 to fund R&D in Saxony-Anhalt (assistance for SMEs in the R&D service field and funding for product and process innovations).

Saxony-Anhalt's technology and innovation funding activities have provided funding for a total of 620 projects in 230 companies since 1991. This assistance also funded approximately 1,500 employees who work in project development or processing. This translates into 233 R&D jobs a year or eight R&D jobs per company.

Technology funding priorities are in the areas of production engineering and new production systems, new materials and materials engineering, biotechnology, environmental and energy technologies including renewable resources, medical technology, and information and communications technologies.

Since 1994, Saxony-Anhalt has fostered the recruiting of young R&D personnel by providing grants for the employment of innovation assistants in SMEs. Seventy-five per cent of these innovation assistants were subsequently hired on a permanent basis by their companies after the funding period ended.

4. International funding measures and international co-operation

Capital to set up science and research centres for priority projects could be raised with the help of funding from the European Structural Fund and the funds allocated to implement the Federal and *Länder* governments' joint task – as prescribed by the constitution – of improving regional economic structures. The research centres Biozentrum Halle (Halle Biocentre), the Zentrum für neurowissenschaftliche Innovationen und Technologien (ZENIT – Centre for Neuroscientific Innovation and Technologies) in Magdeburg, the Forschungs- und Entwicklungszentrum Magdeburg (Magdeburg Research and Development Centre) and the Forschungszentrum Lebensmitteltechnologien (Food Technologies Research Centre) at the Technologiezentrum Köthen (Köthen Technology Centre) have been working in their respective fields since 1998/1999. Currently under construction are the Experimentelle Fabrik Magdeburg (Magdeburg Experimental Factory), the Forschungs- und Entwicklungszentrum Stendal (Stendal Research and Development Centre), the Zentrum für Wissenschaft und Technik Bernburg (Bernburg Centre for Science and Technology) and the Zentrum für Angewandte Medizin und Humanbiologische Forschung Halle (Halle Centre for Applied Medicine and Human Biological Research).

An operative programme for SMEs which forms part of the Community initiatives of the European Commission was effectively implemented via the following funding schemes:

5. Other programmes sponsored by the government of Saxony-Anhalt

The government of Saxony-Anhalt provides research funding with the aim of improving conditions for research and development. The following provides examples of such funding:

Based on proven scientific excellence, 171 projects with an aggregate volume of DM 29 million were approved within the scope of the respective budget estimates for the years 1999/2000. This corresponds to a funding rate of approximately 30 per cent. Saxony-Anhalt's research funding has also provided additional financing primarily for young scientists and ancillary technical personnel.

Funding to date has led to the development of the following priority research fields: mechanical engineering/production systems, biosciences, biotechnology, material sciences, neurosciences, clinical research, medical technologies, agricultural science, food science, environmental research, chemistry and chemical process engineering, and women's studies.

The Innovative Research Funding Programme has provided funding in Saxony-Anhalt for 12 projects that are being conducted under the auspices of the UFZ Centre for Environmental Research Leipzig-Halle and two affiliated institutes, namely the Prof. Hellriegel Institut (Professor Hellriegel Institute) and the Agrarökologisches Institut (Agroecological Institute). All 12 of these projects fall under the categories of agriculture and the environment. This programme has been particularly effective in keeping participants in the former Scientist Integration Programme and their research capabilities in Saxony-Anhalt.

The government of Saxony-Anhalt also provides funding for research in the area of the natural environment and environmental quality and for the development of ecological products and production processes and pollution control technologies. The object of this funding is to foster – on a pilot basis – projects involving applied environmental research and innovative pollution control technologies, giving special attention to anticipatory environmental protection. Fifty projects received a total of DM 6.5 million in funding through this programme in 1998/1999.

Funding for research in the environmental protection field will be geared to the following priorities in the future global warming management (including renewable energy production), nature conservation and the protection of natural spaces, chemistry research, closed-loop systems, the revitalisation of post-mining landscapes, and 'humanity and the environment'.

In the spirit of anticipatory environmental protection, this funding gives special emphasis to fostering the development of new products and production processes which are environmentally sound right from the start. This funding is aimed at fostering applied research and stepping up the funding of collaborative projects between research institutes and, most importantly, small and medium-sized enterprises in Saxony-Anhalt.

Looking at agricultural research, Saxony-Anhalt focused its assistance particularly on measures involving plant production and processing, the utilisation of renewable raw materials and their use in the generation of energy, the environmental assessment of agricultural production systems, livestock breeding and production, and veterinary science. A total of DM 1.7 million in funding was provided for 25 projects in 1998 and 1999.

15. Schleswig-Holstein

1. Underlying principles and priorities of research and technology policy

Schleswig-Holstein has reached an advanced stage in the process of structural change necessary for becoming a knowledge and information society. Today, services, trade and transport account for more value added in Schleswig-Holstein than all other sectors combined. In the future, growth, employment and competitiveness will depend more than ever on the innovative strength of the individual companies and their employees.

As a result, education, science and research are locational factors of the utmost importance. Research and technology policy is a decisive part of Schleswig-Holstein's future-oriented economic development policy. Schleswig-Holstein is also developing its strengths as an attractive and competitive location for science and technology with the help of:

– A range of modern initial and further education programmes
– First-class science and research
– An efficient network for the transfer of technology and for assisting innovation
– A set of demand-driven funding instruments.

Several select priority research fields have played a particularly large role in shaping Schleswig-Holstein's research profile. These include marine research, geosciences, ecological and environmental research, medical research, Scandinavian studies and Baltic studies.

Schleswig-Holstein is home to three universities:

– The Christian-Albrechts-Universität zu Kiel (CAU – Christian Albrechts University of Kiel) with 20,100 students
– The Medizinische Universität zu Lübeck (MUL – Medical University Lübeck) with 2,000 students
– The Bildungswissenschaftliche Hochschule Flensburg, Universität (BWHU – University of Flensburg) with 2,400 students.

Training in the arts is provided by the:

– Musikhochschule Lübeck (Academy of Music) with 430 students
– Muthesius Hochschule Kiel, Fachhochschule für Kunst und Gestaltung (Muthesius University of Architecture, Design and Fine Arts) with 570 students.

Public universities of applied sciences are to be found in:

– Flensburg (2,000 students)
– Kiel (4,900 students)
– Lübeck (2,300 students)
– Heide (660 students). Heide is still being developed.

Schleswig-Holstein also has several *private universities of applied sciences*:

– The Fachhochschule Wedel (Wedel University of Applied Sciences) with 1,000 students and
– The Nordakademie Pinneberg (Pinneberg University of Applied Sciences) with 680 students.

The Verwaltungsfachhochschule (College of Public Administration) in Altenholz with its 1,100 students has special status. Mention is also to be made of the private Fernfachhochschule AKAD (AKAD Distance University of Applied Sciences) in Rendsburg.

Seven major *research institutes* are affiliated with Schleswig-Holstein's universities: the Institut für Weltwirtschaft (IfW _ Kiel Institute of World Economics) with the Deutsche Zentralbibliothek der Wirtschaftswissenschaften (ZBW – German National Library for Economics), the Institut für Meereskunde (IfM – Institute of Marine Research at the University of Kiel), the Institut für die Pädagogik der Naturwissenschaften (IPN – Institute for Science Education at the University of Kiel), the Forschungszentrum für Marine Geowissenschaften (GEOMAR – GEOMAR Research Centre for Marine Geosciences), all in Kiel, the Forschungszentrum Borstel (Borstel Research Centre), the Zentrum für Medizin und Biowissenschaften (FZB – Centre for Medicine and Biosciences), and the Medizinisches Laserzentrum Lübeck (MLL – Medical Laser Centre Lübeck).

As members of the so-called Blue List, the IfW, ZBW, IfM, IPN and FZB are included in the joint funding provided by the Federal and *Länder* governments. The government of Schleswig-Holstein has applied to have the GEOMAR Research Centre added to the Blue List. The Science Council completed its evaluation of the Centre in the autumn of 1997 with excellent results. Other research institutes in Schleswig-Holstein include the Max-Planck-Institut für Limnologie (Max Planck Institute for Limnology) in Plön, the GKSS-Forschungszentrum GmbH (GKSS Research Centre Geesthacht) in Geesthacht, the Fraunhofer-Institut für Siliziumtechnik (IsiT – Fraunhofer Institute for Silicon Technology) which was established in Itzehoe in 1996, the Bundesforschungsanstalt für Milchforschung (Federal Research Institute for Milk Research), the Forschungsanstalt der Bundeswehr für Wasserschall und Geophysik (Federal Armed Forces Underwater Acoustics and Marine Geophysics Research Institute) and branch offices of the Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants) and the Bundesanstalt für Forst- und Holzwirtschaft (Federal Research Centre for Forestry and Forest Products).

2. University research and non-university research

Marine research is the focus of several internationally renowned research institutes in Schleswig-Holstein, including the Institut für Meereskunde an der CAU (IfM – Institute of Marine Research at the University of Kiel), the GEOMAR Research Centre for Marine Geosciences at the University of Kiel and numerous other institutes at the University of Kiel such as the Forschungs- und Technologiezentrum Westküste (FTZ – Research and Technology Centre, West Coast). A cross-disciplinary working group that goes by the name Zentrum für Angewandte Meereswissenschaften (ZAM – Centre of Applied Marine Science) was established in 1999; IfM, GEOMAR, FTZ and other institutes and facilities that are actively involved in marine research are represented in this group. This pooling of

Part IV

resources enables an even greater concentration of marine-technology expertise for implementing the topics:
– Technology development
– Development of measuring methods and monitoring systems
– Aquaculture techniques and
– Environmental management.

Established at the University of Kiel in 1995 as a joint facility for several departments, the Ökologiezentrum Kiel (ÖZK – Ecology Centre) carries out integrative, cross-disciplinary tasks in the areas of applied environmental research and eco-engineering. It was the first of now five major centres in Germany to study ecosystems on a long-term, interdisciplinary basis.

Schleswig-Holstein has important research centres in the medical, medical technology and biomedical fields in Kiel, Lübeck and Borstel. In Lübeck in particular, priority research fields for *interdisciplinary biomedical research* and for *medical technology* have developed with the participation of the Lübeck Medical University, the Lübeck University of Applied Sciences and the Medical Laser Centre. A further priority research field has developed in the area of pneumology (immunology, infectiology, allergology) through the collaborative clinical research conducted by the Centre for Medicine and Biosciences and the Lübeck Medical University. The University of Kiel, the Lübeck Medical University, the Centre for Medicine and Biosciences and other institutes and firms in the region are involved in the *BioInitiative North*. This initiative has established the conditions necessary for mobilising Schleswig-Holstein's broad scientific capacities and for fostering projects that are in line with the objectives of biotechnology-related R&D and the use of its findings in ways that meet the needs of the marketplace.

The University of Kiel's *department of engineering* works in the technologically innovative fields of microelectronics, microsystems technology, sensor technology and actuator technology, high-performance materials and software engineering. The government of Schleswig-Holstein decided in its plan of action, entitled *Information and Communications Technologies in Schleswig-Holstein,* to promote the use of exemplary multimedia applications in research and teaching, among other areas, and to foster an expansion of the *Land*'s technical infrastructure.

The following concentrations of expertise have emerged at Schleswig-Holstein's *public universities of applied sciences*:

Kiel University of Applied Sciences	Automation technology, computer-aided production engineering, electromagnetic compatibility, ecological construction
Muthesius University of Architecture, Design and Fine Arts	Art, architecture, design/industrial design
Lübeck University of Applied Sciences	Assembly and joining technologies, microsystems, laser technology and optoelectronics, materials technology, medical technology
Flensburg University of Applied Sciences	Ship operations and maintenance engineering, renewable energies, biochemical engineering, environmental technology and materials engineering
West Coast University of Applied Sciences	Thin-film sensory technology

3. The promotion and transfer of technology

Technology and innovation policy in Schleswig-Holstein gives priority to SMEs with the aim of strengthening their technological competence, jump-starting innovation processes, and facilitating the fastest possible translation of new ideas and inventions into marketable products and services.

Schleswig-Holstein's efforts to advance technology encompass the promotion of technology use in individual companies, technology support for SMEs, industry-related research, technology transfer and assistance for innovation.

The government of Schleswig-Holstein uses *technology support for SMES* to help such companies conduct their own research and development projects and develop new products and processes. This enhances the technological potential of Schleswig-Holstein's economy and stimulates innovation activity on the part of SMEs. Technology support for SMEs also creates favourable starting conditions for technology-oriented start-ups and the development of new operations. The Production Innovation, Modern, Innovative Technologies, Job-Creating Innovation and Electronic Business programmes are being used for these funding activities.

Efforts to promote *industry-related research* encourage private enterprises to draw upon research institutes and universities as external research departments. They also shorten the timeframes for putting scientific and technical knowledge to use on the shop floor. Sustained collaborative projects between science and industry are fostered with the *Competence Cluster Competition* that is part of the Industry-Related Research programme.

The *transfer of technology* is regarded and pursued as comprehensive *innovation assistance* which takes not only technology issues into consideration but also financing, qualification, company organisation, project management, marketing and the like (www.wirtschaftsforum-nord.de). The *Land*'s innovation consultancy network includes the Technologiestiftung (Technology Foundation, www.tsh.de), Energiestifung (Energy Foundation), Technologie-Transfer-Zentrale (Technology Transfer Office, www.ttz-sh.de), eleven publicly funded technology parks and business incubators, technology transfer agents at the individual universities and financing institutes such as the Mittelständische Beteiligungsgesellschaft. In response to an *evaluation of the technology transfer system* in Schleswig-Holstein that was completed in 1999, the *Land* will be stepping up collaboration on the part of its institutions and develop and refine its active innovation-related consultancy services for SMEs.

The *Innovation Assistant* programme also serves the transfer of technology from the *Land*'s universities to its SMEs by providing grants towards payroll costs to encourage the hiring of university graduates.

By *providing assistance for participation in technology fairs*, the government of Schleswig-Holstein helps firms, research institutes and universities exhibit at joint stands.

The *Land*'s technology promotion activities assign special attention to important *fields of technology* in which Schleswig-Holstein has considerable or above-average development potential.

The government fosters *information and communications technology* not only in the area of e-business applications but also through its *Information Society Initiative of Schleswig-Holstein* which treats I&C as a generic technology that is permeating all areas of society, such as schools and universities. As part of the BMBF-funded *Virtual University of Applied Sciences* lead project, multimedia-based forms of instruction and learning are being developed for the higher education sector under the leadership of the Lübeck University of Applied Science.

Schleswig-Holstein's technology policy supports the rapid development of *biotechnology* in the *Land* on a sustained basis.

The *Land*'s traditionally strong position in *medical technology* is being developed and broadened through the promotion of new and innovative companies.

4. International co-operation

Schleswig-Holstein has renowned, top-flight research institutes which have built up and actively cultivate a wide range of international collaborative relations. The *Land*'s universities participate in the research funding programmes sponsored by the European Commission. *Land*-level agencies and technology transfer agencies work together with partners from the European Union in EU projects that revolve around regional co-operation and the promotion of technology. In light of Schleswig-Holstein's geographic location and the government's own priorities, *co-operation in the Baltic Sea region* is given the most attention. This co-operation is based on a densely woven network of relations at all levels.

16. Free State of Thuringia

1. Underlying principles and priorities of research and technology policy

As part of the *Land*'s efforts to create the genral setting necessary for establishing living conditions that would be comparable with those in Germany's western *Länder*, Thuringia's research and technology policy has been faced for the past ten years with the task of building and securing a higher education and research infrastructure that is competitive at both national and international level.

In the process, Thuringia has had to and is still involved in actively shaping and guiding a difficult restructuring process in not only the *Land*'s science field but also its economic sector. Science and research play a key role in establishing uniform living conditions. This is because in order to develop on a stable, sustained basis without the need for long-term subsidies and low wage levels, trade and industry must have a highly trained workforce and develop innovative products and services. For this reason, ensuring science and industry's technological competitiveness and innovative capability will continue to be one of Thuringia's primary goals.

This places demands on the public sector not only with regard to providing outstanding educational and training institutions. In comparison to Germany's western *Länder* where industrial research and development is sponsored in large part by major corporations, the industrial sector in Thuringia is populated primarily by SMEs.

With their *narrow capital base*, SMEs have fewer opportunities for pursuing independent research and development. And although the amount of independent R&D being conducted in the manufacturing sector is growing rapidly in some areas, the share it represents falls short of the level found in the western *Länder*. This is also true of industry's R&D capacity. The industrial sector's R&D capacity has grown by more than one quarter to over 3,700 employees since 1995, faster than in any of the other new *Länder*. Despite this, it continues to fall substantially short of the average reported by the country's western *Länder*.

This consequently places demands on the *Land*'s *universities and publicly funded research institutes* to not only fulfil their primary tasks in education and basic research but also to serve as *sources of technology and initiators of innovation processes*.

For this reason, the *fostering of R&D capacity at SMEs* and the *creation of collaborative structures* between universities, publicly funded research institutes and business enterprises take on a special role.

In this connection, Thuringia has set itself the following goals and is implementing the following measures:

– Establishing and ensuring internationally competitive higher education and research infrastructures;
– Fostering co-operation between SMEs and scientific research institutes within the framework provided by collaborative projects;
– Fostering research and development in individual companies.

At the same time, Thuringia's research and technology policy concentrates on the following fast growing key technologies:

– Biotechnology
– Information and communications technology
– Microsystems
– Optics and optoelectronics
– Production engineering (including process engineering)
– New materials
– Process measuring and control technology.

This includes overarching fields of technology such as environmental technology and medical technology, and construction engineering and building materials technology.

Thuringia also attaches great importance to providing targeted support for technology-oriented, knowledge-based start-ups within the framework of the *Thuringian Start-Up Campaign*. This campaign includes the *Get-Up Initiative of Thuringian Universities* which was one of the five winners of the BMBF's Exist competition. The Get-Up Initiative targets the founding of spin-offs from universities and non-university research institutes.

2. University research and non-university research

As a full-fledged university with ten departments and more than 100 fields of study, the *Friedrich-Schiller-Universität Jena (FSU – Friedrich Schiller University of Jena)* offers the *broadest research spectrum* in not only the natural sciences but in the humanities and social sciences as well. This potential is manifested by *four DFG-funded collaborative research centres, four postgraduate research groups and three centres of excellence* which presently operate in Thuringia.

The *Zentrum für OPTOMATRONIK* (*Centre for Optomatronics*) is also expected to generate important impetus. Work to set up this new type of optomatronics centre started in 1999 at the instance of the Friedrich Schiller University of Jena and the *Institut für Physikalische Hochtechnologie Jena* (*IPHT – Institute for Physical High Technology Jena*). Optomatronics is regarded as the link that connects optics, laser technology, electronics, biotechnology, production engineering and materials engineering.

The Friedrich Schiller University of Jena works closely together with the non-university research facilities at the *Wissenschafts-Campus Beutenberg (Beutenberg Science Campus) in Jena*:

– Institut für Molekulare Biotechnologie (IMB – Institute for Molecular Biotechnology, a Blue List institute)
– Hans-Knöll-Institut für Naturstoff-Forschung (HKI – Hans Knöll Institute for Natural Materials Research)
– Institut für Physikalische Hochtechnologie (IPHT – Institute for Physical High Technology).

These institutes are linked with the University at personnel level through a number of joint appointments.

Today, the signs are becoming increasingly clear that this research park – which is known for its interdisciplinarism and internationality – is of national and international standing and of special importance for Thuringia.

In the years since 1992, Thuringia has allocated some DM 500 million for the basic funding of research institutes and for construction measures. Work on developing the Beutenberg Campus as both an institution and a physical facility will continue in the future as well; this will include development of the central services used by all the institutes there.

Laboratory space that can be used in a variety of ways will be made available to new entrepreneurs at the *Bio-Instrumente-Zentrum* (Bioinstruments Centre) whose cornerstone was laid in 1999. This centre is the product of a bioinstrument concept that received special mention in the Federal Government's *BioRegio competition*. Its establishment lays the foundation for close co-operation between high-tech firms and basic research and application-oriented research in the biotechnology, pharmaceutical and medical fields. The expertise in advanced physical technologies that already exists in Jena is being incorporated at the same time.

The Beutenberg Campus' attractive environs have induced the Max Planck Society to locate its new *Institut für chemische Ökologie* (Institute for Chemical Ecology, 1996) and *Institut für Biogeochemie* (Institute for Biogeochemistry, 1997) there as well. Already operating in leased premises, these two institutes will have a major impact on the Campus' profile. The Fraunhofer Society will also build a new facility for its Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Fraunhofer Institute for Applied Optics and Precision Engineering) on the campus.

The research conducted at the *Technische Universität Ilmenau (TUI – Ilmenau Technical University)* concentrates primarily on promising, profile-building areas such as Biomedical Systems, Techniques, Materials and Information Systems in Health Care; Design, Simulation and Verification of Complex Systems; Information and Communications Systems in Engineering, Industry and Society; Nanotechnologies; New Principles for and the Optimisation of Power Supplies; and Companies, Markets and Regulations in Flux – Innovative Products and Processes.

One of TUI's *affiliated institutes*, the *Institut für Mikroelektronik und Mechatronik Systeme (IMMS – Institute for Microelectronics and Mechatronic Systems)*, has developed into an integral part of Thuringia's research system. For this reason, it will receive basic funding as a non-university research institute in the future.

Research conducted at the *Bauhaus-Universität Weimar (Bauhaus University of Weimar)* focuses on *civil engineering and materials research*, with importance being attached to having an even balance between industry-related research and basic research. The Deutsche Forschungsgesellschaft began funding a collaborative research centre focusing on Materials and Structures in the Revitalisation of Buildings on July 1, 1999, adding another important focus to the range of research being conducted at the Bauhaus University. Research is being done not only in the University's individual departments but also at the *Materialforschungs- und Prüfanstalt (MFPA – Institute for Materials Research and Testing) which is affiliated with Bauhaus University.*

The *Fachhochschulen (Universities of Applied Sciences) in Erfurt, Jena, Schmalkalden* and the *Fachhochschule Nordhausen (Nordhausen University of Applied Sciences)* which was founded in 1997 and opened its doors to students in 1999 have a statutory mandate to pursue application-related instruction and research and are consequently major players in these areas. These universities work together with not only industrial enterprises and industry-related research institutes, but with non-university research centres as well. One example of this is the collaboration between the Jena University of Applied Sciences with the Institut für Bioprozess- und Analysenmesstechnik (Institute for Bioprocess and Analysis Measurement Engineering) in Heiligenstadt which entails a joint appointment.

Thuringia is cognizant not only of the economic importance of research but also of the importance of *basic research* and of the humanities and social sciences. This is evidenced by its expansion of the *University of Erfurt* which is known for its strengths in the humanities and social sciences. This expansion is proceeding according to plan. The *Max-Weber-Kolleg* (Max Weber Centre for Cultural and Social Studies) which opened in 1998 is the core institute for *interdisciplinary and cross-departmental research* at the University. The University of Erfurt held classes for the first time during the 1999/2000 winter semester.

One example of outstanding basic research is the *quaternary palaeontology* field at the University of Jena's department of geosciences. Following a recommendation by the Science Council, this field will be spun off from the University and added to the Blue List as a *branch of the Research Institute Senckenberg.*

Further information about Thuringia's higher education and research landscape can be found in the brochure "Wissenschaftsland Thüringen".

3. The promotion and transfer of technology

Thuringia's Ministry of Economic Affairs, Labour and Infrastructure uses a set of funding instruments to promote technology. These instruments can be loosely divided into the three categories: technology funding for individual companies; the funding of industry-related research centres; and technology consultancy services and the transfer of technology.

In response to the results of an evaluation, the government of Thuringia has since 1998 given greater consideration to scientific expertise and economic relevance when funding industry-related research institutes. Accordingly, it has, among other things, begun providing core funding to institutes that have been selected on the basis of these criteria. This has concomitantly led to its supporting mainly projects that involve pre-competitive research.

Further progress has been made in developing the research and technology infrastructure that is being expanded in the Erfurt-Jena-Ilmenau triangle in particular. The focus here is on developing *technology and research parks with commercial space*. Work on this type of technology and research park has consequently begun in *Ilmenau*. The most important project at present is the *Applikationszentrum (APZ – Applications Centre)* which is geared to promising high-tech fields such a microtechnologies, image processing, technical vision, medical diagnostics, circuit engineering and hybrid technology which are very important for Thuringia's business enterprise sector and constitute special fields of expertise at the Ilmenau Technical University. The *Anwendungszentrum für Software-Informations- und Kommunikationstechnologien (transit – Thüringen Applications Centre for Software, Information and Communications Technology)* constitutes a further building block. The Centre has already taken up its work.

The *Applikationszentrum Mikrotechnik* (Application Centre for Microtechnology Jena) began operation in 1998. Established in *Jena* by the Fraunhofer-Institut für Optik und Feinmechanik (Fraunhofer Institute for Applied Optics and Precision Engineering) and the Institut für Füge- und Werkstofftechnik (Institute of Joining Technology and Materials Testing), the Application Centre has set itself the goal of ensuring the successful transfer of technology in the fields of *microoptics, microsensor analysis, and assembly and interconnection technology.*

Construction of a technology park has also begun in *Erfurt*. This park will form the heart of the future South-East Erfurt technology region. Microtechnology plays a key role in the master plan for the Erfurt technology park. As a consequence, priority is being given to the establishment of a microsystems application centre.

The government of Thuringia decided to make DM 100 million of the revenue generated by the *privatisation of Jenoptik AG* available to the *Ernst-Abbe-Stiftung (Ernst Abbe Foundation)* and the *Stiftung für Technologie- und Innovationsförderung (STIFT – Foundation for Technology and Innovation Funding)* for activities that foster research and technology. The use of these funds is not to be restricted to the previously mentioned Bioinstruments Centre in Jena or the Applications Centre in Ilmenau. They are also to be used, for example, for infrastructure measures such as the construction project for the Hermsdorfer Institut für technische Keramik (Hermsdorf Institute of Technical Ceramics) and for a centre of excellence for construction engineering and building materials technology in Weimar. STIFT will play a decisive role in the implementation and technical guidance of these projects. In some cases it will assume project management. STIFT will also be involved in co-ordinating the transfer of technology, managing pre-competition technology initiatives, providing assistance for collaborative projects and projects to attract companies to the region, and funding start-ups through the Entrepreneurs in Thuringia Campaign. It will be gradually developed into the central agency for technological expertise for Thuringia's business sector.

Important progress has been made in recent years in further developing an efficient research and technology infrastructure and organising an effective transfer of technology in Thuringia. The *Land*'s *patent balance* provides clear proof that the technological expertise found in innovative companies in the *Land*'s business and industrial sectors as well as in its institutions of higher education and research institutes has continued to develop. The number of patent applications filed with the German Patent Office which came from Thuringia has steadily grown from 565 in 1996 to 698 in 1998, an increase of 24 per cent. *Measured in per capita terms*, Thuringia ranks *first among Germany's new Länder*. The *Erfinderzentrum Thüringen (Thuringen Inventors' Centre)* was established to assist companies, free-lance inventors and industry-related research institutes in their efforts to obtain, protect and exploit industrial property rights.

Thuringia's universities and non-university research institutes submitted a total of 108 patent applications in 1998, with the higher education sector accounting for 60 of them. Compared to Germany's western *Länder*, this is an extremely large share of the total. Thuringia's universities plan to collaborate more closely within the *University Patent Network* when applying for and exploiting patents. Non-university research is also to be included. This network was launched in 1999 with the object of pooling competency and concomitantly make existing resources available to all facilities and institutes. The Ilmenau Technical University's main office – the *Zentrum für Patentinformation und Online-Dienste (PATON – Patent Information Centre and Online Services)* – has been expanded through the addition of a *patent exploitation office* which has the task of helping universities with their patent applications and of endeavouring to market these technologies to small and medium-sized companies in Thuringia. Plans foresee the integration of Thuringia's University Patent Network into national and international patent exploitation activities (the Fraunhofer Patent Centre for German Research, the Technology Alliance) and close collaboration with the Thuringian Inventors' Centre.

4. International co-operation

Thuringia's research institutes were incorporated to an ever greater degree into European and international research systems during the period under review. Thuringian universities and research institutes are participating with increasing success in international projects such as the Human Genome Project and projects which receive funding through the European Union's Fourth and Fifth Framework Programmes on Research.

The *recognition of the Institute for Molecular Biotechnology's (IMB) Structural Research field as a European Large-Scale Facility* is one example of the *Land*'s integration into international activities and the high scientific level of its researchers. The European Union provides financial assistance for stays of scientists from other EU member states and associated countries who conduct research at the IMB's Centre for Design and Structure in Biology. The infrastructure in the areas of nuclear magnetic resonance spectroscopy, X-ray crystallography and electron microscopy offer IMB researchers and visiting scientists outstanding opportunities for exploring the three-dimensional structures of biological macromolecules.

A network of research consultants was set up in 1999 in the various disciplines to improve existing opportunities for participation in EU funding measures. This network assists scientists in a number of ways such as by advising them on EU funding opportunities and application requirements.

Literature

Please see references in the main text.

Part V

International co-operation in research and technology

Introduction

The Federal Republic of Germany plays an important role in the European Union, in European organisations and research institutions and in multilateral organisations, in shaping and implementing European and international policy in the fields of science, research and technology. It is also engaged in co-operation on science and technology with more than 50 countries around the world, in many cases on the basis of intergovernmental agreements; the direct and independent partners in such co-operative ventures are higher education institutions, non-university research institutions and companies engaged in research. Over the years, this has produced a dense network of bilateral and multilateral relations which provides a sound foundation on which to achieve the objectives above mentioned and successfully tackle the tasks in hand.

1. European co-operation

1.1 European Union, European Commission

Rue de la Loi 200
B-1049 Brussels
Belgium

15 member states: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

Basis of research promotion in the European Union

First enshrined in the Single European Act, the structure of research promotion at European level is today based on the Treaty of Amsterdam of 2 October 1997 (Articles 163–173 of the Treaty on European Union):

– The objective of European research promotion is to strengthen the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting research activities deemed necessary to support *other policy areas* of the European Union, e.g. environment and health.
– All Community activities in research promotion and technological development are to be united under the umbrella of an EU *Framework Programme for Research, Technological Development and Demonstration Activities* (and a corresponding programme under the EURATOM Treaty). The aim is to ensure the integration, transparency and co-ordination of research promotion.
– The special emphasis on the *principle of subsidiarity* also applies to Community research promotion. It is not meant to duplicate national research funding. Rather, the Community should become active only in those areas where national schemes cannot be implemented efficiently enough by member states and which can therefore be tackled only or at least better at Community level. This applies to promoting European networking and integration of research activities or to large-scale or costly schemes for which the individual EU member states cannot or cannot adequately provide the necessary funds or the required scientific personnel (e.g. for developments in aeronautics, genome research or controlled thermonuclear fusion). Community activities are particularly appropriate when the problems to be solved are, by their very nature, transboundary, e.g. environment, climate research, health or transport, or where the aim is Community-wide standardisation or harmonisation.
– In the *Treaty of Amsterdam* it was decided to change from the principle of unanimity to a *qualified majority vote for Council resolutions on framework programmes for research*. This is an important step towards increasing the dynamism and efficiency of European research promotion.

Policy decisions on the research areas to be funded and the level of funds to be allocated are taken jointly by the Council of the European Union and the European Parliament and set out in *a multiannual framework programme for research*. The framework programme defines the contents of the activities to be conducted in the various research areas, such as information technology and energy, and contains provisions relating to funding and promoting other research activities – known as "actions" – under EU schemes. This includes

– the promotion of co-operation with third countries and with international organisations,
– the dissemination and exploitation of research results, and
– the training and mobility of researchers.

After consulting the European Parliament the Council implements the framework programme by adopting *specific programmes* which in turn provide the basis for calls for proposals and the allocation of funds to project participants (cf. below Involvement in Community research programmes).

In the Joint Research Centre (JRC), the Community has its own large-scale research centre with eight institutes, four in Italy and the others in Germany, the Netherlands, Belgium and Spain. Here, the Community conducts research especially in the areas of the environment, industrial and materials technologies, measurement and testing, and nuclear safety. The JRC attaches particular importance to supporting Community policies. Furthermore, it contributes to implementing the programme on the *Training and mobility of researchers* by offering scholarships and by participating in scientific networks.

The JRC has a staff of more than 2,000. Taking a competition-driven approach, it will in future compete to a greater extent with research institutions in the member states to provide services for other Commission agencies in support of Community policies.

Substance of Community research policy
Fifth RTD Framework Programme

The Fifth Framework Programme entered into force on 1 January 1999 in immediate succession to the Fourth Framework Programme, whose funding totalled ECU 13.2 billion, or roughly DM 25.7 billion, and which expired at the end of 1998.

Like the Fourth Framework Programme, it consists of two parts: the Research Framework Programme[1] and the EURATOM Research Programme[2]; the two programmes will run until 31 December 2002 and dispose of funding totalling € 14.96 billion, or roughly DM 29.43 billion.

Against the backdrop of the experience gathered with the Fourth Framework Programme and of current trends in the global competition for innovation, the Federal Government initiated a change in the structure of the Fifth Framework Programme with the following objectives:
– Greater focus on themes that are of strategic importance for innovation, competition and fundamental issues of the common good in Europe, e.g. key developments in biotechnology and biomedicine, linking of transport modes, aeronautics, global change;
– Clearer and more transparent programme structure by reducing the number of programmes;
– Greater focus on problems by organising the programmes according to key issues and involving the user community in their definition;
– Strengthening life sciences as one of the important key areas for the future;
– Improving the infrastructure required for high-tech developments in Europe, especially the development of a European-wide high-performance data transmission network in the field of research;
– Developing a clear strategy for introducing Central and Eastern European states to the pan-European research system.

The broad-based structure of the Fourth Framework Programme was replaced by four programmes which define the main substantive orientations.

Within these programmes there are problem-oriented key actions supplemented by so-called generic activities and measures designed to improve the research infrastructure.

Important interdisciplinary issues are tackled under three horizontal programmes:
– Consolidating the international role of Community research (INCO);
– Promotion of innovation and encouragement of participation by small and medium-sized enterprises;
– Enhancing the human research potential and improving the socio-economic knowledge base.

Thermonuclear fusion, nuclear safety and radiation protection are the issues to be dealt with under the EURATOM research programme.

In order to foster international co-operation with the EU, the programmes are open to non-European partners where such international co-operation is objectively necessary and in line with Community interests, particularly with regard to globalisation. The most important change, however, is the association of Cyprus and the Central and Eastern European candidates countries with the Fifth Framework Programme. These countries are now equal partners in the Framework Programme and provide corresponding funding. This means that in an important sector EU enlargement has already become reality. In addition, support is to be given in the pre-accession countries to the establishment of centres of excellence in order to create concentrations of expertise with a pan-European and international impact.

In the first half of 1999, Germany held the *Presidency of the European Council*. In that period, it was possible to complete the association of Cyprus and of eleven Central and Eastern European countries with the Fifth Framework Programme. Since summer 1999, this has meant that higher education institutions, research institutions and companies from these countries can participate in the Framework Programme on the same conditions as institutions in the EU member states. During the German Presidency, the Federal Ministry of Education and Research (BMBF) held an international conference in the Hamburg Congress Centre on 14/15 June 1999 entitled "Forward Thinking: Keys to the Future in Education and Research". Politicians and experts from 13 EU countries, Poland, Hungary, Switzerland, New Zealand, Israel, Russia, Slovenia and the USA exchanged experience on foresight and how to implement it in measures for business, science, education and government. Also, a workshop on "Evaluation of Science and Technology in the New Europe" organised jointly by the BMBF and the European Commission was held in Berlin on 7/8 June 1999.

[1] OJ EC No. L 26 of 1 February 1999, pp. 1 ff.

[2] OJ EC No. L 26 of 1 February 1999, pp. 34 ff.

Info-Box • National contact points of the Federal Government for the EU's RTD Framework Programme

Germany's approach, namely to establish the national contact points with the Federal Government's competent project management organisations, has proven a success. The project management organisations have been charged by the BMBF and by other government departments with managing national research programmes (in fields such as health research, waste water technologies, marine research, new materials, etc.). The organisations therefore have an excellent knowledge of German research activities in their field and are in contact with relevant researchers in public and industrial research institutions.

National contact points of the Federal Government for the Fifth RTD Framework

Horizontal programmes and general tasks

General information concerning FP5	International co-operation	Promotion of innovation and pation of SMEs Innovation
DLR-PT (Bonn) ***Herr Dr. J. Schneider*** *0228/4492-210 (222 fax)* *joerg.schneider@dlr.de*	*DLR-PT (Bonn)* ***Herr Dr. A. Schlochtermeier*** *0228/4492-230 (222 fax)* *andre.schlochtermeier@dlr.de*	*ISI (Karlsruhe)* ***Herr Dr. K. Blind*** *0721/6809-212 (260 fax)* *kb@isi.fhg.de* *FZ Karlsruhe* ***IRCs***:*http://www.cordis.lu/irc/src/whoswho/whowho.htm*
KoWi *(Bonn/Brussels)* *(only public research;* *no national contact point)* *0228/95997-0 (99 fax)* *00322/5480210 (5027533 fax)* *postmaster@bn.kowi.de* *postmaster@bru.kowi.de*	***Frau B. Lieder*** *(fellowships)* *0228/4492-220 (222 fax)* *barbara.lieder@dlr.de*	
	Frau Dr. S. Splett *(INTAS)* *0228/4492-454 (400 Fax)* *stephanie.splett@dlr.de*	

Thematic programmes

Quality of life and management of living resources	User-friendly information society	Competitive and sustainable growth
Programme co-ordination		
DLR-PT (Bonn) ***Herr Dr. H. Lehmann*** *0228/4492-300 (333 fax)* *hans.lehmann@dlr.de*	*DLR-PT-IT (Köln)* ***Herr K. Schütz*** *02203/601-3585 (3055 fax)* *klaus.schuetz@dlr.de*	*PT-NMT (Jülich)* ***Herr Dr. V. Maly*** *02461/61-4890 (2398 fax)* *growth@fz-juelich.de*
Key actions		
• Health, nutrition and environmental factors • Cell factory *PT-BEO (Jülich)* ***Herr Dr. J. Vetter*** *02461/61-4841 (2880 fax)* *j.vetter@fz-juelich.de* *beo21.beo@fz-juelich.de*	• Systems and services for the citizen • Multimedia content and tools *DLR-PT-IT (Köln)* ***Frau Dr. C. Müller*** *02203/601-2643 (3055 fax)* *christiane.mueller@dlr.de*	• Innovative products, processes and organisation *PT-PFT (Karlsruhe)* ***Herr Dr. H. Rempp*** *07247/82-5272 (2891 fax)* *ncp.ippo@pft.fzk.de*

Using this expertise in the management of European funding programmes means optimum synergy between national and European support and efficient integration of German partners into European projects. Furthermore, the preparatory work of the project management organisations enables the BMBF to take national research activities into consideration when co-operating in the design of European funding programmes.

In parallel with the differentiation of the EU's RTD Framework Programme, a pragmatically optimised network of national contact points has thus been established in Germany. In this way, competent support can be provided for individual funding measures.

The national contact points are listed in the following: (For further information see: http://www.dlr.de/sarah)

Programme (as of July 1999)

Horizontal programmes and general tasks

encouragement of innovation and participation of SMEs

PT-NMT (Jülich)
Herr I. Rey
02461/61-4890 (2398 fax)
sme@fz-juelich.de

AiF (Köln)
Herr T. Klein
0221/37680(0)-38 (27 fax)
eu@aif.de

Improving human research potential and the socio-economic knowledge base

DLR-PT (Bonn)
- Training & mobility
- Infrastructure

Herr Dr. J. Schneider
0228/4492-210 (222 fax)
joerg.schneider@dlr.de

- Marie Curie Fellowships

Frau B. Lieder
0228/4492-220 (222 fax)
barbara.lieder@dlr.de

- Socio-economic aspects

Frau Dr. D. Lohmann
0228/4492-240 (222 fax)
dieta.lohmann@dlr.de

Frau T. Bröskamp
0228/4492-204 (222 fax)
theresia.broeskamp@dlr.de

Thematic programmes

Energy, environment and sustainable development

Environment

Energy

Euratom

Programme co-ordination

Environment:

PT-BEO (Jülich)
Frau Dr. R. Loskill
02461/61-3761 (2730 fax)
r.loskill@fz-juelich.de
beo51.beo@fz-juelich.de

Energy:

PT-BEO (Jülich)
Herr Dr. H. Pfrüner
02461/61-3883 (2880 fax)
h.pfruener@fz-juelich.de
beo21.beo@fz-juelich.de

Key actions

- Sustainable management and quality of water

PT-WT (Karlsruhe)
Herr D. Fuhrmann
07247/82-3235 (2377 fax)
dieter.fuhrmann@ptwt.fzk.de

- Cleaner energy systems, renewables

PT-BEO (Jülich)
Herr D. Peisker
02461/61-3266 (2880 fax)
d.peisker@fz-juelich.de
beo21.beo@fz-juelich.de

- Controlled nuclear fusion

BMBF Ref. 412 (Bonn)
Herr Dr. R.-P. Randl
0228/57-3275 (3605 fax)
rolf-peter.randl@bmbf.bund400.de

Thematic programmes

Quality of life and management of living resources	User-friendly information society	Competitive and sustainable growth

Key actions

• Infectious diseases • Ageing population *DLR-PT (Bonn)* ***Frau D. Baroke*** *0228/4492-302 (333 fax)* *dagmar.baroke@dlr.de* • Agriculture, fisheries and forestry *PT-BEO (Jülich)* ***Herr G. van Gyseghem*** *02461/61-4877 (2880 fax)* *g.van.gyseghem@fz-juelich.de* *beo21.beo@fz-juelich.de*	• New methods of work and electronic commerce *DLR-PT-IT (Köln)* ***Herr K. Schütz*** *02203/601-3585 (3055 fax)* *klaus.schuetz@dlr.de* • Essential technologies and infrastructures *DLR-PT-IT (Köln)* ***Herr Dr. F. Gillessen*** *02203/601-3403 (3055 fax)* *friedhelm.gillessen@dlr.de* ***Herr R. Rosenberg*** *02203/601-3435 (3055 fax)* *rolf.rosenberg@dlr.de*	• Mobility and intermodality *PT-M+V (Köln)* ***Herr A. Wurm*** *0221/806-2496 (2712 fax)* *PT-MuV@de.tuv.com* • Land transport and marine technologies *PT-M+V (Köln)* ***Herr H. Kratzel*** *(land transport technol.)* *0221/806-1656 (2712 fax)* *PT-MuV@de.tuv.com* *Forschungszentrum des dt. Schiffbaus (HH)* ***Herr H. Wilckens*** *(marine technologies)* *040/69199-64,47 (73 ffax)* *fds.wilckens@t-online.de* • Aeronautics *DLR-PT-LF (Bonn)* ***Herr Dr. H.-J. Schepers*** *0228/447-663 (710 fax)* *hejo.schepers@dlr.de*

Generic activities

• Chronic and degenerative diseases • Genomes and diseases of genetic origin • Neurosciences • Public health • Biomedical ethics *DLR-PT (Bonn)* ***Herr Dr. H. Lehmann*** ***Frau D. Baroke*** *0228/4492-301 (333 fax)* *hans.lehmann@dlr.de* *dagmar.baroke@dlr.de*	• Future and emerging technologies *DLR-PT-IT (Köln)* ***Herr Dr. F. Gillessen*** *02203/601-3403 (3055 fax)* *friedhelm.gillessen@dlr.de*	• New materials • Steel *PT-NMT (Jülich)* ***Herr Dr. C. Wadewitz*** *02461/61-4890 (2398 fax)* *growth@fz-juelich.de* • Measurement and testing *BAM (Berlin)* ***Herr Dr. J. Lexow*** *030/8104-1003 (3037 fax)* *juergen.lexow@bam.de*

Research infrastructure

PT-BEO (Jülich) ***Herr Dr. J. Vetter*** *02461/61-4841 (2880 fax)* *j.vetter@fz-juelich.de* *beo21.beo@fz-juelich.de*	*DLR-PT-IT (Köln)* ***Herr R. Rosenberg*** *02203/601-3435 (3055 fax)* *rolf.rosenberg@dlr.de*	*PT-NMT (Jülich)* ***Herr Dr. V. Maly*** *02461/61-4890 (2398 fax)* *growth@fz-juelich.de*

Thematic programmes

Energy, environment and sustainable development		Euratom
Environment	**Energy**	

Key actions

Environment	Energy	Euratom
• Global change, climate and biodiversity *PT-UKF (München)* ***Herr Dr. H. Bauer*** *089/651088-50 (54 fax)* *h.bauer@gsf.de*	• Economic and efficient energy *PT-BEO (Jülich)* ***Herr Dr. H. Pfrüner*** *02461/61-3883 (2880 fax)* *h.pfruener@fz-juelich.de* *beo21.beo@fz-juelich.de*	• Nuclear fission *PT-GRS (Köln)* ***Herr H. Casper*** *(reactor safety)* *0221/2068-624 (629 fax)* *cah@grs.de*
• Marine ecosystems *PT-BEO (Rostock)* ***Herr Dr. A. Irmisch*** *0381/51-97287 (509 fax)* *a.irmisch@fz-juelich.de*		*PT-E, (Karlsruhe)* ***Herr Dr. K.-D. Closs*** *(waste disposal)* *07247/8257-90 (96 fax)* *klaus-detlef.closs@pte.fzk.de*
• City of tomorrow *PT-UKF (München)* ***Frau I. Balzer*** *089/651088-56 (54 fax)* *balzer@gsf.de*		

Generic activities

Environment	Energy	Euratom
• Natural and technological hazards • Earth observation • Socio-economic aspects of environmental change *PT-BEO (Jülich)* ***Frau Dr. R. Loskill*** *02461/61-3761 (2730 fax)* *r.loskill@fz-juelich.de* *beo51.beo@fz-juelich.de*	• Socio-economic aspects of energy *PT-BEO (Jülich)* ***Frau P. Mann*** *02461/61-3753 (2880 fax)* *p.mann@fz-juelich.de* *beo21.beo@fz-juelich.de*	• Radiation protection and health • Environmental transfer of radioactive material • Industrial and medical uses • Internal and external dosimetry *Bundesamt für Strahlenschutz (Oberschleißheim)* ***Herr Prof. Dr. Burkart*** *089/31603-101 (140 fax)* *ASchmitt-Hannig@bfs.de*
KMU-Kontaktstelle Umwelt *DLR-PT (Bonn)* ***Herr Dr. F.-V. Künzer*** *0228/4492-304 (333 fax)* *fred-volker.kuenzer@dlr.de*		

Research infrastructure

Environment	Energy	Euratom
PT-BEO (Jülich) ***Frau Dr. R. Loskill*** *02461/61-3761 (2730 fax)* *r.loskill@fz-juelich.de* *beo51.beo@fz-juelich.de*	*PT-BEO (Jülich)* ***Herr Dr. H. Pfrüner*** *02461/61-3883 (2880 fax)* *h.pfruener@fz-juelich.de* *beo21.beo@fz-juelich.de*	*Bundesamt für Strahlenschutz (Oberschleißheim)* ***Frau A. Schmitt-Hannig*** *089/31603-101 (140 fax)* *ASchmitt-Hannig@bfs.de*

1.2 Co-operation with Central and Eastern European countries and the Newly Independent States (NIS) of the former Soviet Union

Germany's scientific and technological relations with **Central and Eastern Europe countries** have been continuously developed and intensified. On the one hand, they are aimed at supporting the efforts of the partner countries to restructure their research systems on the road to the market economy and to become integrated into the international scientific community. On the other hand, close bilateral scientific co-operation in numerous areas has developed with a number of countries which is of mutual benefit and hence also contributes to strengthening Germany's scientific and economic position.

One focus of German co-operation with its neighbours in Central and Eastern Europe is to support their integration into the EU in the field of research and technology. In particular, the involvement since summer 1999 of 11 partner countries in the Fifth RTD Framework Programme of the EU has been prepared and supported through a variety of measures organised by the BMBF. These measures included the Fourth Status Seminar held by the BMBF with its partner countries in Prague in October 1998, which aimed to help them prepare for participation in the Fifth Framework Programme, and the Fifth Status Seminar held in Portoroz, Slovenia, in October 1999, which was devoted to the evaluation of their participation in the first calls for proposals under the Fifth Framework Programme. In addition, a large number of additional training and support schemes have been organised to foster the participation of the Central and Eastern European countries in the Fifth Framework Programme, e.g. training for technical and administrative multipliers and internships in Germany and Brussels; these measures will be continued in the years to come.

Bilateral co-operation with the Central and Eastern European countries has seen particularly encouraging developments in relations with **Hungary**, **Poland** and **Slovenia**. Progress is also being made on the intensification of co-operation with the **Czech Republic** and **Estonia**, which are also candidates for the first round of accession, as well as with the **Slovak Republic**, **Latvia**, **Lithuania**, **Romania** and **Bulgaria**.

One example of successful co-operation is the Bay Zoltán Foundation in **Hungary**, whose establishment was supported by Germany. The Foundation is modelled on the Fraunhofer Society and has three institutes for applied, industry-related research. On the occasion of the fifth anniversary of the creation of the Bay Zoltán Foundation, a demonstration and user centre for laser technology, built with German assistance, was opened at the institute in Budapest at the end of 1998.

In general, funding is tight in the countries in the region. For this reason, the reform of the research structures mainly involved the restructuring of existing research institutions and only rarely the establishment of new ones. In **Poland** and **Romania**, for example, German experts provided advice on this restructuring. In the course of the reorientation of the TRANSFORM programme, projects were carried out in **Hungary** and the **Czech Republic** to establish venture capital structures to help small and medium-sized firms, and several joint workshops were held with **Hungary** which were chiefly aimed at facilitating contacts and partnerships between small and medium-sized enterprises.

German experience with setting up technology-based business incubators, especially in the new *Länder*, has met with wide interest in Central and Eastern European countries. German experts acted as advisers to central and regional governments, universities and potential start-ups in **Hungary**, the **Slovak Republic** and **Romania**. In these countries several technology-based business incubators have been established or have reached the final project phase. In co-operation with the **Baltic states**, a much noted investment forum was held in summer 1998 to encourage contacts between German and Baltic technology-based companies.

The INCREASE co-operative research exercise between nine German and fourteen Polish research institutions, in which the UMSICHT Institute in Oberhausen plays a key role, has a pilot function. In the areas of environmental, energy and safety technologies, the institutions conduct joint research projects which are funded by the BMBF and also involve industry. Co-operation with Poland in the field of Oder research (pollutant input and distribution as well as flood models and flood control) deserves special mention. The Deutsches Historisches Institut (DHI – German Historical Institute) in Warsaw, which was founded in 1993, promotes German-Polish co-operation in the humanities.

In **Slovenia** and **Poland**, support is provided for applying and developing modern methods of technology transfer from research to industry with a view to improving future competitive opportunities on the world market and alleviating the westward brain drain through the creation of new jobs. In **Hungary**, the technology potentials of various sectors of Hungarian industry were studied in order to create adequate European technology facilities. The methods employed for assessing research and technology potentials will be made available to other Central and Eastern European countries if requested. Advisory activities in **Bulgaria** are aimed at facilitating technological co-operation between the two countries through a better flow of information.

The co-operation with the Newly Independent States succeeding the former Soviet Union is focused on **Russia**, **Ukraine** and **Belarus**. Germany is Russia's most important partner in the field of research co-operation.

An important role in this co-operation is played by the Internationales Wissenschafts- und Technologiezentrum in Moscow (IWTZ – International Science and Technology Centre) and the Ukrainisches Wissenschafts- und Technologiezentrum (UWTZ – Ukrainian Science and Technology Centre).

Co-operation with Russia, Ukraine and other successor states of the former Soviet Union covers virtually all fields of research and technology. The countries of this region are also being assisted in restructuring their research systems in line with market-driven needs.

Priorities of bilateral co-operation are:

Physical and chemical technologies and materials research

Despite the extremely difficult financial situation of the science sector there is still very considerable potential in these fields in Russia, Ukraine and to some extent also in Belarus. Co-operation is particularly well-developed in the field of laser research and technology, and has already led to the establishment of several joint ventures. More and more German industrial enterprises are participating in trilateral German-Russian-Ukrainian co-operation on the extensive work to utilise high-temperature superconductivity.

Basic physical research

A large number of joint projects – especially activities using large-scale equipment – are being conducted in this area. Project co-operation is most intensive at the German Electron Synchrotron (DESY) in Hamburg, at the Gesellschaft für Schwerionenforschung (GSI – Heavy Ion Research Centre) in Darmstadt, at the Jülich Research Centre, at the BESSY electron storage ring in Berlin, and at the Joint Institute for Nuclear Research (JINR) in Dubna/Russia. The construction of a joint German-Russian beamline at BESSY for bilateral experiments is a particularly significant area of co-operation.

Environmental and climate research; marine and polar research

Co-operation primarily focuses on the study of flowing water bodies. Following an initial phase of joint studies of the Oka and Elbe rivers, co-operation has now begun on the Russian programme to revitalise the Volga. Extensive activities in the field of marine and polar research that are conducted during joint sea and land expeditions will help explore the global significance of the Laptev Sea and its major tributaries. The preparatory work to establish a joint German-Russian laboratory for marine and polar research (the Otto Schmitt Laboratory in St. Petersburg) was completed successfully in 2000. The support for the interdisciplinary research into the Aral Sea, involving Kazakh, Uzbek, Russian and German scientists, is of considerable regional and international importance.

Space research and technology

Work centres on the International Space Station, ISS, to which both Russia and Germany contribute. An intergovernmental agreement with Russia on space co-operation is intended to improve the basic conditions for scientific, technical and industrial co-operation.

SME co-operation

The mutually beneficial co-operation between German small and medium-sized enterprises (SMEs) and research institutes, universities and enterprises in the former Soviet Union has been gradually expanded under the special Research Co-operation and Pro Inno programmes (the latter from 1999). This development was considerably furthered by liaison offices set up in selected partner countries by the Arbeitsgemeinschaft industrieller Forschungsvereinigungen e.V. (AIF – German Federation of Industrial Co-operative Research Associations).

The exchange of information and experience relating to government innovation policy has become especially important. Two bilateral seminars were held with Russia in 1999 and 2000 on the instruments of innovation policy. A Ukrainian delegation of experts visited Germany in 1999, followed by Russian and Belarusian delegations in 2000. The aim of this measure is to pass on German experience, so that it can help to shape research policy in the partner countries.

In the period under review the exchange of several thousands of scientists and students was promoted with sizeable federal funds, especially via the Deutsche Forschungsgemeinschaft (DFG), and the Deutscher Akademischer Austauschdienst (DAAD – German Academic Exchange Service). Russia was one of the three countries receiving the largest number of Humboldt fellowships and awards.

Bilateral co-operation in the civil sector is also complemented on a long-term basis by activities of the International Association for the Promotion of Co-operation with Scientists from the Former Soviet Union (INTAS) in Brussels; activities of the International Science and Technology Centre in Moscow and the Ukrainian Science and Technology Centre in Kiev augment collaborative ventures in the former military-industrial sector ("conversion of brains"). A large number of bilateral co-operation arrangements have emerged in the course of these European and international initiatives.

Info-Box

The international offices

The BMBF's international offices are tasked with supporting the Ministry in its international co-operation. They are organised on the basis of regions and the BMBF's partner countries.

The BMBF's international office at the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre) covers co-operation with

- Asia, Australia and New Zealand
- North and South America
- Europe and the CIS states.

The international office at the Jülich Research Centre covers co-operation with

- Africa and the non-African Arab countries
- Turkey and Israel.

These international offices work on behalf of the BMBF in certain countries and on selected collaborative priorities. In particular, they support contacts with institutions and scientists from various countries in advance of and alongside the BMBF's specialised programmes, in order to identify the interest in co-operation and to prepare and implement joint research projects. In an age of increasing globalisation, this is intended to result in a more strategic orientation of the work done by the international offices in shaping scientific and technological co-operation.

In addition to universities and research institutes, the partners in co-operation projects are increasingly also private-sector companies co-operating with research institutions. The legal framework for the work done by the international offices is generally provided by bilateral agreements at intergovernmental level on scientific and technological co-operation with other countries.

The international offices also support the BMBF in its co-operation with other countries in the fields of higher education and vocational education and training. This is done in close contact with the relevant mediating organisations in Germany :DAAD (German Academic Exchange Service), Stiftung für wirtschaftliche Entwicklung und berufliche Qualifizierung (Sequa – Foundation for Economic Development and Vocational Training) and CDG (Carl Duisberg Society).

1.3 European organisations and research institutions

1.3.1 EUREKA

Secretariat: Rue Neerveld 107, B-1200 Brussels, Belgium
Phone: +32 2 777 09 50
Fax: +32 2 770 74 95
Internet address: http://www.eureka.be
EUREKA/COST Office of the BMBF at the DLR:
Königswinterer Strasse 522–524,
D-53227 Bonn, Germany
Phone: +49 228 44 92 2 50
Fax: +49 228 44 92 2 33
Internet address: http://www.dlr.de/EUREKA/

History and membership

The European EUREKA research initiative was established in 1985 by European research ministers meeting in Hanover. EUREKA currently has 27 *members*: all 15 EU member states plus the Czech Republic, Hungary, Iceland, Lithuania, Norway, Poland, Romania, the Russian Federation, Slovenia, Switzerland, Turkey and the European Commission. Croatia, Israel and Latvia were admitted in 2000. As a matter of policy, participants from non-member countries can also take part in individual EUREKA projects.

Tasks and objectives

EUREKA provides a flexible and open framework for co-operation on civilian research and development with a strong practical element. The member states aim to use EUREKA to co-ordinate and strengthen cross-border co-operation by companies and research institutions on innovative industrial projects.

EUREKA helps to ensure

- that better use is made of the experts, expertise, institutions and financial resources available in Europe;
- that Europe's competitiveness on the world markets is enhanced;
- that cross-border problems, particularly in the environmental field, are resolved;
- that European infrastructures and standards are developed;
- that the single European market is made a reality.

EUREKA thus also represents an additional instrument alongside the European Union's research programmes. Furthermore, EUREKA acts as a bridge to the countries of Central and Eastern Europe.

Special features

- Bottom-up approach: i.e. the initiative for projects comes from the participants who themselves define the theme, identify the partners and determine the nature and scope of the co-operation.
- Not a funding programme providing project funding. The participants in the projects are themselves responsible for the funding. If German partners require grants, they may apply for funding under all relevant programmes of the Federal Government, the *Länder* and the EU.
- Lean administration and simple application procedure.
- Opening up to Central and Eastern Europe: inclusion in 1999 of Lithuania as a sixth eastern European country.

Organisation

One particular characteristic of EUREKA is its decentralised structure. Working units in the partner countries together form a flexible network with little bureaucracy. The chairmanship moves each year from one member state to another.

- *Ministerial Conference* – EUREKA's supreme political body stipulates objectives and structures and meets once a year at the end of a chairmanship.
- *Inter-parliamentary Conference* of members of the national parliaments – convenes once a year before the Ministerial Conference as a multiplier and co-ordinating body.
- *High Level Group* – prepares the decisions of the Ministerial Conference and monitors their implementation.
- *National Project Co-ordinators* – executive organs in the member states; contact points for project participants and other interested parties; provide information in their countries about EUREKA (in Germany – BMBF, Referat 115 A, supported by the EUREKA/COST Office at the DLR).
- *EUREKA Secretariat in Brussels* – joint services centre; EUREKA project database.

Current developments

On 23 June 1999, the *Federal Republic of Germany* assumed the *chairmanship of EUREKA* for one year. In the run-up to this, a comprehensive evaluation of EUREKA was undertaken on the initiative of Germany and Turkey. The outcome: EUREKA has proved its worth as an industry-led, pan-European and flexible instrument for supporting market-driven research, but needs to be repositioned.

On this basis, the Federal Government drafted the programme for the year of its chairmanship. The overriding objective was to revitalise the initiative, e.g. by increasing the involvement of small and medium-sized firms, by launching new strategic projects and further integrating Central and Eastern European countries in transition. In addition, greater efforts should be made to advertise EUREKA at national and international level. In order to achieve these objectives, it is also necessary to allocate again more public funding to EUREKA projects. Greater use should also be made of private sources of funding. Virtually no use has been made so far of Germany's rapidly expanding private venture-capital market to fund EUREKA projects.

At the Ministerial Conference on 23 June 2000 at EXPO 2000 in Hanover, the chairmanship of EUREKA was passed on to Spain.

Project statistics (Status: January 2000)

At present, 681 EUREKA projects are underway involving funding of roughly € 8.2 billion, including 220 projects with German participation and German funding of € 1.7 billion. The priorities include environmental technology and biotechnology, production engineering, and information and communications technology.

Further information

- The EUREKA Web Server (http://www.eureka.be);
- EUREKA in Germany (http://www.dlr.de/EUREKA/);
- "Technologische Zusammenarbeit in Europa, Dokumentation 1999" (available free of charge from the EUREKA/COST Office).

1.3.2 COST – European co-operation in the field of scientific and technical research

COST Secretariat at the Council of the EU,
Rue de la Loi 175, B-1048 Brussels, Belgium
Phone: +32 22 85 68 96
Fax: +32 22 85 65 80
Internet address: http://www.belspo.be/cost

COST Secretariat of the European Commission,
Rue de la Loi 200, B-1049 Brussels, Belgium
Phone +32 22 99 36 83
Fax: +32 22 99 39 60

EUREKA/COST Office of the BMBF at the DLR,
Postfach 30 03 64, D-53183 Bonn, Germany
Phone: +49 228 44 92 260
Fax.: +49 228 44 92 233
Internet address: http://www.dlr.de/COST/

INFO-BOX

OPPORTUNITIES IN EUROPE – EUROPEAN EDUCATIONAL PROGRAMMES AND CO-OPERATION ON EDUCATION

In the education sector, the new EU vocational training programme LEONARDO DA VINCI II, the higher education programme TEMPUS III and the education programme SOCRATES II were adopted in 1999. At the same time, a priority objective was to ensure that the new educational programmes were ready to be launched on schedule on 1 January 2000. Under LEONARDO II, funding is given to pilot projects, mobility measures for trainees and instructors, networks and comparative studies. LEONARDO II was adopted with a budget of € 1.15 billion for seven years.

SOCRATES II also runs for seven years and has a budget of € 1.85 billion. The following actions are funded under SOCRATES II:

- Action 1 Comenius (school education),
- Action 2 Erasmus (higher education),
- Action 3 Grundtvig (adult education),
- Action 4 Lingua (teaching and learning of languages),
- Action 5 Minerva (multimedia in education),
- Action 6 Joint actions,
- Action 7 Observation and innovation, and
- Action 8 Accompanying measures.

Implementation of LEONARDO DA VINCI I and SOCRATES I in Germany

LEONARDO DA VINCI I, the action programme for the implementation of a common vocational training policy which ran from 1995 through 1999 aimed to improve the quality of vocational training in the participating European countries and thus to enhance the efficiency of these countries' vocational training systems. The budget for the entire period of the programme, including top-ups, amounted to ECU 620 million.

The number of approved projects under German leadership, which were designed to develop innovative solutions and facilitate subject-related visits abroad by trainees, students at vocational schools, young workers and instructors, totalled 81 in 1999, with total funding of almost € 14 million.

Under the programme, the Carl Duisberg Gesellschaft (CDG – Carl Duisberg Society) had allocated around DM 8.4 million (€ 4.3 million) in 1999 to financing such visits abroad by trainees, students at vocational schools, young workers and instructors. In total, the programme's funding grew by 30 per cent over the previous year. In this way, it was possible to finance some 360 vocational training measures both in-house and outside companies in one of the 28 partner countries involved in the programme. About 4,100 participants benefited from these schemes which lasted from two weeks to up to a year. It proved possible again in 1999 to second a large number of trainees (more than 300) to receive training for more than three months at a foreign training centre/company.

The SOCRATES I action programme, which ran from 1995 to 1999, emphasised the European dimension and promoted transnational co-operation in the field of general education (schools, higher education and other areas). ECU/€ 920 million was allocated to this programme during its five-year term.

In 1999, a total budget of € 217 million was available, of which € 120 million was allocated to higher education. The number of participating German higher education institutions is still rising. The 236 German higher education institutions that are participating now have received around € 5.9 million for the organisation of student mobility, the exchange of lecturers, curriculum development and the development of the European Community Course Credit Transfer System (ECTS). Roughly € 14 million was spent on funding student mobility. Some 15,500 students integrated a period at a foreign higher education institution into their study course in the 1999/2000 academic year. The leading destination for German students is the United Kingdom. Germany continues to be one of the three main destinations for foreign students in Europe.

Growth was also recorded in the school sector. In particular, the number of German schools participating in Comenius rose substantially. There were 596 participating schools in 1997 and 831 in 1998; the figure for 1999 increased to over 1,200. Of the € 36.7 million available for Comenius across Europe, German schools were able to utilise € 6.4 million for European collaborative exercises.

The promotion of language acquisition under the Lingua programme section, which primarily benefits participants from the field of vocational training, has also been further expanded. In 1999, it benefited roughly 1,480 students at vocational schools who received funding via the Pädagogischer Austauschdienst (Educational Exchange Service) of the Kultusministerkonferenz (KMK – Standing Conference of the Ministers of Education and Cultural Affairs of the Länder) and some 1,830 trainees, who were assisted by the Carl Duisberg Society. 1,700 teachers and instructors participated in the exchange in order to learn a foreign language.

Information: http://europa.eu.int/comm/education/index_en.html

History and membership

Since 1971, COST *(European Co-operation in the field of Scientific and Technical Research)* has provided a framework in which European research centres, higher education institutions and companies come together to work on joint projects – mainly in the field of basic research, but also in research at pre-competitive level and research into issues of public interest.

Members: currently the 15 EU countries and Croatia, the Czech Republic, Estonia, Hungary, Iceland, Malta, Norway, Poland, Romania, the Slovak Republic, Slovenia, Switzerland and Turkey, and since May 1999 also Bulgaria, Cyprus, Latvia and Lithuania.

Tasks and objectives

Co-operation under COST, which – as a matter of principle – is open to any subject field, is currently focusing on: information and communications technology, transport and traffic including aeronautical research, meteorology and oceanography, environment, agriculture and forestry, biotechnology and food sciences, medical, physical and chemical research, materials research, nanosciences, urban civil engineering, social sciences. Here, too, the aim is to achieve an ever greater integration of national research capacities into an ever more efficient science community.

The following principles apply to co-operation:
- All member states and the European Union may propose research projects for inclusion as COST actions (bottom-up approach).
- Participation in COST actions is based on the à-la-carte principle, i.e. each member state is entitled, but not obliged, to participate in an action.
- Co-operation takes the form of concerted actions, i.e. it is the result of the co-ordination of national research projects.
- If participants wish to seek government funding, this occurs on a national basis.

COST supplements the work done under the Fourth and Fifth RTD Framework Programmes and has prepared the ground for many of the subjects covered there. Efforts are being made to achieve an even greater link between COST activities and the specific programmes and other research initiatives.

Organisation

- *Ministerial Conference* – supreme decision-making body, meets every few years.
- *Committee of Scientific Officials* – highest decision-making body between the ministerial conferences.
- *COST Secretariat at the Council of the EU* – supports the Committee of Scientific Officials.
- *COST Secretariat of the European Commission* – supports those participating in the actions.
- *Management committees* – co-ordinate within the individual actions.
- *Technical committees* – for broader thematic areas; assess new proposals, monitor running projects and are responsible for the final evaluation of the actions.

Statistics

COST has kept growing since the early 1980s. Since 1990, interest has risen sharply. The total number of running actions is now roughly 160, 145 with German participation.

Current developments

Substantive: in the field of environmental research, an ad-hoc group is studying the possibility for synergies between the various fields of COST, the Fifth Framework Programme and national environmental research; the same goes for activities in the field of nanosciences.

Organisational: the way the administration is organised and carried out is being streamlined and adjusted to the large number of members and guests and the increased number of actions.

Further information

- COST homepage (http://www.bespo.be/cost);
- COST in Germany (http://www.dlr.de/COST/);
- COST-Handbuch (available free of charge in the EUREKA/COST Office).

1.3.3 European Space Agency (ESA)

8–10, rue Mario Nikis, F-75738 Paris Cédex 15, France
Internet address: http://www.esa.int

Members: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom;

Canada participates in the individual programmes on the basis of a co-operation agreement.

The European Space Agency (ESA) was established on 31 May 1975 by the merger of two predecessor institutions (ELDO, ESRO), with the aim of ensuring and developing co-operation between European countries for exclusively peaceful purposes in the field of space research and technology. ESA's activities include major space technology programmes in the field of infrastructure, such as the development of the ARIANE launcher family and the manned spaceflight programme, under which the European role in the International Space Station is being implemented in the form of the COF (Columbus Orbital Facility) laboratory module and supply flights with the ATV (Automated Transfer Vehicle). Also, programmes in areas like researching the universe, conducting science missions in space, remote sensing of the earth, telecommunications and navigation are organised and carried out on a European basis in ESA.

Tasks

- Development and promotion of co-operation between European countries for exclusively peaceful purposes in the field of space research, space technology and space technology applications, as well as
- elaborating and implementing a long-term European space policy and a European space programme, as well as an industrial policy.

To this end, the following activities are taking place:
- extraterrestrial research in the context of a scientific programme;
- programmes on space infrastructure (especially ARIANE, ATV, COF);
- application-oriented programmes in the fields of research under microgravity conditions, earth observation, telecommunications and navigation;
- technology programmes;
- the necessary basic and support activities which are part of the General Budget.

Structure and budget

The organisation's organs are the Council and the Director General. The Council consists of representatives of the member states. On behalf of the Federal Government, the Deutsches Zentrum für Luft- und Raumfahrt (DLR – German Aerospace Centre) represents German interests and heads the German delegation to the ESA Council and the other ESA bodies.

In addition to its headquarters in Paris, ESA also has the following branches/establishments:
- ESTEC, the European Space Research and Technology Centre in Noordwijk (Netherlands). This is mainly a base for ESA's technical research and testing facilities;
- SOC, the European Space Operations Centre in Darmstadt, with the satellite control and computer centre and the ground stations in Redu (Belgium) and Villafranca (Spain). In addition, ground stations in Perth (Australia), Fucino (Italy), Malindi (Kenya), Ibaraki (Japan), Maspalomas (Canary Islands/Spain) and Kiruna (Sweden) are used. In particular, ESOC is responsible for controlling most of the European satellites;
- ESRIN in Frascati (Italy) has scientific and technical information services (IRS) and the Earthnet programme office, which receives, processes, archives and distributes remote sensing satellite data;
- AC, the European Astronaut Centre in Cologne-Porz, the European astronauts' home base since it was founded in 1989. Alongside ESOC, it is the second ESA establishment in Germany;
- Kourou (French Guyana), a launch facility for European launcher systems.

Expenditure in € million	Actual		Planned	
	1997	1998	1999	2000
Current expenditure	2179	2304,6	3108	2641
of which:				
Expenditure on staff (excluding non-ESA staff)	(165.3)	(164.1)	(171)	(193)
Investment	92.1	84.2	109	110
Total	**2271.1**	**2388.8**	**3217**	**2751**
Permanent ESA staff*	1852	1747	1686	1723

* Due to ESA's complex organisational structure, it is not possible to make a breakdown into scientific, technical and administrative staff.

Source: DLR

Current developments

A Council conference at ministerial level was held in Brussels in May 1999. One of the key results was the mandate given to the Director General to continue the efforts of ESA to reform, particularly in the fields of industrial policy, internal ESA procedures, decision-making and increased financial flexibility. The ministers supported the efforts to intensify the dialogue with the EU and expressed their support for the establishment of a European network of space centres.

The meeting in Brussels adopted programmes which aim to maintain industrial and scientific competitiveness. The decision on launcher systems (German participation in the ARIANE 5 Plus, ARTA and Infrastructure programmes) is intended to ensure that Europe retains an outstanding position on the world market in the first decade of the new millennium. In the field of scientific earth observation, a framework programme was adopted with Germany as the largest participant.

In the field of application-oriented programmes, the definition phase of a GalileoSat navigation programme was adopted. This joint programme with the EU is intended to provide better for civilian needs in security-critical applications and to ensure the largest possible share of this growing world market for European industry; it is to be implemented in the form of a public-private partnership (PPP).

1.3.4 European Organisation for Nuclear Research European Laboratory for Particle Physics (CERN)

CH-1211 Geneva 23, Switzerland
Phone: +41 22-7 67 61 11
Fax: +41 22-7 67 65 55
E-mail address: Neil.Calder@cern.ch
Internet address: http://www.CERN.CH

Members: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom

Legal status

International organisation (basis: international convention of 1 July 1953)

Tasks

Basic research in the field of elementary particles (high energy physics), focusing on:
- Study of the elementary components of matter with the aid of particle accelerators;
- nuclear physics;

– promotion of international co-operation in the field of high energy physics;
– technology transfer;
– operation of the Large Electron-Positron collider (LEP);
– construction of the Large Hadron Collider (LHC) by 2005.

Structure and budget
The funding for the activities is provided by the member states on the basis of a contribution percentage determined by a GNP key. Germany currently provides about 25 per cent of the budget.

Expenditure in SFr million	Actual		Planned	
	1997	1998	1999	2000
	876	904	940	1022
Staff	1997	1998	1999	2000
	2819	2754	2734	2660

Source: BMBF

Current developments
The world's largest particle accelerator, the LEP Large Electron-Positron Collider, will continue to operate until 2000 despite the installation of the Large Hadron Collider (LHC) in the LEP tunnel. In fact, the energy has been more than doubled compared with initial plans – expressed in energy units: 2 x 100 GeV. This is a major advance in the search for the Higgs-Boson, a key elementary particle in high energy physics.

1.3.5 European Southern Observatory (ESO)

Karl-Schwarzschild-Strasse 2, D85748 Garching, Germany
Phone: +49 89-320 06-0
Fax: +49 89-320 23 62
E-mail address: ips@eso.org
Internet address: http://www.eso.org

Members: Belgium, Denmark, France, Germany, Italy, Netherlands, Sweden, Switzerland

Legal status
International organisation (subject of international law, basis: intergovernmental agreement of 5 October 1962)

Tasks
Construction, instrumentation and operation of astronomical observatories based in the southern hemisphere with the following priorities:
– Completion and operation of the world's most powerful optical telescope (Very Large Telescope – VLT);
– Development of new telescopes and instruments;
– Promotion of international co-operation in astronomy;
– Management of the European co-ordination body for the HUBBLE space telescope.

Structure and budget
The funding for the activities is provided by the member states on the basis of a contribution percentage determined by a GNP key. Germany currently provides 26.75 per cent of the budget (ceiling).

Expenditure in DM million	Actual		Planned	
	1997	1998	1999	2000
	196	165	182	173
Staff	1997	1998	1999	2000
	224	224	261	267

Source: BMBF

Current developments
The first two 8 metre telescopes of the Very Large Telescope started operations in the period covered by the report. In mid-2000, all four telescopes will be completed.

ESO is the leading European partner in the current planning phase of the Atacama Large Millimeter Array, ALMA, which is designed as a global project in co-operation with the USA and Japan. The decision to build this large radiotelescope has not yet been taken.

1.3.6 European Molecular Biology Conference (EMBC)

Postfach 102240, D-69012 Heidelberg, Germany
Phone: +49 6221-38 30 31
Fax: +49 6221-38 48 79
E-mail address: EMBO@EMBL-Heidelberg.de
Internet address: http://www.embo.org

Members: Austria, Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom

Legal status
International organisation (basis: intergovernmental agreement of 13 February 1969)

Tasks
EMBC is tasked with promoting European co-operation in the field of molecular biology research by
– awarding research grants;
– organising congresses and courses.

EMBC has transferred responsibility for implementing the programme to the European Molecular Biology Organisation (EMBO), a private organisation under Swiss law.

Structure and budget

The funding for the activities is provided by the member states on the basis of a contribution percentage determined by a GNP key. Germany provides 25 per cent of the budget.

Expenditure in € million	Actual		Planned	
	1997	1998	1999	2000
	9.6	10.1	10.2	10.3
Staff	1997	1998	1999	2000
	7	7	7	7

Source: BMBF

Current developments

The Conference is preparing a new programme to promote the building of networks for young bioscientists.

1.3.7 European Molecular Biology Laboratory (EMBL)

Postfach 10 22 09, D-69012 Heidelberg, Germany
Phone: +49 6221-3870
Fax: +49 6221-38 73 06
E-mail address: info@embl-heidelberg.de
Internet address: http://www.embl.heidelberg.de

Members: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Israel, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom

Legal status

International organisation (basis: intergovernmental agreement of 10 May 1973)

Tasks

– Promotion of co-operation between European countries on biological research; molecular biology research in selected areas (cell biology, structural biology, developmental biology, gene expressions, bioinformatics);
– Implementation of molecular biology experiments with synchrotron radiation at the Hamburg outstation at DESY and at the Grenoble outstation at ESRF as well as with neutron beams at ILL;
– Establishment of the European Bioinformatics Institute (EBI) and development of a database as a European collection point for nucleotide and protein sequences at the Cambridge outstation;
– Establishment of the mouse biology programme in Monterotondo (Italy);
– Education and training of young bioscientists, e.g. via a comprehensive visitor programme and the international PhD programme.

Structure and budget

The funding for the activities is provided by the member states on the basis of a contribution percentage determined by a GNP key. Germany provides 26.4 per cent of the budget.

Ausgaben in Mio. DM	Actual		Planned	
	1997	1998	1999	2000
	123	127	127	130
Staff	1997	1998	1999	2000
	378	399	405	410

Source: BMBF

Current developments

A technology transfer and enterprise management company set up in 1999 to promote technology transfer and the commercial exploitation of patents and other industrial property rights produced at EMBL (EMBLEM GmbH) has begun work. At the end of 2000, the EMBL Council will adopt a new scientific five-year programme for the period 2001 to 2005.

1.3.8 European Synchrotron Radiation Facility (ESRF)

B.P. 220, F-38043 Grenoble Cédex, France
Phone: +33-476 882 000
Fax: +33-476 882 020
E-mail address: cornuejols@esrf.fr
Internet address: http://www.esrf.fr

Members: France, Germany, Italy, Spain, Switzerland, United Kingdom, Nordsync (Denmark, Finland, Norway, Sweden), Benesync (Belgium, Netherlands) and, as scientific members with restricted rights: Portugal and Israel

German shareholder

Forschungszentrum Jülich GmbH

Legal status

Company under French private law (basis: intergovernmental agreement of 16 December 1988)

Tasks

– Construction and operation of the synchrotron radiation facility for research in the field of condensed matter;
– Development and construction of new types of experimental facilities;

– Scientific and technical support for external groups of scientists from the member states in planning, implementing and evaluating the measurements;
– Promotion of its own scientific activities.

Structure and budget
Following the end of the construction phase, Germany contributes 25.5 per cent of the operating costs.

Expenditure in FF million	Actual		Soll	
	1997	1998	1999	2000
	410	428	428	436
Staff	**1997**	**1998**	**1999**	**2000**
	477	500	525	551

Source: BMBF

Current developments
ESRF is encouraging the use of synchrotron radiation by industry for innovative and improved products and is intensifying technology transfer by granting licences.

An agreement has been signed with Israel making it an associate member.

1.3.9 Institut Max von Laue – Paul Langevin (ILL)

B.P. 156, F-38042 Grenoble Cédex, France
Phone: +33-4-76 20 71 11
Fax: +33-4-76 48 39 06
E-mail address: Buttner@ill.fr
Internet address: http://www.ill.fr

Members: France, Germany and United Kingdom and, as scientific members with restricted rights: Austria, Czech Republic, Italy, Russia, Spain and Switzerland

German shareholder
Forschungszentrum Jülich GmbH

Legal status
Company under French private law (basis: intergovernmental agreement of 19 January 1967 with additional agreement, founding treaty and shareholders' statutes of 19 January 1967 plus additional agreements)

Tasks
– Operation of a high flux reactor and its instruments;
– Development and construction of new types of experimental facilities;
– Scientific and technical support for external groups of visitors with regard to planning, implementing and evaluating their measurements;
– Promotion of its own scientific activities.

Structure and budget
The funding for the activities is provided by the member states on the basis of an agreed contribution. Germany currently provides around 37 per cent of the budget.

Expenditure in FF million	Actual		Planned	
	1997	1998	1999	2000
	372	369	354	341
Staff	**1997**	**1998**	**1999**	**2000**
	402	398	402	402

Source: BMBF

Current developments
2000 will see the end of a five-year programme to develop instrumentation which is safeguarding ILL's leading position in neutron research.

1.3.10 European Centre for Medium-Range Weather Forecasts (ECMWF)

Shinfield Park, Reading RG2 9AX, United Kingdom
Phone: +44-11 89 49 90 00
Fax: +44-11 89 86 94 50
E-mail address: ECMWF-Director@ecmwf.int
Internet address: http://www.ecmwf.int

Members: EU countries (except Luxembourg); Norway, Switzerland, Turkey, Yugoslavia[1]

The establishment of the European Centre for Medium-Range Weather Forecasts is the outcome of European co-operation under COST.

Tasks
– Regular issue of medium-range and seasonal weather forecasts;
– Improvement of forecasting techniques through research and development work;
– Further training of scientists in the national meteorological services;
– Establishment and maintenance of a meteorological database for use by the meteorological institutions of the member states for their own studies.

[1] Membership inactive since 5 June 1992

Structure and budget

The ECMWF's leading body is the Council, composed of two representatives of each member state. The Council appoints the Director, who runs the operations, research and administration sections. He is supported by a finance committee, a scientific and a technical advisory committee.

Budget in £ million	1997	1998	1999	2000
German contribution	5.4	5.4	5.4	5.4
Total contributions	24.7	20.7	22.0	22.1

Source:BMVBW (Federal Ministry of Transport, Building and Housing)

1.3.11 European University Institute (EUI)

Badia Fiesolana, Via die Roccettini, 9,
I-50016 San Domenico di Fiesole (near Florence), Italy
Phone: +39 55-4 68 51
Fax: +39 55-46 85-2 98

Established by international agreement of 1972
Contracting states: EU countries

Tasks

The European University Institute is a teaching and research institute for post-graduates. Its task is to contribute – through teaching and research at university level – towards the development of Europe's cultural and scientific heritage. As part of its general academic programme, it develops interdisciplinary projects to do research into the key issues of European politics and society. To this end, the Institute offers the following possibilities for young graduates in the fields of history and cultural history, economics, law, political science and social sciences:

– an EUI doctorate for post-graduates after three years of research at the EUI;
– a special master's degree for graduate lawyers and economists after one year of research;
– a year to do research on European issues and the development of European institutions (Jean Monnet scholarships).

In 1992, the EUI decided to establish the *Robert Schuman Centre*, which is to do research into major overarching questions of European integration. The teaching staff and research assistants from the departments of the EUI, supported by visiting professors and the Jean Monnet chair, come together in working groups to co-ordinate research work on certain topics, organise the expansion of international co-operation networks in their research fields, and hold colloquia and round-table discussions.

Structure and budget

The organs of the EUI are the High Council, the Principal of the Institute and the Academic Council. The High Council, which consists of two representatives from each of the member states, adopts the Institute's budget and stipulates the main guidelines for the EUI. 46 full-time professors form the heart of the international teaching and research staff.

The total expenditure (1998: approx. DM 55.9 million) is funded via contributions from the member states, external funding – mainly from the EU – and a small amount of the EUI's own funds. Like France, Italy and the United Kingdom, Germany pays 17.89 per cent of the contributions from the member states (in 1998: DM 5.7 million from the budget of the BMBF) and also awards 29 scholarships a year via the German Academic Exchange Service (DAAD).

Expenditure in DM million	Actual		Planned	
	1997	1998	1999	2000
Total budget	47.623	55.996	51.929	52.168
German contribution (17.89 per cent of the contracting states' contributions)	5.737	5.836	5.949	6.097
Staff	**1997**	**1998**	**1999**	**2000**
Financed by member states	150	151	151	154
Total (including EU funding)	179	182	185	186

Source: EUI

1.3.12 Stiftung Deutsch-Niederländischer Windkanal (DNW – German-Dutch Wind Tunnel Foundation)

Voorsterweg 31, Gemeinde Noordoostpolder,
NL-8300 AD Emmeloord, Netherlands
Phone: +31-52 72 48-5 21
Fax: +31-52 72 48-5 82

Foundation under Dutch private law

Members: Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR – German Aerospace Centre); Nationaal Lucht- en Ruimtevaartlaboratorium (NLR) – each with a 50 per cent share

Tasks

Operation and development of the largest and most modern low-speed wind tunnel in Europe. In co-ordination with the shareholders, the DNW Foundation is assuming responsibility for the operation of further wind tunnels and associated facilities in Europe. Here, the aim of both partners and the ministries is to achieve a further optimisation of the cost and staff structure. Wind tunnel studies are carried out on a contractual basis on behalf of the European aeronautical industry and other interested parties.

Structure and budget

The Foundation's only organ is the steering committee, on which all sides are equally represented (two representatives from each of the partners and the relevant ministries). Its work is supported by an advisory committee consisting of eight representatives of industry and science.

Expenditure in FF million	Actual		Planned	
	1997	1998	1999	2000*
Current expenditure, including:	9.8	11.5	11.7	35.0
Staff	(6.5)	(7.6)	(7.5)	(22.4)
Investment	2.2	2.8	3.6	8.0
Total	12.0	14.3	13.1	43.0
Staff numbers	49	50	51	148

* Including spending on other wind tunnels whose management has been transferred to the DNW.

Source: BMBF

1.3.13 European Transonic Wind Tunnel (ETW)

Ernst-Mach-Strasse,
D-51147 Cologne-Porz, Germany
Phone: +49 22 03-609-110
Fax: +49 22 03-609-270

Company under German private law
(European Transonic Windtunnel GmbH)

Shareholders: France, Germany, Netherlands, United Kingdom

Tasks
Operation of the world's first and only cryogenic transonic wind tunnel to simulate and optimise new aircraft projects under cruise flight conditions at the design stage.

Structure and budget
The supervisory board consists of representatives of the governments and the national research institutions of the member countries.

The construction costs of the wind tunnel amounted to DM 666.6 million. The initial operations phase began in mid-1994 and was completed in 1999. Germany (Federal Government only) bore

Expenditure in DM million	Actual		Planned	
	1997	1998	1999	2000
Operating costs (without depreciation)	22.6	19.0	14.3	12.4
Investment	4.0	2.3	1.7	2.0
Total	26.6	21.3	16.0	14.4
Staff	47.0	43.0	29.0	29.0

Source: BMBF

31 per cent of the costs of the initial operations phase. The first major studies are to be carried out from 2000 for the A 3XX Airbus wide-body jet. The participating governments are preparing a new agreement providing for the joint financing of costs not otherwise covered in the first operations phase from 2000 to 2003.

1.3.14 Franco-German Research Institute Saint-Louis (ISL)

5, rue du Général Cassagnou, B. P. 34
F-68301 Saint Louis, France
Postal address: Postfach 12 60
D-79574 Weil am Rhein, Germany

Joint research institute in the sphere of the German Federal Ministry of Defence and the French Defence Ministry

Tasks
The Institute carries out basic research and scientific studies and basic preliminary developments in the field of arms and ammunition. The work covers the following main areas: spread and effect of air waves and turbulences, lasers, tank penetration/tank protection, explosives/detonation, internal ballistics, electromagnetic acceleration, intelligent target approach and measurement procedures.

Legal status
The ISL is operated jointly by Germany and France in line with the agreement signed by the two governments on 31 March 1958. Following a proposal from the scientific advisory board, which consists of nine German and nine French representatives, the administrative board, consisting of three members appointed by each of the two governments, defines both a short-term and a medium-term research programme.

Staff and budget
The ISL currently has 429 staff (339 French and 90 German nationals). Roughly half of them work in three scientific working groups, which consist of seven departments and two project groups. Wherever possible, the 88 scheduled positions for scientists and the 95 posts for engineers and highly qualified technical personnel are staffed with equal numbers of German and French nationals.

Expenditure in DM million[1]	Actual		Planned	
	1997	1998	1999	2000
	41.5	39.2	38.3	40.4
Staff	**1997**	**1998**	**1999**	**2000**
Total staff (excluding trainees, actual figure as of 30 June)	458	458	458	429

1 German share

Source: BMVg (Federal Ministry of Defence)

France and Germany each provide half of the funding for the activities.

1.3.15 Council of Europe

Council of Europe
F-67075 Strasbourg Cédex, France
Phone: +33 388 412 000
Homepage: http://www.coe.int

The Council of Europe was founded on 5 May 1949. The number of member states has risen from 23 to 41 since the political and economic changes in the countries of Central and Eastern Europe.

Tasks
The activities of the Council of Europe are centred on promoting democracy, human rights and the rule of law. The organisation also works to preserve the diversity of Europe's cultural heritage and addresses the risks of new technologies and questions of bioethics.

Under the European Cultural Convention, an Education Committee and a Higher Education and Research Committee were set up. The latter is assisting with the legislative reforms in the higher education and research sectors in Central and Eastern Europe.

Budget
The budget of the Council for Cultural Co-operation, which embraces these two committees, amounted to FF 25 million in 1999. In 2000, FF 33 million is allocated. Germany contributes 12.75 per cent to this funding, which also finances cultural co-operation and the preservation of the cultural heritage.

FF 730,000 and nine posts are earmarked in 2000 for the legislative reform programme and for technical support and co-operation in the education sector.

2. Co-operation with non-European countries and regions

Also in recent years, world-wide co-operation in research and technology was intensified for the benefit of all participants. Basically, co-operation serves a two-fold objective: It aims to continue to strengthen the co-operative network in those countries that are leading in science and technology and it strives to develop co-operation with important developing and newly industrialised countries in areas of mutual interest. This is not least done with a view to economic co-operation at the business enterprise level that is building on or developing alongside the bilateral co-operation between Germany and other countries and regions.

2.1 Co-operation with the USA and Canada

Among the industrialised countries, the **USA** ranks first in scientific and technological co-operation with Germany. US research institutes are front runners in almost all forward-looking technologies. This is why more than 50 bilateral co-operation agreements were concluded with the USA alone. They provide the basis for a close network of US-German research projects. The new agreement on scientific and technological co-operation concluded between the USA and Germany in 1998 takes into account the European dimension of research co-operation that includes the Central and Eastern European countries, thus creating new opportunities for co-operation.

Existing bilateral programmes focus on the following areas:

– Space research and spaceflight technology
  Activities in this area centre on the International Space Station, ISS, to whose construction Germany is making a major contribution The first modules of the Station are already in place. There is also intensive bilateral co-operation focusing on extraterrestrial research (e.g. the German contribution to the Mars Pathfinder mission), earth observation and technology development.

– Environmental and climate research / environmental technology
  As in spaceflight activities, there are many US-German project partners who co-operate in this sector within the framework of world-wide research networks. Studies concentrate on the varied interrelationships within the overall terrestrial system, the climate system (e.g. the El Niño phenomenon) and the ozone layer. Another central aspect is the exploration of new methods for cleaning up and rehabilitating contaminated sites. In this context the use of biotechnological processes is gaining increasing importance.

– Information technology/multimedia
  There are many ongoing research activities between US and German universities in the field of basic IT technologies and IT applications which often also involve business companies. Subjects being studied include the SQUID technology, semiconductor heterostructures and ion technologies.

– Energy research
  A new framework agreement on co-operation in energy research was concluded between the BMBF and the US Department of Energy (DoE) in February 1998. It provides a new foundation for already existing close bilateral co-operation.

– Medical research
  In 1998, a modernised version was signed of the agreement concluded 20 years ago between the BMBF and the Department of Health and Human Services (DHHS) on bilateral co-operation in health research. It provides an up-to-date contractual basis for already existing close links between German and US medical research.

Another example of close transatlantic co-operation is the joint use of large-scale scientific equipment in the USA or in Europe. This includes US and Canadian involvement in DESY as well as US participation in the construction of the Large Hadron Collider (LHC) at CERN, including the two major LHC experiments (see Part III, section 2).

In all areas of science and research, a host of initiatives in science and industry and several thousands of government-financed visits every year by scientists and students to the partner country and a traditionally extensive exchange of information ensure that there is an enormously wide range of joint or complementary scientific work.

The German Historical Institute (DHI) in Washington provides a basis for the co-operation between German and US historians (see Part VI, section 5). In early 1998 the German-American Centre for Visiting Scholars (GACVS) was set up in the institute building with BMWi project funds. It offers young German and US scientists of all disciplines a place and the necessary infrastructure for scientific work in Washington, D.C.

The Deutscher Akademischer Austauschdienst (DAAD – German Academic Exchange Service), the Alexander von Humboldt Foundation (AvH) and the Deutsche Forschungsgemeinschaft (DFG) are committed to the exchange of scientists and the promotion of joint research projects. The German-American Academic Council (GAAC) also used to be very active in this field. In particular, it managed the Trans-Coop Programme for the co-operation of young German and US humanities scholars and social scientists. The Council which had been founded in 1993 and was supported by the leading science organisations in both countries promoted an intensive scientific dialogue between Germany and the US. However, due to persistent major shortcomings in administrative work the board of trustees of the GAAC followed a BMBF proposal and decided to close down the organisation by the end of 2000.

Building on the successful activities of the GAAC aimed at creating ties between high-ranking US and German scientific representatives, the transatlantic scientific dialogue will be consistently continued even after the GAAC will have ceased to exist. During the year 2000 already, science organisations on both sides of the Atlantic will get together and define a new programme that will be in keeping with the extraordinary significance attached to US-German scientific relations, meet the high expectations of all those involved and round off ongoing transatlantic activities.

The agreement on scientific and technological co-operation signed with **Canada** in 1971 has spawned activities on a high scientific and technological level. A joint committee which last met in Canada in October 1999 has been entrusted with selecting the subjects to be tackled in joint research projects from proposals made by German and Canadian teams of research scientists.

German-Canadian research co-operation is currently concentrating on four areas:
– Marine research, focusing on integrated coastal zone management;
– Geosciences, focusing on marine environmental geology;
– Materials research and physical technologies, focusing on laser applications;
– Environmental research and technology, focusing on the remediation of contaminated soils as well as on atmospheric physics.

Traditionally, this range is rounded out by research projects in agriculture and forestry as well as medical research and IT. An outstanding example of such co-operation is the digital audio broadcasting project which meanwhile has been successfully completed.

Bilateral co-operation is complemented by agreements on scientific and technological co-operation between Canada and the EU. Under the umbrella of multilateral agreements Canada and Germany (see Part III) are also partners in space, marine and global change research.

2.2 Co-operation with Latin America

For Germany Latin America is an important partner region in the political and economic arenas as well as in education, science, research and technology. By intensifying co-operation in these areas the Federal Government intends to enhance the traditionally flourishing economic and cultural relations. A major impetus in this respect was provided by the EU summit meeting with Latin American and Caribbean countries held in Rio de Janeiro at the end of June 1999.

Co-operation with **Brazil** is especially extensive. The creation of the German-Brazilian Technology Institute which was founded by the local German chamber of industry and commerce has provided a new focus in the field of vocational education and training. The Institute is intended to offer continuing education and training for technicians and engineers and at the same time serve as a showcase for German technology.

An additional impetus for co-operation was provided by the establishment of a German-Brazilian working group to study educational issues. Under the joint leadership of the BMBF and the Brazilian Ministry of Education the German mediating organisations, the *Länder* governments, the Standing Conference of *Länder* Ministers of Education and the Deutscher Industrie- und Handelstag (DIHT – Association of German Chambers of Industry and Commerce) were able to intensify their co-operation with their Brazilian partner organisations in the fields of higher education and vocational education and training. The Bundesinstitut für Berufsbildung (BIBB – Federal Institute for Vocational Training) will organise a joint workshop in Germany; it is also planned to hold a conference on vocational education and training in Brazil. In addition to its traditional exchange programmes the DAAD – using BMBF funds – has developed new programmes to encourage new contacts with Brazilian scientists; these schemes include a multilateral biotechnology project and the International Study Partnership Programme.

Scientific and technological co-operation with Brazil is based on a framework agreement concluded in 1969 whose updated version entered into force on 18 February 1997. This new agreement provides for an essential new element in that it involves Brazilian and German industrial partners in scientific and technological co-operation. The framework agreement is complemented by a number of special agreements.

The emphasis of co-operation is on:
– Environmental research and technology
– Biotechnology
– Information technology
– Materials research
– Marine research
– Space research.

A special focus of co-operation is on environmental research and technology for which a comprehensive concept for biosphere research is being developed. Management concepts are devised for tropical ecosystems, and ecologically sound technologies are developed for industrial applications. The Fraunhofer Society has initiated co-operation with the federal states of São Paulo und Rio Grande do Sul to set up branch offices dealing with automotive technology and computer science.

Co-operation with **Argentina** which is also based on a 1969 framework agreement on scientific and technological co-operation concentrates on priorities similar to those of Brazil. In addition, there are a number of medical and Antarctic research projects. The committee on scientific and technological cooperation is expected to provide a new impetus for stepping up co-operation at its next meeting in 2000.

It is intended to develop scientific and technological co-operation with **Chile** in application-oriented technology areas in particular. To this end, a programme of action was adopted for 1999 and 2000 to intensify bilateral scientific and technological co-operation and its implementation was agreed on. The programme focuses on environmental research and technology, marine research, biotechnology and the geosciences as well as on technology transfer. Both countries have appointed outstanding scientists to act as expert consultants and stimulate and monitor co-operation in these areas.

Scientific and technological co-operation with **Mexico** will also focus on the application-oriented technology areas mentioned above. Business enterprises in both countries will be involved to the greatest extent possible. Mexico has agreed to the German proposal to appoint expert consultants. The biotechnology workshop which will be held in Mexico in April 2000 with the participation of industry is expected to develop a concrete follow-up programme.

2.3 Co-operation with Mediterranean and African countries

Bilateral co-operation in science and research in this region is focusing on Israel, Egypt, Turkey, Tunisia, Morocco and South Africa. The Euro-Mediterranean Partnership and the Barcelona Process are gaining more and importance for co-operation with Mediterranean countries at the political level.

The longstanding successful co-operation with **Israel** in basic and applied research is a particular highlight in bilateral relations. Tools of co-operation include the Minerva Stiftung, co-operation between the BMBF and the Israeli Ministry of Science, Culture and Sports (MoS), the German-Israeli Foundation for Scientific Research and Development (GIF) and German-Israeli Project Co-operation.

The Minerva-Stiftung Gesellschaft für die Forschung mbH with its three programmes was founded more than 40 years ago when it marked the beginning of scientific co-operation with Israel. It provides funding for research projects conducted at the Weizmann Institute of Science in Rehovot, for centres of excellence (Minerva Centres) at Israeli universities and research institutions as well as for fellowships for young scientists. This programme aims to enable young scientists in particular to spend up to two years at an institute in the partner country to do post-doctoral research.

Under the umbrella of co-operation between the BMBF and the Israeli Ministry of Science, Culture and Sports German-Israeli research projects that focus on natural, engineering and life sciences receive funds from specialised BMBF programmes. German business enterprises also participate in these projects under some specialised programmes. Co-operation is augmented and intensified by the German-Israeli Foundation for Scientific Research and Development (GIF) set up in 1986. Quite a considerable number of the Foundation’s bilateral research projects are now also focusing on the humanities and social sciences.

In 1997, German-Israeli Project Co-operation was established as yet another instrument of bilateral collaboration. The purpose of this programme is to fund major interdisciplinary projects in research areas that are especially important for future development. Ongoing projects are focusing on the natural and life sciences.

The BMBF and the Israeli Ministry for Industry and Trade (MIT) intend to initiate co-operation between small and medium-sized enterprises in both countries and are currently discussing the general setting required for such a collaborative scheme for industry. The plan provides for BMBF and MIT to contribute up to DM 2.5 million each every year.

In its endeavour to support the peace process in the Middle East, the Federal Government also participates in multilateral co-operative projects in marine research and environmental technologies involving Israel and its Arab neighbours.

Scientific and technological co-operation with **Egypt** is based on intergovernmental agreements signed in 1979 and 1981 and on various special and project agreements concluded between 1980 and 1985. In recent years new thematic priorities have been defined for this collaboration. Attempts have been made to focus co-operation on a few areas of mutual interest and enhance the application-oriented character and industrial relevance of bilateral projects. At the same time, new university and non-university partners in Egypt joined this co-operation so that its basis could be broadened. Co-operation is focusing on environmental and climate research, the geosciences, materials research, data processing/ microelectronics and plant and agricultural research.

A special agreement concluded in 1997 between the Jülich Research Centre and the Scientific and Technical Research Council of Turkey (TÜBITAK) provides the legal framework for bilateral scientific and technological co-operation with **Turkey**. Bilateral projects are focusing on environmental research, health research, biotechnology and materials research. Activities are also underway in the fields of geosciences and information technology. A new programme was devised for the continuing education and training of young Turkish scientists at German research institutions; its purpose is to enhance co-operation in science and technology.

In September 1998 a Memorandum of Understanding (MoU) on developing scientific and technological co-operation was signed with **Tunisia** with a view to intensifying bilateral relations in the fields of science and research. Based on this MoU a German-Tunisian workshop was held in Tunis in May 1999. Its objective was to define research topics of mutual interest and subsequently implement bilateral projects. About 10 joint projects have meanwhile been initiated as a result of this workshop.

In October 1998 a Memorandum of Understanding (MoU) on developing scientific and technological co-operation was signed with **Morocco;** its purpose, too, is to step up bilateral research co-operation. At the moment, a bilateral geological research project is underway; further activities are planned to prepare future projects.

Scientific and technological co-operation with **South Africa**, which was initiated after the end of apartheid and which is based on an agreement concluded in 1996, was rapidly expanded. Comprising about 45 ongoing bilateral projects, it has developed into an interesting focus of Germany's co-operation with African countries. Collaboration centres on information technology, health research, environmental research, materials research, biotechnology and biomedicine.

2.4 Co-operation with Asia-Pacific

After the economic difficulties on the Asian continent have abated the Asian countries are regaining importance in scientific research and technological development. This is demonstrated, among other things, in the endeavour to step up research funds substantially (**Korea**, for instance, intends to raise its research expenditure to 3 per cent of GNP by the end of 2000). This development is also reflected in increased political activities and invitations to international conferences such as the meeting within the ASEM framework of ministers of science and research organised by the Chinese government in Beijing in October 1999.

The Federal Government is responding to this trend by considerably stepping up its activities. These include in particular:

– *A greater German presence abroad by pro-actively staging presentations at the Technogerma exhibition in Indonesia in March 1999, by organising a technology week in India in November 1999 with major participation of scientific institutions, by holding technology events in several Indian cities and by setting up Technology Area Managers at local German chambers of industry and commerce or at offices of the Fraunhofer Society abroad;*
– Intensified project-oriented co-operation, e.g. by providing additional funds from specialised programmes for the exchange of post-doctoral scientists and by increasing the attraction of Germany for qualified students through granting sur-place fellowships in co-operation with German industry;
– A substantial increase in funds allocated to marketing Germany as an attractive location for higher education and research, and appointment of a Federal Government Commissioner for German University Marketing Abroad who in September 1999 presented a Memorandum on the Future Role of the Federal Republic of Germany in these sectors.

During more than 20 years of scientific and technological co-operation with **China, India, Indonesia, Japan, Korea, Australia and New Zealand** Germany has created a substantial foundation of trust which serves as a basis for further intensifying and extending co-operative activities. Countries with a large number of university graduates who were educated in Germany, such as **Vietnam** and **Mongolia,** are also becoming increasingly interesting partners for our country.

Major events which at the same time highlight the tremendous prospects for the further development of co-operation include:

China

– Official events in Bonn and Beijing in October 1998 to commemorate the 20th anniversary of the signature of the intergovernmental agreement on scientific and technological co-operation;
– visit of the Chinese Minister of Education to Germany in July 1999;

Visit of the Federal Minister of Education and Research to China in October 1999: During this visit the Minister agreed on stepping up co-operation with both the Chinese Ministry of Science and Technology and the Chinese Ministry of Education. This includes:

– *Joint planning by two universities in Germany and China of common curricula for study courses in natural and engineering sciences;*
– *Joint development of methods to preserve organic material from Chinese excavations with a view to creating the basis for the joint opening of important archaeological sites in China; this project is to be decided upon in due time by both partners;*
– *Intensifying research into diagnosing genetic causes of heart diseases which is performed at the joint German-Chinese laboratory at the Fuwai Hospital in Beijing; this objective is to be attained by establishing a research alliance with industrial partners under the German Human Genome Research Programme.*

Japan

– The major organisations involved in co-operation are universities and research institutions, the German-Japanese Council for High Technology and Environmental Protection (DJR) and the German-Japanese Strategic Forum for Information Technology. Co-operation is also supported by the work of the Japanese-German Centre in Berlin (JDZB) which organises a wide range of events and activities, e.g. exchange schemes and language programmes.
– Co-operation consists mostly of scientific events and workshops, e.g. on digital signature and start-ups, organised by the DJR, and of participation in special events such as the WASTEC 1998 and 1999 environmental exhibitions in Japan. Of particular scientific and technological interest are the discussions on a wide range of subjects from new media to computers to semiconductors that

since 1984 have been organised by the Strategic Forum on Information Technology; these events take place alternately in Germany and Japan.
- The planned structural changes within the Japanese government and the Japanese research system which are to mirror German conditions – such as the merger of the Monbusho Ministry of Education with the Science and Technology Agency and the transfer of comprehensive rights to state universities and government-run research organisations – will help to make bilateral co-operation easier.

India
- At its second meeting in Ooty in April 1998 the bilateral committee on scientific and technological co-operation identified new priorities for scientific co-operation. Since that time a number of workshops have been held which dealt in particular with health research focusing on cancer research, as well as with materials research, production engineering and space research/remote sensing. These workshops spawned numerous joint projects. Co-operation in Antarctic research is in the process of being prepared.
- The Under-Secretary for Education and Research, accompanied by a high-ranking delegation, visited India in October 1999 to commemorate the 25th anniversary of the beginning of German-Indian scientific and technological co-operation. During an Indo-German Technology Week technological symposia were held in several Indian cities; the so-called Technology Summit which included an exhibition took place in Hyderabad, and a presentation of the German system of Fachhochschulen (Universities of Applied Sciences) was organised as well.
- The DAAD introduced the following new exchange programmes for undergraduates and scientists:
  - A sandwich Master programme financed by the BMZ involving the five Indian Institutes of Technology and six German Technical Universities which offers continuing education and a higher level of qualification for Indian students in Germany. The term "sandwich" already indicates that this programme involves flexible multi-phase support with activities to be organised alternately in India and in Germany;
  - A project-related staff exchange programme financed by the BMBF to implement bilateral projects involving scientific institutions in the two partner countries.

Indonesia
- For more than 20 years Germany and Indonesia have enjoyed close scientific and technological co-operation. The fact that Indonesia was chosen as the host country for the Technogerma 1999 exhibition and trade fair underlined the importance of this partnership and demonstrated trust in the efforts made by Indonesia to bring about economic and political reforms. After the general election in 1999 the Indonesian research system will be fundamentally restructured, a process in which Germany will play an eminent advisory role: For the first time the Federal Government will support an important newly industrialised country in adapting its research system to meet the requirements of the world market.
- One focus of co-operation might develop in the field of marine research; the joint Steering Committee on Marine Research met for the first time in spring 2000 to discuss sustainable coastal zone management. Sustainability in agriculture and forestry will also be supported by joint research projects, e.g. regarding palm oil production and tropical forest ecology. There are numerous ongoing projects of scientific and technological co-operation in other areas (e.g. in production-oriented environmental protection). IG-Biotech, the new German-Indonesian biotechnology programme, has been designed specifically to support the participation of industry in joint projects.

Vietnam
- The Vietnamese-German Centre at Hanoi Technical University, which was established with the assistance of the Federal Government (Foreign Office and BMBF) and German industry and which is intended to serve as a meeting place and contact centre for representatives of education, science and industry, was inaugurated in December 1999. Vietnam which has a large number of scientists educated in Germany is developing into one of Germany's most dynamic partners in the region.

Korea
- The first joint projects concerning co-operation in the field of environmental protection as an integral part of the production process were discussed as the result of a 1999 fact-finding mission.
- This year the Korean Research Institute KIST Europe which was founded in Germany will start its research activities in a new building.

Australia and New Zealand
- Co-operation with Australia and New Zealand which began more than 20 years ago was continued. A new Australia Centre which was established at the University of Potsdam will open up new possibilities of co-operation in research, higher education and education in general. In 1998, the BMBF contributed to the Centre's programme of events by organising a conference on the two countries' higher education systems. The Federal Minister of Education and Research agreed to become the Centre's German patron in 1999.
- Scientific and technological co-operation with New Zealand continues at a high level. Apart from the USA, Germany is New Zealand's most important partner in international co-operation.

2.5 Co-operation with developing countries

The Federal Government has made it its business to advance the capabilities and performance of third world countries, and hence their development and prosperity, through scientific and technological co-operation. In 1999, the total funding appropriated by the BMBF for scientific and technological co-operation with developing countries amounted to about DM 269 million (excluding funds for energy research and technology), compared with some DM 282 million in 1997. Since 1999 co-operation in the field of energy research and technology has been financed with BMWi funding. The activities of the BMBF in the area of scientific and technological co-operation complement the development schemes of the Federal Ministry for Economic Co-operation and Development (BMZ), thus enabling some partner countries to develop and improve their scientific and technological infrastructure (higher education, technology centres, research institutes).

BMBF activities aim in particular to extend national research programmes, to provide market access for German industry and to train internationally experienced, skilled manpower by

- developing and testing new technologies for use in developing countries,
- adapting processes and technologies commonly used in industrialised countries to the conditions prevailing in the respective partner countries, as well as
- transferring scientific and technological knowledge in order to strengthen the R&D capacities and economic performance and competitiveness of the developing countries.

Co-operation is particularly desirable in those areas where German scientists necessarily have to collaborate with the countries concerned (such as global environmental issues, primeval forest ecology, tropical medicine etc).

Funding and support are focusing on the following priorities:

- In environmental research the *study of tropical ecosystems* is becoming more and more important. The relevant projects aim to deepen the understanding of the mechanisms of action within ecologically important biosystems and to develop concepts for their ecologically sound utilisation. In addition, they intend to improve environmental management strategies and environmental protection in the partner countries. New activities include research plans for maintaining biodiversity which are expected to make major contributions to protecting and sustainably preserving the biosphere.
- Co-operation in the field of *environmental technologies* focuses on developing and adapting low-emission technologies for use in developing countries. Important activities include the development of ecological manufacturing processes, sewage and waste treatment as well as studies of soil and air pollution.
- *Biotechnology* also provides a common basis for co-operation with developing countries. Areas of mutual interest include the study and control of tropical diseases, microbial treatment of sewage and waste, plant breeding, biochemical production processes for food and luxury goods as well as the extraction of active plant ingredients for medical drugs.
- Co-operation with coastal countries in the third world in the field of *marine research* is primarily intended to enhance the conditions required for utilising marine resources and improve the control of marine environmental problems.

3. Multilateral organisations

3.1 Organisation for Economic Co-operation and Development (OECD)

2, rue André Pascal
F-75775 Paris Cedex 16
Internet address: http://www.oecd.org/

Members: 29 states (19 West European states, USA, Canada, Australia, Japan, New Zealand, Mexico, Czech Republic, Korea, Hungary, Poland)

Tasks

The main task of the OECD is to contribute towards the economic development of its member states while endeavouring to maintain a balance of the three paradigms of economic growth, social stability and good public management. To this end, member states promote the development of their resources and encourage research in the scientific and technological field. In the areas of R&D and innovation the OECD also provides a politically and technically highly useful platform for exchanging information and experience, comparative analyses and statistics.

Structure and budget

The OECD's Directorate for Science, Technology and Industry deals with the exchange of information and with science policy studies and co-ordinates activities in selected areas. The working programme is discussed and co-ordinated in the Committee for Science and Technology Policy (CSTP) with its Working Party of National Experts on Science and Technology Indicators and its Working Parties on Biotechnology and on Technology and Innovation Policy and its Global Science Forum in consultation with the Committee for Information, Computer and Communications Policy (CICCP) with its numerous sub-committees. In 1999, the Directorate had a staff of 88 and a budget of FF 55.2 million to which Germany contributed some 10.9 per cent.

With the exception of New Zealand and Poland, all OECD countries are members of the Nuclear Energy Agency (NEA). The Agency conducts nuclear energy studies, provides discussion fora for achieving a consensus on issues of research and licensing in the areas of nuclear safety, the nuclear fuel cycle and nuclear waste management and operates the NEA database. In 1999, the Nuclear Energy Agency had a budget of about FF 73.3 million and a scheduled positions for a staff of 79. Its executive body is the Steering Committee.

The OECD's Centre for Educational Research and Innovation

(CERI) conducts research and provides consultancy in the field of educational policy including social and economic aspects. In 1999, CERI had 20 staff and a budget of FF 19.7 million.

Current developments

In 1998, the Science, Technology and Industry Outlook was published which addresses the drivers of productivity gains, the role of cutting-edge technologies in the revitalisation process of mature industries, and the impact of information and communications technologies on the science system.

Work relating to the interdependence of technology, productivity and the creation of jobs was continued in 1998 with a report on Best Policy Practices.

On 22 and 23 June 1999, the CSTP met at ministerial level and discussed

- the promotion of innovation as a contribution towards sustainable growth and new employment opportunities,
- the response to globalisation and the promotion of international co-operation,
- the adaptation of the legal framework to meet the requirements of scientific and technological progress.

As a result of the preparatory work done by the Megascience Forum, the ministers supported the foundation of a Global Biodiversity Information Facility (GBIF) and set up a working party to resolve the conflict between astronomy and telecommunications regarding the utilisation of the radio wave spectrum.

CSTP and CICCP have started work to contribute towards a study into the causes of differences in growth between the member states and into factors and activities to boost growth.

The German Delegation to CSTP announced that a conference on Benchmarking Industry-Science Relationships would be held in Berlin on 16 and 17 October 2000.

3.2 International Energy Agency (IEA)

8, rue de la Fédération
F-75739 Paris Cedex 15
Internet address: http://www.iea.org/

Members: All OECD states
except: Iceland, Korea, Mexico and Poland

The ministerial meeting held on 24 and 25 May 1999 highlighted the fact that even 25 years after its foundation the IEA's main mission is still to ensure energy supply. This includes reducing the dependence on energy and especially oil imports from a small number of countries and creating efficient crisis management mechanisms.

The ministers confirmed the mid-term plans in place and their objectives. Special attention will be given to the deregulation of the energy markets, climate change as well as research, development and technology. In order to accomplish its tasks more efficiently, the IEA intends to intensify the dialogue with representatives of industry and step up its co-operation with non-member states.

In the field of energy research, development and technology member states are endeavouring in particular to widen the energy basis and contribute towards global warming management. Based on multinational co-operation involving as many IEA member states as possible, new and better energy technologies will be developed and commercialised in four areas: Fossil fuels and Fusion as well as Renewable energies and End-use technologies, i.e. the more efficient and effective use of energy. The framework for this co-operation is provided by about a dozen multinational Implementing Agreements which cover a total of almost 70 ongoing projects. In addition, comparative analyses will be made of the energy and climate technologies developed in the various member countries and of their funding and promotion policies in order to transfer experience gathered with suitable policies designed to develop and disseminate new technologies that are relevant for the energy and environmental sectors.

3.3 International Atomic Energy Agency (IAEA)

Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna
e-mail: Official.Mail@iaea.org

Members: 131 states

The International Atomic Energy Agency was founded in 1957 within the United Nations system.

Tasks

- Promoting worldwide co-operation in nuclear research and technology by organising expert meetings, co-ordinating funding programmes, developing guidelines and recommendations for nuclear safety and radiation protection and by producing comprehensive documentation;
- Supporting developing countries by seconding experts, granting scholarships, organising training courses and supplying equipment;
- Implementing safeguards, especially under the umbrella of the Non-Proliferation Treaty, to prevent the diversion of nuclear materials for building nuclear weapons or other nuclear explosive devices.

The IAEA operates laboratories in Seibersdorf near Vienna, in Monaco and in Trieste.

Structure and budget

The organs of the IAEA are the General Conference of all member states which meets annually, the Board of Governors which currently comprises 35 members and the Director General. Since 1972 Germany has invariably been represented on the Board of Governors.

Germany is participating intensively in the IAEA's work. In addition to its contribution to the Agency's budget Germany also provides funds for activities focusing on safeguards, nuclear safety and

Technical Co-operation. In order to support IAEA safeguards Germany has contributed funding for an R&D programme since 1978 under which conceptual problem solutions and engineered safeguards tools are being developed.

Germany contributes about 9.9 per cent to the IAEA's budget. The 2000 regular budget was US$ 219.1 million. In addition, Germany makes contributions to the Technical Co-operation Fund whose target for 2000 was US$73 million.

Current developments

So far, 45 member states have signed an Additional Protocol of the Agency which – complementing existing safeguards agreements – provides for more extensive duties concerning the provision of information and greater control powers. This is meant to enhance the IAEA's ability to detect undeclared nuclear material or activities. The German law enacting international agreements and the law implementing the Additional Protocol were adopted by the German Bundestag und the Bundesrat, the two chambers of parliament, in late 1999. The Additional Protocol will enter into force in Germany as soon as all 13 non-nuclear-weapon states of the EU will have created the necessary conditions at national level.

The 1999 General Conference provided an opportunity for the German delegation to highlight the fundamental changes in the German energy policy. In spite of Germany's plans to phase out nuclear energy as a source of electricity generation the IAEA will continue to play an important role for Germany, especially in the fields of nuclear material safeguards and nuclear safety.

3.4 United Nations Educational, Scientific and Cultural Organisation (UNESCO)

7, Place de Fontenoy, F-75700 Paris
Internet address: http://www.unesco.org
Specialised United Nations agency

Members: 188 states (as of 15. Nov.1999)

Tasks and current developments

The main objective of UNESCO is to contribute to peace and security in the world by promoting collaboration among nations through education, science, culture and communication.

In the scientific fields of work UNESCO promotes – especially in developing countries – the establishment and development of scientific research and training institutions and of international networks for scientific and technological basic research. UNESCO has launched numerous long-term programmes to support the study and protection of the human environment, also by promoting international co-operation in environmental research (Man and the Biosphere Programme – MAB); the programmes are also designed to co-ordinate marine research through the Intergovernmental Hydrological Commission (IOC – see section 3.5), to explore geological processes (International Geological Correlation Programme – IGCP) and to study the hydrological cycle with a view to the efficient management of water resources (International Hydrological Programme – IHP).

Under an intergovernmental programme called MOST (Management of Social Transformations) UNESCO promotes interregionally networked and comparable social science research projects which deal, among other things, with issues of urbanisation, multicultural co-existence and migration. As far the ethics of science is concerned, UNESCO concentrates on bioethics and hence established the International Bioethics Committee (IBC). In 1997 the 29th General Conference of UNESCO adopted a Universal Declaration on the Human Genome and Human Rights. The World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) set up in 1997 looks into the ethical aspects of other scientific areas.

Under the General Information Programme (PGI) UNESCO is trying to improve the international exchange of information (databases, libraries, archives). More recently, the Organisation's programmes have been increasingly looking into problems arising in the wake of new media technologies.

The World Science Conference held in Budapest in July 1999 took critical stock of scientific achievements and shortcomings at the end of the 20th century and discussed the importance of science for peace. The UNESCO secretariat was commissioned to explore within the COMEST framework whether and how formal obligations could be introduced to strengthen the ethical responsibility of scientists. Mention should be made of the debate on a stronger promotion of women in science; in the course of this discussion the German delegation in particular submitted proposals for concrete measures.

The 30th General Conference held in Paris decided to launch a new project on technical and vocational education and vocational education research. Under this programme an International Centre for Technical and Vocational Education and Training (UNEVOC) will be established in Bonn to direct the exchange of information in this field within a global network of technical and vocational education and training institutions.

The budgets adopted by the General Conference for 2000 and 2001 have remained largely unchanged at a nominal total of some US$ 104 million.

Structure and budget

The Organisation's organs are the General Conference, the Executive Board comprising 58 members (including Germany), and the Director General.

Scientific consultations on programmes take place within scientific committees and intergovernmental or international councils. Being a mediating organisation in the field of cultural policy abroad, the German UNESCO Commission has the task to act as an advisory body to the Federal Government and other responsible agencies, to contribute to implementing the UNESCO programme in Germany, to inform the public and establish contacts between scientific organisations, institutions and experts and UNESCO.

Funding earmarked for important programmes in the regular UNESCO budget

Funding in US$ million	2000/01
Man and the Biosphere (MAB)	10.5
Geology/Natural disasters	7.3
International Hydrological Programme (IHP)	6.7
Intergovernmental Oceanographic Commission (IOC) and other marine research	6.6
Towards a communication and information society for all	18.0
Advancement, transfer and sharing of scientific knowledge	33.7
Social transformations (MOST)	12.0

Source: UNESCO

3.5 Intergovernmental Oceanographic Commission of UNESCO (IOC)

7, Place de Fontenoy
F-75700 Paris
Internet: http://www.unesco.org/ioc

Members: 117 states

The IOC was established in 1960 under the umbrella of the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

Tasks
The IOC is responsible for the international co-ordination of
- marine science through global and regional programmes, including its five main programmes:
  - ocean science in relation to the ocean-climate interaction,
  - ocean science in relation to living resources,
  - ocean science in relation to non-living resources,
  - ocean mapping,
  - marine pollution research and monitoring;
- marine services such as the worldwide system of ocean measuring stations, the international exchange of oceanographic data and the regional tsunami warning system in the Pacific;
- the training of marine scientists from developing countries (TEMA Programme).

Global IOC marine science programmes in which German scientists participate include above all the Global Ocean Observation System (GOOS) and the Joint Global Ocean Flux Study (JGOFS). For details see Part III, section 3.

Structure and budget
The governing bodies of the IOC are the assembly of all member states which meets once every two years and the Executive Council which consists of the chairman, four deputy chairmen and delegates from 29 other countries (including Germany). The Executive Council meets between Assembly meetings. The IOC Secretariat is located in the UNESCO building in Paris.

3.6 UN Commission on Sustainable Development (CSD)

Secretariat: United Nations Plaza, Room DC2-2220
New York, N.Y. 10017, USA
Phone: 001-212-9 63 31 70
Fax: 001-212-9 63 42 60
e-mail: dsd@un.org

Tasks
In the wake of the Earth Summit in Rio de Janeiro the UN Commission on Sustainable Development (CSD) which was established in 1993 has assumed a central role in monitoring the progress made in implementing the commitments of, and advancing, Agenda 21 and other Rio resolutions. CSD membership comprises 53 countries, including Germany. The CSD meets once a year for a two-week conference preceded by expert meetings.

Current developments
The June 1997 special session of the General Assembly again confirmed the role of the CSD as a leading, high-ranking political forum. There was agreement that in future the CSD would concentrate on certain priorities and take on board new issues which were of special importance for implementing the objective of sustainable development and which had not been sufficiently addressed by other international bodies or fora. The CSD's programme of work for 1998 to 2002 reflects this change in emphasis. The next detailed review of Agenda 21 has been scheduled for 2002 ("Rio + 10"). Agenda 21, the programme of action adopted in Rio in 1992, applies to both industrialised and developing countries. It includes commitments relating to combating poverty, demographic policy, trade and environment, waste, chemicals, air quality and energy policies as well as finances, research and technology. The Federal Government is developing its bilateral and multilateral development co-operation programmes in keeping with Agenda 21 and helping to translate it into specific policies in the partner countries. The CSD involves key players outside government (e.g. business enterprises and non-government organisations) in its work.

The 6th session of the Commission on Sustainable Development took place in New York in 1998. The most important issues it addressed were "Industry and sustainable development" and "Freshwater management". The 7th CSD session in 1999 dealt with "Oceans and seas", "Consumption and production patterns", "Tourism" and educational issues. A national report on the progress achieved in implementing Agenda 21 is now being prepared and will serve as a basis for preparing the "Rio + 10" conference in 2002. An intergovernmental group of experts on "Energy and sustainable development" was set up to prepare – by the date of the next CSD session in 2001 – a strategy for a future with sustainable energy supply. The 8th CSD session scheduled for 2000 will address "Integrated planning and management of land resources", "Financial resources, trade and investment, economic growth" as well as

"Agriculture". Other issues to be dealt with include the reports by the Intergovernmental Forum on Forests (IFF) and the interim reports on "Energy", "Poverty" and "Consumption and production patterns".

3.7 United Nations Framework Convention on Climate Change (Climate Change Convention)

Climate Change Secretariat, Haus Carstanjen,
Martin-Luther-King-Straße 8,
P.O. Box 26 01 24
D-53153 Bonn
e-mail: secretariat@unfccc.de
Internet: http://www.unfccc.de

The Climate Change Convention entered into force on 21 March 1994 and was ratified by 154 countries as well as the EU. This was the first time that a legally binding basis for global warming management had been created. The aim of the Convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The convention provides, among other things, for industrialised countries to reduce their greenhouse gas emissions to 1990 levels by the year 2000. Worldwide, Germany is among the countries that are leading in terms of global warming policy. This was one of the reasons why in 1996 the secretariat of the Convention moved to Bonn.

Every year a Conference of the Parties (COP) is held to ensure the implementation and advancement of the Climate Change Convention. Germany hosted the first COP in Berlin from 28 March to 7 April 1995. The most important result of that conference was the Berlin Mandate for further negotiations on strengthening the commitments to limiting and reducing greenhouse gases. A success in this respect could be achieved after intensive negotiations at the third COP in Kyoto from 1 to 12 December 1997. COP 5 which was held in Bonn from 25 October to 5 November 1999 was an important milestone on the way to settling open issues, especially those of a technical nature, in the run-up to COP 6 which is scheduled to take place in The Hague in November 2000.

The process of implementing and advancing the Convention receives considerable support from research. The Federal Government is making contributions mostly within the framework of its environmental and energy research.

3.8 Intergovernmental Panel on Climate Change (IPCC)

IPCC Secretariat, WMO,
41, Av. Guiseppe Motta,
C.P.N 2300
CH-1211 Genf 2
e-mail: IPCC_Sec@gateway.wmo.ch

Member: All member states of WMO and/or UNEP

The IPCC was established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP).

Supported by a large number of scientists from all over the world and based on most recent research results, the IPCC prepares scientific reports on climate change/global warming management. These reports provide important information for the organs of the Climate Change Convention.

Government representatives of about 120 countries adopted the IPCC's Second Assessment Report at their meeting in Rome in December 1995. This report stated for the first time that all previous findings suggested that there was a man-made impact on the climate. The Third Assessment Report is currently under preparation as its completion is scheduled for 2001. To cover the wide range of issues the IPCC has set up three Working Groups: Working Group I is assessing the scientific aspects of the climate system, Working Group II is addressing the consequences of climate change and options for adapting to it and Working Group III is assessing options for limiting greenhouse gas emissions and otherwise mitigating climate change.

Ongoing German research activities have made important contributions to IPCC Reports. A number of German scientists have either co-authored or commented on the Draft Reports. While the Third IPCC Assessment Report was drafted, Germany was able to augment its contributions.

An essential prerequisite for these activities was the establishment of a national IPCC co-ordinating agency. This agency which is being funded by the BMBF started its activities in 1998 and is located at the DLR (German Aerospace Centre) which manages the BMBF's environmental research and technology projects.

3.9 World Meteorological Organisation (WMO) – a United Nations Specialised Agency

41, Av. Guiseppe Motta, CH-1211 Genf 2
Phone: +41-22 730 8111
Fax: +41-22 730 8181
E-mail: ipa@gateway.wmo.ch
Internet: http://www.wmo.ch

Members: 84 states and territories

Tasks

– To facilitate international cooperation in the establishment of networks of stations for making meteorological and hydrological observations;
– To promote the establishment and operation of systems for the rapid exchange of meteorological and related information;
– To promote the standardisation of meteorological observations to ensure consistent quality;
– To further applications of meteorology to aviation, shipping, water management, agriculture and other human activities;
– To encourage research and training in meteorology and related areas and to support the co-ordination of international research and training activities.

Structure and budget

The *World Meteorological Congress* is the supreme body of WMO where the delegates of member states meet every four years. Among other things, the Congress adopts the long-term plan of WMO, approves the budget for the next four years and elects the members of the Executive Council.

The *Executive Council* is composed of thirty-six directors of national meteorological and hydrological services. It meets at least every year to supervise the implementation of Congress resolutions, to study all matters affecting international meteorology and the operation of meteorological services and to prepare pertinent recommendations.

The *Secretariat* is located in Geneva.

Budget in SFR million

	1997	1998	1999	2000
German contribution	5.6	5.9	5.9	5.8
Total contributions	62.2	65.3	65.3	64.3

Source: BMVBW

3.10 North Atlantic Treaty Organisation (NATO)

Boulevard Leopold III,
B-1110 Brussels
Internet: http://www.nato.int/science

Members: 19 states in Europe and North America

Tasks

In addition to its military and security tasks within the Alliance NATO promotes co-operation in science and on environmental issues.

Structure and budget

NATO has a Council comprised of representatives of the member states and an Executive Secretariat with five divisions, one of which is the Division of Scientific and Environmental Affairs managed by an Assistant Secretary General.

The NATO Science Programme promotes:

– Young scientists from Partner countries through science fellowships allowing them to continue their studies or pursue their research for a period in a NATO country, and *vice-versa*;
– Scientific and technical co-operation also with Mediterranean Dialogue countries by funding collaboration on research projects, advanced study institutes and advanced research workshops;
– Computer networking and science and technology policy and organisation under the umbrella of its research infrastructure support scheme;
– Research for application to industrial activities or to environmental problems in Partner countries under its Science for Peace sub-programme.

The Research and Technology Organisation/Research and Technology Agency (RTO/RTA) supports collaboration in defence research activities by building a network.

Funding for the Science Programme (SP) as well as for RTO/RTA is appropriated in NATO's civil budget to which Germany contributes 15.54 per cent from its federal budget.

Current developments

In 1999, NATO's Science Programme fully concentrated on co-operation with Partner countries. Every year about 13,000 scientists are involved as recipients of fellowships, grantees, participants in events or expert consultants.

Funding appropriated for the Science Programme (SP) and RTO/RTA in NATO's civil budget

	1997	1998	1999
SP BF million	1067.6	969.4	951.5
RTO/RTA FF million	30.04	28.72	29.7

3.11 Human Frontier Science Programme Organisation (HFSPO)

Bureau Europe, 20, Place des Halles
F-67080 Strasbourg Cedex
Internet: http://www.hfsp.org

Members: Canada, France, Germany, Italy, Japan, Switzerland, UK, USA and EU

Following an initiative of the Japanese government, the Organisation was established in 1989 by the participants of the world economic summit.

Tasks

The HFSPO promotes international collaboration in basic research in molecular biology and neurobiology as well as the exchange of

Part V

scientists and scientific events. In 1998 and 1999 a total of US$ 90 million was appropriated for research projects, research grants and workshops.

Structure and budget

The main organs of the organisation are the Board of Trustees, which is comprised of representatives of the member states, the Council of Scientists and the Secretary General.

The Human Frontier Science Programme is financed from voluntary contributions by the member states. In the fiscal year 1999 the budget was US$ 47 million to which Germany contributed 2.5 per cent.

3.12 Consultative Group for International Agricultural Research (CGIAR)

1818 H. St., N. W. Washington D.C. 20433, USA

Members: More than 55 donors, including almost all Western industrialised countries (including Germany), developing countries, some of the OPEC countries, three major US foundations (Rockefeller, Ford, Kellogg) as well as international organisations such as the World Bank, UNDP, UNEP und FAO

The CGIAR is an association of governments, international and regional organisations and private foundations under the leadership of the World Bank; it supports a network of sixteen international agricultural research centres and institutes with a view to improving food production in developing countries.

Tasks

In order to respond to the global challenge to ensure the future food supply of a rapidly growing world population on the basis of ever scarcer natural resources the CGIAR has defined the following five major research areas:

- Resource management;
- Safeguarding, utilisation and improvement of genetic resources
- Agricultural systems in keeping with local conditions;
- strategy and organisational development in agricultural policy;
- strengthening of national agricultural research systems.

Structure and budget

Members of the Group meet once a year and there is also a mid-term meeting to discuss the research agendas of the centres and their priorities and to pledge funds in support of those agendas.

The CGIAR Secretariat is a department of, and its staff is appointed by, the World Bank. It provides financial and across-centre administrative services such as acting as a financial clearing-house, organising conferences and monitoring research centre management.

To co-ordinate the centres' research activities and programmes the CGIAR is supported by the Technical Advisory Committee (TAC) whose secretariat is located at the FAO in Rome. Each of the 16 centres has its own autonomous board of trustees which decides on the centre's policy in consultation with the TAC and the Secretariat.

Germany supports the various centres and their research programmes under the Federal Government's development policy priority programmes. In 2000 the CGIAR budget will total US$ 340 million. Germany will contribute about US$ 28 million.

4. International agreements

4.1 Treaties, agreements and memoranda of understanding

In addition to close links within the European Union, Germany has numerous international relations in science and research. Co-operation is in many cases based on treaties, agreements and memoranda of understanding concluded by the Federal Government and its departments, the *Länder*, individual universities and research institutions and in particular the Helmholtz Centres. The major German research funding organisations such as the Max-Planck-Gesellschaft, the Deutsche Forschungsgemeinschaft and the Fraunhofer-Gesellschaft with their contacts with national academies of sciences and similar institutions abroad also contribute to Germany's close interlinkage with the international science community and international centres of excellence.

4.2 Bilateral scientific and technological agreements until March 1998

The following is an overview of the bilateral agreements in the fields of science and research concluded by the Federal Government with one or several partners until March 1998.

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
Argentina					
Governments	Framework Agreement	Scientific research and technological development	31.03.1969	22.10.1969	BGBl. 1970 II 5
DFG – Consejo Nacional de Investigaciones Científicas y Técnicas	Agreement	Co-operation in basic research	11.09.1987	see footnote 1	not published
Australia					
Governments	Agreement	Scientific and technological co-operation	24.08.1976	25.10.1976	BGBl. 1976 II 1941
DFG – Australian Research Council and the Australian National Health and Medical Research Council	Memorandum of Understanding	Research co-operation	15.02.1994	see footnote 1	
Austria					
BMFT – Federal Ministry of Science and Research	Exchange of Letters	Information and documentation	15.09.1980	15.09.1980	not published
MPG – Austrian Academy of Sciences	Agreement	Scientific co-operation in basic research	23.12.1980	01.01.1981	not published
FhG – Austrian Research Centre Seibersdorf	Agreement	Information and scientist exchanges, etc.	16./ 30.08.1988	30.08.1988	not published
Belarus					
BMBF – Ministry of Education and Science	Joint Declaration	Co-operation in the field of industry, science and technology	18.03.1996	19.03.1996	not published
Brazil					
Governments[2]	Framework Agreement	Scientific research and technological development	09.06.1969	12.08.1969	BGBl. 1969 II 2119
DAAD –CNPq	Special Agreement	Exchange of highly qualified scientists for research activities	24.07.1974	24.07.1974	not published
	Supplementary Agreement	To the DAAD Agreement of 24.07.1974	01.10.1976	01.10.1976	not published
Governments	Agreement	Peaceful use of nuclear energy	27.06.1975	18.11.1975	BGBl. 1976 II 334
FhG/Fraunhofer Institute for Information and Data Processing – Centro Tecnológico para Informática/Instituto de Automaçao	Agreement	Industrial automation	14.04.1983	14.04.1983	not published

Part V

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
MPG – CNPq	Agreement	Basic research	28.02.1984	28.02.1984	not published
DFG – CNPq	Special Agreement	Scientific research	05.04.1984	see footnote 1	not published
BMFT – Ministry for Industry and Trade	Special Arrangement	Co-operation on technological innovations for small and medium-sized enterprises	12.09.1985	18.12.1985	BGBl. 1986 II 466
BMFT – Ministry for Mining and Energy	Agreement	New and renewable energy utilisation technologies (supplementing the Framework Agreement of 09.06.1969)	29.08.1989	29.08.1989	not published
Governments	Supplementary Agreement	Renewable energy sources	03.06.1993	03.06.1993	not published
DFG – CAPES	Agreement	Scientific co-operation	27.11.1995	see footnote 1	
Bulgaria					
DFG – Bulgarian Academy of Sciences	Agreement	Scientific co-operation	14.03.1975	see footnote 1	not published
Governments	Agreement	Scientific research and technological development	25.02.1988	25.02.1988	BGBl. 1988 II 372
Canada					
Governments	Agreement	Peaceful use of nuclear energy	11.12.1957	18.12.1957	BAnz. 46/1958
Governments	Agreement	Scientific and technological co-operation	16.04.1971	30.06.1971	BGBl. 1972 II 566
DFG – Natural Sciences and Engineering Research Council of Canada (NSERC)	Agreement	Scientific co-operation	16.06.1983	see footnote 1	not published
FhG/Fraunhofer Institute for Manufacturing Engineering and Automation – Le Centre de Recherche Industrielle du Québec	Agreement	Use of computers in flexible manufacturing systems	07.06./ 17.06.1983	17.06.1983	not published
BMFT – Canda Owners Group (COG)	Agreement	Information exchange in reactor safety research	04.06./ 07.09.1990	07.09.1990	not published
Chile					
Governments	Agreement	Scientific research and technological development	28.08.1970	23.10.1970	BGBl. 1971 II 106

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
DFG – Comisión Nacional de Investigación Científica y Tecnológica	Agreement	Scientific co-operation	09.04.1981	see footnote 1	not published
China					
MPG – Chinese Academy of Sciences (CAS)	Agreement	Basic research	15.09.1978	01.01.1979	not published
MPG – Chinese Academy of Sciences (CAS)	Extensions	Basic research	29.09.1981 28.08.1984 11.10.1987 26.05.1990	01.01.1982 01.01.1985 01.01.1988 01.01.1991	not published
Governments	Agreement	Scientific and technological co-operation	09.10.1978	10.11.1978	BGBl. 1978 II 1526
FhG – Chinese Academy of Sciences (CAS)	Special Agreement	Applied research	11.06.1979	11.06.1979	not published
BMFT – State Commission for Science and Technology (SCST)	Agreement	Implementation of a joint energy study	20.11.1979	20.11.1979	BGBl. 1980 II 61
BMFT – SCST	Agreement	Raw materials and materials research	20.11.1979	20.11.1979	BGBl. 1980 II 63
BMFT – Minister for Metallurgy	Agreement	Ore mining, dressing and metallurgy	20.11.1979	20.11.1979	BGBl. 1980 II 65
BMFT – Minister for the Oil Industry	Agreement	Implementation of a joint research project to determine the hydrocarbon potential in parts of the Linyi Basin	20.11.1979	20.11.1979	BGBl. 1980 II 68
BMFT – Minister for Geology	Agreement	Search for hydro-carbons in the East China Sea	20.11.1979	20.11.1979	BGBl. 1980 I 70
BMJFFG – Health Ministry	Agreement	Health	16.05.1980	16.05.1980	
BMFT – SCST	Agreement	Solar energy pilot project on the utilisation of renewable energy sources for the supply of rural regions	29.10.1980	26.03.1981	BGBl. 1981 II 320
DFG – Education Ministry	Agreement	Scientific research	05.11.1981	see footnote 1	not published
		Supplemented and extended with legal successor	28.03.1998	see footnote 1	

Part V

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
BML – Minister for Agriculture	Agreement	Scientific and technological co-operation in agricultural research	23.11.1981	23.11.1981	BGBl. 1981 II 1143
BMFT – Minister for the Electronics Industry	Agreement	Radio navigation systems for civil aviation	09.12.1982	03.01.1983	BGBl. 1983 II 29
BMFT – Minister for the Space Industry	Agreement	Civil space science and technology	07.03.1083	07.03.1983	BGBl. 1984 II 319
Governments	Agreement	Peaceful use of nuclear energy	09.05.1984	09.05.1984	BGBl. 1984 II 554
BMFT – Central State Oceanographic Office	Agreement	Marine research and development of marine technology	27.06.1986	27.06.1986	BGBl. 1986 II 844
DFG – National Science Council (NSC)	Protocol	Scientific co-operation	28.10.1987	see footnote 1	not published
DFG – Natural Science Foundation (NSFC)	Agreement	Scientific co-operation	25.03.1988	see footnote 1	not published
BMFT – SCST	Agreement	Ecological research, environmental technology	10.09.1988	10.09.1988	BGBl. 1989 II 147
BMFT – SCST	Agreement	Renewable energies	15.12.1988	15.12.1988	BGBl. 1989 II 215
BMFT – SCST	Agreement	Biotechnology	12.10.1991	12.10.1991	not published
FhG – Commission for Science and Technology of the Province of Lia-oning	Special Agreement	Scientific and technological co-operation	20.03.1995	20.03.1995	
FhG – Centre for the Exchange of Science and Technology of the Province of Guangdong	Special Agreement	Scientific and technological co-operation	27.03.1995	27.03.1995	
DARA – China National Space Administration (CNSA)	Agency Agreement	Space research and utilisation of space for peaceful purposes	23.06.1995	23.06.1995	not published
Costa Rica DFG – Consejo Nacional para Investigaciones Científicas y Tecnológicas (CONICIT)	Agreement	Scientific co-operation	09.10.1991	see footnote 1	not published
Croatia BMFT – Ministry of Science and Technology	Joint Declaration	Scientific and technological co-operation	12.07.1994	12.07.1994	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
Czech Republic					
Governments [3]	Agreement	Scientific and technological co-operation	02.11.1990	02.11.1990	BGBl. 1990 II 1691
DFG – Academy of Sciences	Memorandum of Understanding	Research co-operation	01.07.1994	see footnote 1	not published
Egypt					
DFG – Academy of Scientific Research and Technology	Protocol	Scientific research	09.05.1974	see footnote 1	not published
Governments	Agreement	Scientific research and technological development	11.04.1979	20.02.1980	BGBl. 1981 II 135
Finland					
DFG – Academy of Finland	Agreement	Scientific co-operation	17.02.1981	see footnote 1	not published
France					
Governments	Agreement	Construction, launching and utilisation of the SYMPHONIE telecommunications satellite	06.06.1967	10.11.1967	BGBl. 1969 II 84
DFG – Centre National de la Recherche Scientifique (CNRS)	Agreement	Scientific co-operation	01.02.1971	see footnote 1	not published
BMFT – Centre National pour l'Exploitation des Océans	Agreement	Exploration, mining and processing of manganese nodules	26.04.1974	26.04.1974	BGBl. 1974 II 837
BMFT – Ministère de l'Industrie et de la Recherche	Agreement	Advanced reactor systems	13.02.1976	13.02.1976	not published
BMFT – Commissariat à l'Energie Atomique (CEA)	Agreement	Safety research on lightwater reactors	28.09.1983	28.09.1983	BGBl. 1978 II 1300
BMFT – CEA	1st Supplementary Agreement		28.09.1983	28.09.1983	BGBl. 1984 II 944
BMFT – CEA	2nd Supplementary Agreement		20.09.1988	28.09.1988	BGBl. 1989 II 15
Governments	Agreement	Technological and industrial co-operation in the field of broadcasting satellites	29.04.1980	01.12.1980	BGBl. 1981 II 49

Part V

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
DFG – Institut National de la Santé et de la Recherche Médicale	Agreement	Scientific co-operation in the bio-sciences	12.01.1981	see footnote 1	not published
MPG – CNRS	Special Agreement	Scientific research	15.06.1981	15.06.1981	not published
Governments	Agreement (Exchange of Notes)	Joint export of broadcasting satellites	22.09.1981	22.09.1981	BGBl. 1981 II 938
BML – Institut National de la Recherche Agronomique	Agreement	Scientific and technological co-operation in agricultural research	13.06.1986	13.06.1986	BGBl. 1986 II 846
BMFT – CEA	Agreement	Radioactive waste, spent fuel elements, etc.	06.05.1991	06.05.1991	BGBl. 1992 II 1030
Greece					
BMFT – Minister for Co-ordination	Agreement	Solar energy	05.10.1978	05.10.1978	not published
BMFT – Minister for Co-ordination	Framework Agreement	Scientific and tech-nological co-operation	30.11.1978	30.11.1978	BGBl. 1979 II 137
BMFT – Minister for Co-ordination and Minister of Labour	Agreement	Solar village Lykovrissi	31.07.1981	21.02.1983	BGBl. 1985 II 105
BMFT – Minister of Labour	Supplementary Agreement	Solar village project	18.10.1990	18.10.1990	BGBl. 1991 II 599
Hungary					
DFG – Hungarian Academy of Sciences	Agreement/ Exchange of Letters	Scientific co-operation/ legal successor to the Institute for Cultural Relations	27.10.1978 26.02.1981	see footnote 1	not published
Governments	Agreement	Scientific research and technological development	07.10.1987	07.10.1987	BGBl. 1988 II 242
India					
Governments	Agreement	Peaceful use of nuclear energy and space research	05.10.1971	19.05.1972	BGBl. 1972 II 1013
Governments	Agreement	Scientific research and technological development	30.01./ 07.03.1974	07.03.1974	BGBl. 1974 II 998

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
Governments	Memorandum of Understanding	Marine research and marine technology	29.04.1986	29.04.1986	not published
DFG – Indian National Science Academy (INSA)	Agreement	Scientific research	03.04.1990	see footnote 1	not published
FHG – Council of Scientific and Industrial Research (CSIR)	Letter of Intent	Scientific research and technological development	02.02.1994	02.02.1994	not published
Indonesia Governments	Agreement	Peaceful use of nuclear energy and prospecting for uranium	14.06.1976	24.02.1977	BGBl. 1977 II 361
Governments	Agreement	Scientific research and technological development	20.03.1979	06.11.1979	BGBl. 1979 II 1286
BMFT – State Minister for Research and Technology	Agreement	Aeronautical research and technology	19.08.1987	19.08.1987	BGBl. 1987 II 733
Iran Governments	Agreement	Co-operation in scientific and technological development	30.06.1975	21.11.1977	BGBl. 1978 II 280
BMFT – Atomic Energy Organization of Iran	Agreement	Co-operation in the field of the peaceful use of nuclear energy	04.07.1976	21.11.1977	BGBl. 1978 II 284
Iraq Governments	Agreement	Economic, scientific and technological co-operation	26.05.1981	15.07.1981	BGBl. 1981 II 653
Ireland DFG – The Royal Irish Academy	Memorandum of Understanding	Research co-operation	10.03.1993	see footnote 1	
Israel MINERVA – Weizmann Institute of Science	Agreement	Implementation of research projects	17.06.1964	01.01.1964	not published
BMFT – National Council for Research and Development (NCRD)	Exchange of Letters	Appointment of a joint committee to support co-operation in scientific research and technological development	06.08.1973	06.08.1973	not published

Part V

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
BML – Minister of Agriculture	Agreement	Scientific and technological co-operation in the field of agricultural research	22.01.1985	22.01.1985	BGBl. 1985 II 378
BMFT – Minister of Science and Development	Agreement	Foundation for scientific research and development	04.07.1986	04.07.1986	BGBl. 1986 II 890
BMFT – Minister of Science and Technology	Agreement	Amendment of the Agreement on the Foundation for scientific research and development	25.03.1993		
FhG – Technion	Agreement	Microelectronics, information technology, etc.	01.06.1988	01.06.1988	not published
DFG – The Israel Academy of Sciences and Humanities	Memorandum of Understanding	Scientific co-operation	24.03.1993	see footnote 1	
DARA – Israeli Space Agency (ISA)	Agency Agreement	Space research and space utilisation for peaceful purposes	04.12.1995	04.12.1995	not published
Italy DFG – Consiglio Nazionale delle Ricerche (CNR)	Agreement	Scientific co-operation	15.06.1977	see footnote 1	not published
DFG – CNR	Revised Version		10.12.1982	see footnote 1	not published
Japan Governments	Agreement	Co-operation in the field of science and technology	08.10.1974	08.10.1974	BGBl. 1974 II 1326
MPG – Institute of Physical and Chemical Research (RIKEN-Institute)	Agreement	Scientific co-operation in basic research	15.06.1984	15.06.1984	not published
DFG – Japan Society for the Promotion of Science	Agreement	Scientific co-operation	20.05.1992	see footnote 1	not published
Korea (Republic) DFG – Korea Science and Engineering Foundation	Agreement	Scientific co-operation	04.07.1977	see footnote 1	not published
FhG/Fraunhofer Institute for Manufacturing Engineering and Automation (IPA) – Korea Advanced Institute of Science and Technology (KAIST)	Agreement	Production engineering/ automation	04.11.1981	04.11.1981	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
FhG/IPA – Korea Institute of Machinery and Metals (KIMM)	Agreement	Production engineering/ automation	11.05.1982	11.05.1982	not published
Governments	Agreement	Scientific and technological co-operation	11.04.1986	09.09.1986	BGBl. 1986 II 928
Governments	Agreement	Peaceful use of nuclear energy	11.04.1986	11.04.1986	BGBl. 1986 II 726
DFG – Korea Research Foundation	Agreement	Science and technology	20.10.1987	see footnote 1	not published
Kuwait Governments	Agreement	Scientific and technological co-operation	13.12.1979	04.11.1980	BGBl. 1980 II 1502
Mexico Governments	Framework Agreement	Scientific and technological co-operation	06.02.1974	04.09.1975	BGBl. 1976 II 223
BMFT –Secretaría de Asentamientos Humanos y Obras Públicas de los Estados Unidos de Mexico (SAHOP)	Special Agreement	R&D projects for solar energy utilisation	02.05.1978	02.05.1978	not published
BMFT – Secretaría de Patrimonio y Fomento Industrial (SEPAFIN)	Special Agreement	Environment-friendly production technologies	10.02.1982	10.02.1982	not published
DFG – Consejo Nacional de Ciencia y Tecnología (CONACYT)	Agreement	Scientific co-operation	07.10.1991	see footnote 1	not published
Morocco DFG – Centre National de Coordination et de Planification de la RechercheScientifique et Technique (CNR)	Agreement	Science and technology	28.10.1986	see footnote 1	not published
Netherlands BML – Minister for Agriculture and Fisheries	Agreement	Co-operation in the field of agricultural research	30.04.1968	30.04.1968	not published
FhG – Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek	Special Agreement	Applied research	15.06.1987	15.06.1987	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
New Zealand					
Governments	Agreement	Scientific and technological co-operation	02.12.1977	23.08.1978	BGBl. 1979 II 9
Governments	Agreement	Scientific co-operation in Antarctica	26.06.1981	26.06.1981	BGBl. 1981 II 1062
Norway					
BMFT – Norwegian Space Centre	Agreement	Co-operation in hypersonic technology	20.11./ 05.12.1990	05.12.1990	not published
FhG – SINTEF Trondheim	Agreement	Information, laser technology, etc.	01.11.1989	01.11.1989	not published
Pakistan					
Governments	Agreement	Scientific research and technological development	30.11.1972	15.10.1973	BGBl. 1974 II 68
Philippines					
DFG – National Academy of Science and Technology	Agreement	Scientific co-operation	12.12.1983	see footnote 1	not published
DFG – National Research Council	Agreement	Scientific co-operation	13.12.1983	see footnote 1	not published
Poland					
DFG – Polish Academy of Sciences	Protocol	Scientific co-operation	19.06.1974	see footnote 1	not published
BMJFFG – Health Ministry	Agreement	Health	31.10.1975	31.10.1975	
Governments	Agreement	Science and technology	10.11.1989	01.02.1990	BGBl. 1990 II 302
BMJFFG – Health Ministry	Agreement	Health system and medical science	10.11.1989	01.02.1990	BGBl. 1990 II 302
Governments	Agreement	Mutual establishment of institutes for cultural affairs and scientific and technological information	10.11.1989	21.02.1991	BGBl. 1991 II 730
DFG – Polish Academy of Sciences	Memorandum of Understanding	Research co-operation	26.09.1995	see footnote 1	

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
Portugal					
Governments	Agreement	Scientific research and technological development	15.06.1981	21.09.1981	BGBl. 1981 II 1034
BMFT – Ministry for Industry	Agreement	Construction and operation of a solar process heat facility	16.12.1981	16.12.1981	not published
Romania					
Governments	Agreement	Scientific research and technological development	29.06.1973	29.06.1973	BGBl. 1973 II 1481
BMFT – State Committee for Nuclear Energy	Agreement	Peaceful use of nuclear energy	29.06.1973	29.06.1973	BGBl. 1973 II 1484
BML – Minister for Agriculture and the Food Industry	Agreement	Scientific and technological cooperation	16.10.1973	16.10.1973	not published
DFG – Romanian Academy	Agreement	Scientific co-operation	21.10.1976	see footnote 1	not published
DFG – Romanian Academy	Memorandum of Understanding	Research co-operation	07.02.1995	see footnote 1	
BMFT – Ministry of Science, Higher Education and Technology Policy	Sectoral Agreement	High-temperature superconductivity	10.04.1991	10.04.1991	not published
BMFT – Ministry of Science, Higher Education and Technology Policy	Sectoral Agreement	Laser research and laser technology	11.08.1992	11.08.1992	not published
Russia					
DARA – Russian Space Agency (RKA)	Agency Agreement	Space research and utilisation of space for peaceful purposes	01.03.1993	01.03.1993	not published
BMFT – Ministry of Science and Technology Policy	Agreement	Protection of water bodies and environmental technology	01. and 06.06.1994	06.06.1994	not published
BMFT – Ministry of Science and Technology Policy	Agreement	Information and documentation	01. and 07.06.1994	07.06.1994	not published
BMFT – Ministry of Science and Technology Policy	Agreement	Biotechnology	02. and 21.06.1994	21.06.1994	not published
BMFT – Ministry of Science and Technology Policy	Agreement	Marine and polar research	10.02.1995	10.02.1995	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
DFG – The Russian Foundation for Basic Research	Memorandum of Understanding	Research co-operation	06.02.1995	see footnote 1	
Saudi Arabia					
Governments	Agreement	Scientific research and technological development	07.01.1980	24.03.1982	BGBl. 1982 II 565
BMFT – Saudi Arabian National Centre for Science and Technology	Exchange of Letters	Guidelines for the implem entation of joint projects	11.05./ 12.07.1982	12.07.1982	not published
BMFT – King Abdulaziz City for Science and Technology (KACST)	Special Arrangement	HYSOLAR project	23.02.1986	23.02.1986	BGBl. 1986 II 635
	1st Supplementary Agreement		18.01.1990	01.01.1990	BGBl. 1992 II 489
	2nd Supplementary Agreement		10.05.1992	01.01.1992	BGBl. 1992 II 489
Singapore					
BMFT – Ministry of Trade and Industry	Agreement	Scientific research and technological development	13.04.1994	13.04.1994	not published
Slovak Republic					
Governments [3]	Agreement	Scientific and technological co-operation	02.11.1990	02.11.1990	BGBl. 1990 II 1691
DFG – Academy of Sciences	Memorandum of Understanding	Scientific co-operation	19.09.1994	see footnote 1	
Slovenia					
BMFT – Ministry of Science and Technology	Joint Declaration	Scientific and technological co-operation	02.06.1993	02.06.1993	not published
South Africa					
BMBF – Director General for Art, Culture, Science and Technology	Declaration of Intent	Scientific and technological co-operation	02.11.1995	02.11.1995	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
Spain					
Governments	Framework Agreement	Scientific research and technological development	23.04.1970	10.03.1971	BGBl. 1971 II 1006
DFG – Consejo Superior de Investigaciones Científicas (CSIC)	Exchange of Letters	Scientific co-operation	16.12.1970/ 29.01.1971	see footnote 1	not published
Governments	Agreement	Construction and operation of the "German-Spanish Astronomical Centre"	17.07.1972	21.05.1973	BGBl. 1973 II 1557
MPG – National Commission for Astronomy	Special Agreement	Construction and operation of the "German-Spanish Astronomical Centre"	17.07.1972	21.05.1973	not published
Governments	Agreement	Peaceful use of nuclear energy	05.12.1978	13.12.1978	BGBl. 1979 II 134
Governments	Agreement	Solar energy	05.12.1978	13.12.1978	BGBl. 1979 II 130
BML – Ministry of Agriculture	Agreement	Scientific and technological co-operation in agricultural research	22.10.1979	22.10.1979	BGBl. 1979 II 1178
Governments	Agreement	Radioastronomy	15.05.1980	03.08.1981	BGBl. 1981 II 945
MPG – CSIC	Agreement	Scientific co-operation in basic research	02.07.1980	01.01.1981	not published
Sweden					
BMFT – Swedish Office for Space Activities	Exchange of Letters	Co-operation in space research	05.03.1984	05.03.1984	not published
DFG – Research Council for Humanities and Social Sciences	Agreement	Humanities and social sciences	27.05.1987	see footnote 1	not published
BMFT – Swedish National Space Board (SNSB)	Agreement	Freja satellite project	15.08.1990	15.08.1990	BGBl. 1991 II 346
BMFT – SNSB	Agreement	Co-operation in the field of hypersonic technology	26.09.1990	26.09.1990	not published
BMBF – Swedish Nuclear Fuel and Waste Management Company (SWB)	Agreement	Research on the final disposal of radioactive wastes	04.07.1995	01.01.1995	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
Switzerland					
BMFT – Swiss Federal Office for the Energy Industry	Exchange of Letters	Reactor safety	03.04.1982	03.04.1982	not published
Governments	Agreement	Mutual information on the construction and operation of nuclear facilities	10.08.1982	19.09.1983	BGBl. 1983 II 734
BMFT – Swiss Federal Office for Education and Science	Exchange of Letters	Safe disposal of radioactive wastes (Felslabor Grimsel project)	24.02.1983	24.02.1983	not published
Thailand					
DFG – National Research Council	Agreement	Scientific co-operation	11.09.1978	see footnote 1	not published
Turkey					
DFG – Türkiye Bilimsel ve Teknik Arastirma Kurumu	Agreement	Scientific and technological research	03.10.1984	see footnote 1	not published
UK					
BMFT – Science and Research Council (SERC)	Agreement	Active magneto-spheric particle tracer explorer project	17.10.1983	17.10.1983	not published
BMFT – SERC	Agreement	X-ray satellite project	17.10.1983	17.10.1983	not published
BMFT – Medical Research Council	Agreement	AIDS research	18.09.1989	18.09.1989	
BMFT – SERC	Agreement	Basic physical research	02.11.1989	02.11.1989	not published
Ukraine					
BMFT – State Committee for Science and Technology	Joint Declaration	Scientific and technological relations	10.06.1993	10.06.1993	not published
DFG – National Academy of Sciences	Agreement	Research co-operation	04.07.1995	see footnote 1	
USA					
BMFT – National Aeronautics and Space Administration (NASA)	Agreement	Implementation of an aeronomy satellite project	10.06.1969	10.06.1969	BGBl. 1970 II 166
BMFT – NASA	Agreement	Implementation of a HELIOS project (solar probe)	10.06.1969	10.06.1969	BGBl. 1970 II 171
BMFT – Department of the Interior	Agreement	Magnetohydrodynamic energy conversion	21.04.1971	21.04.1971	BGBl. 1971 II 1011

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
BMFT/BMV – Department of Transportation (DOT)	Agreement	Development of advanced ground transportation systems, in parti-cular trackbound rapid transit systems with contactless support, guidance and drive technology	12.06.1973	12.06.1973	BGBl. 1973 II 1029
BMFT/BMV – DOT	Agreement	Extension of the agreement with DOT of 12.06.1973	12.07./ 30.08.1978	30.08.1978	BGBl. 1980 II 1211
BMFT – Atomic Energy Commission (AEC)	Agreement	Reactor safety research and development	06.03.1974	06.03.1974	BGBl. 1974 II 740
BMFT – United States Nuclear Regulatory Commission (USNRC)	Agreement	Extension of the agreement with AEC of 06.03.1974	21.01./ 08.03.1983	08.03.1983	not published
Governments	Agreement	Environmental issues	09.05.1974	26.03.1975	BGBl. 1975 II 1717
Governments	Extension	Environmental issues – including environmental research and development measures	22.03.1985	22.03.1985	BGBl. 1985 II 663
BMFT – AEC	Agreement	Conditioning and disposal of radioactive wastes	20.12.1974	20.12.1974	BGBl. 1975 II 268
BMFT – Department of Energy (DOE)	Agreement	Supplement to the agreement with AEC of 20.12.1974	19.03.1980	19.03.1980	BGBl. 1980 II 1418
BMFT – DOE	Agreement	Extension of the agreement with AEC of 20.12.1974	17.04./ 19.04.1985	31.12.1984 (retroactively)	BGBl. 1985 II 870
BMFT – DOE	Extension		03.09./ 10.10.1990	31.12.1989	BGBl. 1991 II 513
BMFT – DOE	Extension		31.12.1990/03. 01.1991	30.12.1990	BGBl. 1991 II 513
BMFT –Energy Research and Development Administration (ERDA)	Agreement	Sodium-cooled fast breeder reactors	28.06.1976	08.06.1976	BGBl. 1976 II 1448
BMFT – ERDA	Exchange of Letters	Extension with DOE until 31.12.1987	26.08./ 07.10.1986	07.10.1986	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
BMFT – ERDA	Exchange of Letters	Extension with DOE until 31.12.1988	15.12./ 31.12.1987	31.12.1987	
BMFT – ERDA	Extension		01.11./ 30.12.1988/ 08.02.1989	01.01.1989	BGBl. 1991 II 616
BMFT – ERDA	Extension		14.01./ 07.02.1991	01.01.1991	BGBl. 1991 II 616
BMFT – Department of Health, Education and Welfare (DHEW)	Agreement	Biomedical research and technology	22.09.1976	22.09.1976	BGBl. 1976 II 1732
BMFT – Department of Health and Human Services (DHHS)	Exchange of Letters	Extension of the agreement with DHEW of 22.09.1976	20.08.1982/ 14.09.1982	22.09.1981 (retroactively)	not published
BMFT – ERDA	Agreement	Concepts and technologies for gas-cooled reactors	11.02.1977	11.02.1977	BGBl. 1977 II 345
BMFT – ERDA	Exchange of Letters	Extension of the agreement of 11.02.1977	20.01./ 07.04.1987	07.04.1987	BGBl. 1987 II 728
BMFT – ERDA	Agreement	Safeguards and physical protection of nuclear material and facilities	29.09.1977 ---	29.09.1977	not published
BMFT – ERDA	Exchange of Letters	Extension with DOE		29.07.1985	not published
BMFT – NASA	Agreement	BMFT participation in NASA's Jupiter Orbiter and Probe project	05.10.1977	05.10.1977	not published
BMFT – DOT	Agreement	Development of national flight safety systems	20.08.1979	20.08.1979	not published
BMFT – DOE	Agreement	Project for the conversion of methanol to gasoline	20.03.1980	20.03.1980	BGBl. 1980 II 1453
BMFT – Environmental Protection Agency (EPA)	Agreement	Development and demonstration of environmental control technologies for energy systems	02.05.1980	02.05.1980	not published
DFG – National Science Foundation (NSF)	Agreement	Basic research and applied research	24.06.1980	see footnote 1	not published
BMFT – NASA	Agreement	Utilisation of the space transportation system	28.04.1981	30.06.1981	BGBl. 1981 II 650

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
BML – Department of Agriculture (USDA)	Agreement	Co-operation in the field of agri-cultural science and technology	01.06.1981	01.06.1981	BGBl. 1981 II 1977
BMFT – DOE	Special Agreement	Experiments in the Asse salt mine	01.10.1981	01.10.1981	not published
BMFT – DOE	Extension	Experiments in the Asse salt mine	09.09./ 24.09.1986	01.10.1986	not published
BMFT – NASA	Agreement	Active magneto-spheric particle tracer explorer project (AMPTE)	15.10.1981	15.10.1981	BGBl. 1982 II 406
BMFT – NASA	Agreement	X-ray satellite	08.08.1982	08.08.1982	BGBl. 1984 II 540
BMFT – Electric Power Research Institute (EPRI)	Agreement	Energy research and reactor safety	26.08./ 10.09.1982	10.09.1982	not published
BMFT – Federal Aviation Administration	Agreement	Development of air transportation systems	03.10./ 06.11.1984	06.11.1984	not published
BMFT – Department of the Air Force (USAF)	Agreement	Correlation of data from the wind tunnel and flight experiments with a transsonic wing	12.09./ 19.09.1986	19.09.1986	not published
BMFT – DOE	Agreement	Remote control technology	24.04.1987	24.04.1987	BGBl. 1987 II 582
BMFT – NASA	Agreement	Cooperative flights of the Space-borne Imaging Radar- C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR)	06.10.1987	06.10.1987	BGBl. 1987 II 736
BMFT – DOE	Agreement	Exchange of information in the energy sector	20.11.1987	20.11.1987	BGBl. 1987 II 120
BMFT – NSF	Agreement	Continental deep drilling	03.06.1988	03.06.1988	not published
BMFT – NASA	Agreement	Flight activities with the space shuttle	10.07.1989	10.07.1989	BGBl. 1990 II 28
BMFT – NASA	Agreement	Exchange of data on orbital objects (space debris)	08./ 21.09.1989	21.09.1989	BGBl. 1990 II 30
BMFT – DOT	Agreement	Safety of high-speed maglev trains	19.02./ 01.05.1990	01.05.1990	not published

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
BMFT – DOE	Agreement	Monitoring and instrumentation of MOXII facility	28.02.1991	28.02.1991	not published
BMFT – NSF	Agreement	Geoscientific research	07.03.1994	07.03.1994	BGBl. 1994 II 418
BMBF – USNRC	Agreement	Reactor safety research and development	13.12.1995	13.12.1995	BGBl. 1996 II 542
Former USSR4)					
DFG – Academy of Sciences[5]	Agreement	Scientific co-operation	28.09.1970	see footnote 1	not published
Governments	Agreement	Scientific and technological co-operation	22.07.1986	07.07.1987	BGBl. 1988 II 394
BMFT – State Committee for the Utilisation of Nuclear Energy	Agreement	Peaceful use of nuclear energy	22.04.1987	07.07.1987	BGBl. 1988 II 394
BMJFFG – Ministry of Health	Agreement	Health system and medical science	23.04.1987	07.07.1987	BGBl. 1988 II 394
BML – State Committee for the Agroindustrial Complex	Agreement	Agricultural research	04.05.1987	07.07.1987	BGBl. 1988 II 394
BMFT – Academy of Sciences	Agreement	Space research	25.10.1988	05.07.1990	BGBl. 1990 II 801
Venezuela					
Governments	Framework Agreement	Scientific and technological co-operation	16.10.1978	28.12.1978	BGBl. 1979 II 77
BMFT – Minister for Energy and Mining	Special Agreement	Technological co-operation in the energy field	16.10.1978	16.10.1979	not published
DFG – Consejo Nacional de Investigaciones Científicas y Technológicas (CONICIT)	Agreement	Scientific co-operation	06.11.1989	see footnote 1	not published
Former Yugoslavia[6]					
BMFT – Federal Office for International Co-operation in the Field of Science, Education, Culture and Technology	Agreement	Scientific research and technological development	23.05.1975	23.05.1975	BGBl. 1975 II 920

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agreement	Subject	signed on	in force since	Source
Bilateral agreements with several partners					
Belgium/Netherlands Governments	Memorandum	Fast breeder reactors	24.01.1967	24.01.1967 (D/B)	not published
UK/Netherlands Governments	Agreement	Development and utilisation of the gas centrifuge process for the production of enriched uranium	04.03.1970	19.07.1971	BGBl. 1971 II 929 and 1027
USA/France/ Switzerland BMFT – ERDA / CEA / Office of Science and Research of the Swiss Confederation (AWF)	Agreement	Concepts and technologies for gas-cooled reactors	30.09.1977	30.09.1977	not published
France/Spain MPG – CNRS / Instituto Geográfico Nacional (Institut de Radio-Astronomie Millimétrique)	Agreement	Radioastronomy	02.04.1979 MPG/CNRS Supple-mented by IGN on 28.09.1990	02.04.1979	
Japan/USA BMFT – JAERI / US Nuclear Regulatory Commission (NRC)	Agreement	Safety research for cooling pressurised water reactors	25.01./ 20.03./ 18.04.1980	18.04.1980	not published
BMFT – JAERI / NRC	Extension	Safety research for cooling pressurised water reactors	13.03./ 04.04./ 15.04.1985	18.04.1985	not published
BMFT – JAERI / NRC	Extension		16.06./ 19.07./ 14.08.1989	01.10.1988	not published
Belgium/France/ Italy/UK Governments	Agreement	Sodium-cooled breeder reactors	10.01.1984	10.01.1984	BGBl. 1984 II 516

Part V

Footnotes and sources at the end of the table

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
Since Report of the Federal Government on Research 1996:					
Belarus BMBF-Ministry of Education and Science	Joint Declaration	Scientific and technological relations	18.03.1996	18.03.1996	not published
South Africa BMBF-Ministry of Art, Culture, Science and Technology	Agreement	Co-operation in the field of science, research and technology	12.06.1996	12.06.1996	BGBI 1997 II 37
Brazil	Framework Agreement	Co-operation in scientific research and technological development	01.09.1997	18.02.1997	BGBI 1997 II 41
USA BMBF-Stanford Linear Accelerator Centre	Memorandum of Understanding	Co-operation in basic physical research until 01.01.1999	11.01.1997	11.01.1997	not published
BMBF-Department of Energy (DOE)	Framework Agreement	Co-operation in energy research	20.02.1998	20.02.1998	to be published in BGBl. II
BMBF-Department of Health and Human Services (DHHS)	Framework Agreement	Co-operation in health research	24.02.1998	24.02.1998	to be published in BGBl. II

1 The various DFG agreements entered into force shortly after being signed owing to decisions taken by the responsible bodies of the contracting parties.

2 New framework agreement will replace 1969 framework agreement as soon as it enters into force.

3 The agreement concluded with former Czechoslovakia is being applied for the Czech Republic and the Slovak Republic.

4 The agreements under international law concluded between the Federal Republic of Germany and the former USSR continue to be applied in the relations between the Federal Republic of Germany, the Russian Federation and the other successor states (cf. in particular announcement of 14.08.1992 relating to Russian Federation – BGBl. 1992 II p. 1015).

5 The DFG agreement was adopted by Russia and the Ukraine. The contracting parties are the Academies of Sciences of the two countries. Co-operation with scientists of the other countries is being continued for the time being without concluding particular agreements.

6 As regards the successor states of former Yugoslavia, it will be examined in every individual case whether and, if so, on what basis co-operation will be resumed.

Source: BMBF

4.3 Bilateral scientific and technological agreements since March 1998

The following is a list of the bilateral agreements in the fields of science and research concluded by the Federal Govern-ment during the reporting period (March 1998 through March 2000)

Overview of bilateral scientific and technological agreements

Country/Partner	Type of agree-ment	Subject	signed on	in force since	Source
Marokko BMBF-Ministry for Higher Education, Management Staff Training and Research	Memorandum of Under-standing	Scientific and technological co-operation	09.10.1998	09.10.1998	not published
Tunisia BMBF-State Secretariat for Scientific Research and Technology	Memorandum of Under-standing	Scientific and technological co-operation	10.09.1998	10.09.1998	not published

Source: BMBF

Part V

Part VI

Funding organisations, research organisations and research institutions in Germany

(with detailed information on tasks, postal address, telephone, fax and Internet address as well as on budget and staff)

Introduction

This part gives an overview of funding organisations and research institutions in Germany with detailed information on their tasks, postal address, telephone and fax number and Internet address as well as their budgets.

The first chapter introduces the large research funding organisations. The Deutsche Forschungsgemeinschaft (DFG) holds an outstanding position in university research. R&D-funding foundations of national importance with public financial resources are also listed.

In the following four chapters, research institutions and research organisations in the R&D sector are introduced which are co-financed by the Federal Government and the *Länder*. Amongst them figure

– the institutes of the Max-Planck-Gesellschaft (MPG – Max Planck Society) (chapter 2.1);
– the institutes of the Fraunhofer-Gesellschaft (FhG - Fraunhofer Society) (chapter 2.2);
– the research centres of the Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF – Hermann von Helmholtz Association of National Research Centres) (chapter 3);
– Blue List institutions – nearly all members of the Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (WGL – Gottfried Wilhelm Leibniz Science Association) - (chapter 4).

Furthermore, considerable research capacity is available in Federal institutions performing R&D, which are financed by the Federal Government. These institutions are introduced in chapter 5.

The presentation is rounded off by a portrait of the CAESAR foundation.

Chapter 7 gives an overview of service institutions for information and documentation, chapter 8 introduces the DLR space management as well as the project management agencies of the BMBF and the BMWi.

1. Funding organisations

1.1 Deutsche Forschungsgemeinschaft e.V. (DFG)

Kennedyallee 40, 53175 Bonn
Tel.: 02 28-8 85-1; Fax: 02 28-8 85-27 77
E-mail: postmaster@dfg.d400.de
Internet: http://www.dfg.de

Founded:
In 1920 as Notgemeinschaft der Deutschen Wissenschaft, re-established in 1949, after merger with the Forschungsrat (1951) renamed DFG.

Members:
66 universities, 14 non-university research institutions, 7 academies, 3 science associations.

Financing:
In principle, Federal Government (50 percent) and *Länder* (50 percent); for collaborative research centres and the Leibniz Programme, Federal Government (75 percent) and *Länder* (25 percent); for postgraduate research groups, Federal Government (65 percent) and *Länder* (35 percent) (since January 1, 1999: 50 percent : 50 percent) as well as foundation funds and – for special tasks – special funds by the Federal Government.

Structure:
The DFG is the central autonomous organisation of German science.

The central scientific decision-making body is the *Senate*, with 39 scientific members of all disciplines. The Senate among other things annually adopts the DFG's priority programmes and decides on medium-term financial planning (prospects of research and its funding). The *Grants Committee* of the DFG decides on the financial support of research, in particular by decisions on individual applications. It consists of 19 scientific members, eight representatives of the Federal Government and eight of the *Länder* and two representatives of the Donors' Association for the Promotion of Sciences and Humanities in Germany. Decisions on special research programmes and postgraduate research groups are taken by the *Grants Committees*, made up of the members of the Senate committees for special research programmes and postgraduate research groups as well as of representatives of the Federal Government and the *Länder*.

Tasks:
The main task of the DFG is financial support of research projects with resources going mainly to the university sector. DFG statutes furthermore stipulate the tasks of support of cooperation between researchers, support of young scientists, scientific advice for parliaments and authorities and fostering of relations between the science communities in and outside Germany.

In order to live up to these tasks, the DFG has the following instruments and procedures at its disposal:

– *Individual grants programme* – Funding of research projects initiated by a single researcher, funding period one to three years, extension possible;
– *Priority programmes* – Funding and co-ordination of work done by several researchers at different places on a certain topic or project, funding period usually six years;
– *Research units* – A few scientists join forces on a medium-term basis in order to work jointly on particularly innovative, usually interdisciplinary research projects;
– *Collaborative research centres* – Long-term but not permanent research centres of one or – less frequently – several higher education institutions, often in cooperation with non-university research institutions, in which scientists cooperate within the framework of cross-disciplinary research programmes; *transfer centres* are an option for cooperation between scientists and users and serve the rapid translation of innovative ideas from basic research into practical application;
– *Postgraduate research groups* – Long-term programmes established by higher education institutions for the support of young scientists;
– *Career development groups in special programmes* – Additional ways of supporting qualified young scientists are offered by the Emmy Noether Programme, the programme to support professional candidates, the Heisenberg Programme as well as the Gerhard Hess Programme; the Heinz Maier Leibniz Award for the support of young scientists has been awarded annually for 20 years now, since 1997 jointly by the Federal Minister of Education and Research and the President of the Deutsche Forschungsgemeinschaft (individual prize of DM30,000);
– *Gottfried Wilhelm Leibniz Programme* – Outstanding scientific achievements are honoured and supported with the prize of the Leibniz Programme;
– *Centres of excellence* – Special programme on the improvement of research structures at higher education institutions in the new *Länder* and thus the enhancement of their performance; simultaneously support of cooperation with non-university institutions including industry;
– *Humanities research centres* – Complementary support with project resources for six humanities institutions established as successors to former institutes of the GDR's Academy of Sciences;
– *Central research facilities* – Central facilities for research available to all scientists.

DFG funding and its sources

Source of funds/ funding procedure	1998 Actual		1999 Budget		2000	
	Amount DM million	Share %	Amount DM million	Share %	Amount DM million	Share %
Federal Government:						
General research funding [1]	621.1	29.5	686.5	30.1	706.8	30.1
Collaborative research centres	437.9	20.8	459.8	20.2	473.6	20.2
Emmy Noether Programme	-	0.0	-	0.0	20.5	0.9
Leibniz Programme (cutting-edge research)	22.1	1.1	18.0	0.8	20.0	0.9
Postgraduate research groups	75.2	3.6	69.5	3.1	72.0	3.1
Support for professional candidates [2]	21.5	1.0	12.5	0.5	6.3	0.3
Socio-economic panel	2.2	0.1	2.3	0.1	2.3	0.1
For specific tasks	77.3	3.7	91.2	4.0	62.9	2.7
Total	*1257.33*	*59.8*	*1339.8*	*58.8*	*1364.4*	*58.2*
Länder:						
General research funding	620.8	29.5	686.2	30.1	706.6	30.1
Collaborative research centres	146.0	6.9	153.3	6.7	157.9	6.7
Emmy Noether Programme	-	0.0	-	0.0	20.5	0.9
Leibniz Programme (cutting-edge research)	7.4	0.4	6.0	0.3	6.7	0.3
Postgraduate research groups	40.5	1.9	69.5	3.1	72.0	3.1
Support for professional candidates [2]	21.5	1.0	12.5	0.5	6.3	0.3
Socio-economic panel	2.2	0.1	2.3	0.1	2.3	0.1
For specific tasks	2.1	0.1		0.0	0.0	0.0
Total	*840.5*	*39.9*	*929.8*	*40.8*	*972.3*	*41.5*
Donors' Association for German Science	4.2	0.2	5.5	0.2	5.5	0.2
Other funds	3.0	0.1	1.7	0.1	1.7	0.1
Administrative and other earnings	1.2	0.0	1.9	0.1	1.4	0.1
Earnings total	2106.2	100.0	2278.7	100.0	2345.3	100.0

1 Special government funds included (BLE).

2 Heisenberg Programme included.

Source: DFG

Grants awarded by the DFG by funding procedure and programme

Grants awarded[1]	1997			1998		
	Number[2]	Amount DM million	Share %	Number[2]	Amount DM million	Share %
General research funding[3]	17 917	1 220.8	60.0	18 219	1319.3	60.4
of which:						
Individual grants programme[4]	*5 996*	*779.9*	*38.3*	*6 513*	*877.0*	*40.1*
Research units	*81*	*79.0*	*3.9*	*68*	*86.2*	*3.9*
Priority programme procedures[5]	*1 868*	*281.6*	*13.8*	*1 780*	*275.2*	*12.6*
Scientific library services	*365*	*36.4*	*1.8*	*337*	*40.5*	*1.9*
Fostering of scientific contacts abroad	*9 584*	*18.5*	*0.9*	*9 490*	*18.9*	*0.9*
Central research facilities	*4*	*19.3*	*0.9*	*4*	*16.7*	*0.8*
Others	*19*	*6.1*	*0.3*	*27*	*4.8*	*0.2*
Collaborative research centres	256	554.0	27.2	266	598.4	27.4
Postgraduate research groups	292	118.8	5.8	330	128.3	5.9
Heisenberg Programme	117	25.4	1.2	122	24.9	1.1
Postdoctoral programme	213	13.6	0.7	219	14.3	0.7
Leibniz Programme	14	26.9	1.3	10	23.9	1.1
Gerhard Hess Programme	29	8.5	0.4	29	7.9	0.4
Support for professional candidates	395	27.7	1.4	386	27.1	1.2
Centres of excellence[7]	21	21.1	1.0	12	33.3	1.5
Humanities research centres[8]	6	18.0	0.9	6	8.4	0.4
Total	19 451[6]	2034.8	100.0	197 813[6]	2185.8	100.0

1 Grants awarded including multi-annual grants awarded for the following years. Additional grants awarded and cancellations not taken into account.

2 Number of individual grants awarded as well as number of grants awarded to research units, central research facilities, collaborative research centres and postgraduate research groups.

3 Special funds included, without post-doctoral programme and Gerhard Hess Programme.

4 Without research units.

5 In 113 (1997) and 117 (1998) funded priority programmes.

6 191 (1997) and 214 (1998) seminars of collaborative research centres included.

7 Only one-year grants awarded (only for 1997)

Source: DFG

Grants Awarded[1] by the DFG by field of science and subject of study

Field of science / subject of study	1997 Amount DM million	1997 Share %	1998 Amount DM million	1998 Share %
Humanities and Social Sciences				
Social Sciences	66.9	3.6	86.8	4.3
History and Art	67.9	3.6	73.0	3.6
Language and Literature	62.4	3.3	75.1	3.7
Theology, Philosophy, Psychology, Education Science	81.6	4.3	88.4	4.4
total	*278.8*	*14.9*	*323.3*	*16.0*
Biology/Medicine				
Medicine, Nutritional Sciences	343.9	18.3	369.8	18.3
Biology	270.2	14.4	304.4	15.0
Veterinary Medicine	4.9	0.3	4.3	0.2
Agricultural Sciences and Forestry	44.5	2.4	47.2	2.3
total	*663.5*	*35.3*	*725.7*	*35.8*
Natural Sciences				
Mathematics	43.5	2.3	43.9	2.2
Physics	192.2	10.2	183.6	9.1
Chemistry	130.3	6.9	138.5	6.8
Geosciences2)	100.2	5.3	108.1	5.3
total	*466.2*	*24.8*	*474.1*	*23.4*
Engineering				
General Engineering Sciences and Mechanical Engineering	312.9	16.7	330.7	16.3
Architecture, Urban Development, Civil Engineering	25.1	1.3	26.6	1.3
Mining Engineering and Metallurgy	20.7	1.1	20.7	1.0
Electrical Engineering, Computer Science	109.9	5.9	124.4	6.1
total	*468.6*	*25.0*	*502.4*	*24.8*
Total	1 877.1	100.0	2 025.5	100.0

1 Individual grants programme and priority programme procedure, data processing equipment and large-scale research equipment (over DM100,000), research units, special funds, collaborative research centres, postgraduate research centres, post-doctoral programme and support for professional candidates.

2 Solid earth sciences, marine and water research, atmospheric sciences.

Source: DFG

1.2 Deutscher Akademischer Austauschdienst
(DAAD – German Academic Exchange Service)

Kennedyallee 50, 53175 Bonn
Tel.: 02 28-8 82-0; Fax: 02 28-8 82-4 44
E-mail: postmaster@daad.de
Internet: http://www.daad.de

Founded:
Originally in 1925, re-established as registered association under private law in 1950.

Members:
Full members are the universities which are represented in the University Rectors' Conference as well as the student bodies of these universities.

Financing:
Mainly by the public purse, primarily by the Federal Government (approximately 90 percent) and the EU (approximately 6 percent).

Structure:
Apart from the General Assembly, the other organs of the association are the *Board of Trustees* – consisting of appointed representatives of the Federal Government, the *Länder*, university professors, students, science organisations as well as elected representatives of the General Assembly - and the *Executive Committee*. Members of the Executive Committee are the President, the Vice-President, nine personalities with experience in foreign relations, one representative of the Donor's Association for German Science as well as three student representatives.

Tasks:
The DAAD as joint institution of German universities has the task of promoting foreign relations in higher education in particular by means of exchanges of students and scientists. Its programmes are usually open to all disciplines and all countries; Germans and foreigners may equally benefit from them.

With its more than 200 individual programmes, the DAAD pursues the following four main objectives:
– *Individual qualification by cross-border mobility in research, teaching and study* made possible by individual grants, group programmes of German higher education institutions, support for students as placement, bilateral exchanges of university teachers, short programmes;
– *Institutional and project-related academic cooperation with other countries* by regional special programmes, support in the staffing of academic structures, recruitment and placing of German academic teaching staff abroad, support of university partnerships, project-oriented exchange of individuals;
– *Promotion of the German language and of German literature abroad* by recruitment and placing of German lecturers for the German language, special programmes for foreign teachers of German language and literature, promotion of information and cooperation in German studies;
– *(Follow-up) Counselling for scholarship holders, information and publication, higher education marketing, advice for policy-makers* by means of organising events for scholarship holders and follow-up seminars, by providing information and publications for foreigners (Germans) on studies in Germany (abroad), by opinions on issues of foreign cultural policy and international university cooperation.

The total budget for 1999 was DM422.2 million; in addition there are resources held in trust as well as indirect programme resources.

1.3 Alexander von Humboldt-Stiftung
(AvH – Alexander von Humboldt Foundation)

Jean-Paul-Str. 12, 53173 Bonn
Tel.: 02 28-8 33-0; Fax: 02 28-8 33-1 99
E-mail: post@avh.de; Internet: http://www.avh.de

Founded:
Originally in Berlin in 1860; re-established in 1953 by the Federal Republic of Germany as private law foundation with legal capacity.

Financing:
Most funds (approximately 90 percent) come from the Federal Government, in addition, approximately 5 percent come from the *Länder* budgets and 5 percent from private sources.

Structure:
The members of the *Board of Governors* of the Humboldt Foundation are its *President* and the presidents of the large self-governing organisations of German science, the president of the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* and two Federal ministers.

Tasks:
The main objective of the Foundation is to give highly qualified foreign academics an opportunity to implement research projects in Germany and to maintain resulting contacts with scientists in Germany. In this connection, the Foundation also supports German scientists spending research periods abroad.

The AvH can use the following instruments in implementing these tasks:
– Annually, it awards up to 600 research grants to foreign post-docs aged under 40. There are no quotas for countries or disciplines.
– Within the framework of different programmes, it annually awards furthermore up to 150 Humboldt research prizes to internationally renowned foreign scholars and scientists. 80 of these research prizes are awarded to US scientists. In addition, there are up to 12 Max Planck research prizes for international cooperation.
– Under the Federal Chancellor's Grants Programme, a further 10 grants are available to future US leaders in science, industry, politics and society for a long-term stay in Germany. Finally, the Foundation manages research grants for particular purposes.
– Research periods abroad of German scholars and scientists are supported in particular by the annually up to 150 Feodor Lynen research grants awarded by the AvH. German scholars and scientists wishing to spend research periods in Japan can apply for one of the

annually 35 research grants of the Japan Society for the Promotion of Science (JSPS) and the Science and Technology Agency (STA).

Total expenditure in 1999 was approximately DM118 million (target).

1.4 Deutsche Bundesstiftung Umwelt
(DBU – German Federal Foundation for the Environment)

An der Bornau 2, 49090 Osnabrück
Tel.: 05 41-96 33-0; Fax: 05 41-96 33-1 90
E-mail: info@dbu.de; Internet: http://www.dbu.de

Founded:
By an act of the German *Bundestag* of July 18, 1990 as a private law foundation with legal capacity.

Financing:
Income from endowment capital, the proceeds from the sale of the state-owned Salzgitter AG, of some DM2.5 billion.

Structure:
A board of trustees of 14 members is appointed by the Federal Government; the board appoints a secretary general who heads the foundation's office.

Tasks:
The main task of the foundation is support of environmental protection projects, giving special consideration to SMEs. It supports projects running outside state-funded programmes in the areas of environmental technology, environmental research and prevention and environmental communication.

Funding is provided for projects which
– differ clearly from the current state of the art and represent a further development (innovation),
– are interesting e.g. for an entire branch of industry because of potential broad application and can be implemented speedily under free-market conditions (model),
– open up new, complementary potential to relieve the burden on the environment.

In its support activities, the foundation focusses in particular on clean products and production. Small and medium-sized enterprises are at the centre of support activities. Basic research is not supported.

Apart from project support, the foundation has also established a grants programme in support of highly qualified young scientists. Annually, it makes available 50 grants for doctoral and post-doctoral research projects in the area of applied environmental protection.

Furthermore, the foundation awards the German Environment Award honouring efforts and achievements which have contributed substantially and in an exemplary manner to the protection and preservation of the environment or which will make a major contribution to relieving the burden on the environment in the future.

Approximately DM150 million annually are available for project support.

1.5 Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e.V
(AiF – German Federation of Industrial Co-operative Research Associations "Otto von Guericke)

Main Office
Bayenthalgürtel 23, 50968 Köln
Tel.: 02 21-3 76 80-0;
Fax: 02 21-3 76 80-27
E-mail: info@aif.de;
Internet: http://www.aif.de

Berlin Office
Tschaikowskistraße 49, 13156 Berlin
Tel.: 0 30-4 81 63-3;
Fax: 0 30-4 81 63-4 01
E-mail: asb@aif.de;
Internet: http://www.aif.de

Founded:
In 1954 as umbrella organisation of 20 of the industrial research associations existing at that time in the Federal Republic of Germany.

Members:
106 research associations from different industrial sectors and broad fields of technology with 54 own research institutions and a total of over 800 closely networked institutes.

Financing:
The work of the AiF is partly financed by small and medium-sized enterprises, partly by the Federal Government. In sector-wide co-operative industrial research, public funds (1999: DM165 million) go exclusively to individual research projects. The linked organisational work and the innovation network behind it are financed with industrial funds (1998: DM444 million). With company-specific support measures (1999: DM317 million), the AiF acts as project managing agency for certain Federal Ministries, which reimburse the expenses incurred by the AiF.

Structure:
Pursuant to its statutes, the AiF has following bodies: General Assembly, Presiding Committee, Board of Trustees, Scientific Council, Management Advisory Board, Grants Committee and Auditing Committee.

Tasks:
As self-governing organisation of small and medium-sized enterprises, the AiF aims to support applied research and development (R&D) to the benefit of SMEs.

Since its founding in 1954, the AiF has been a competent partner for the Federal Government working at the interface between industry and science within the framework of different support measures. The AiF's work include both sector-wide and company-specific activities. From the very beginning, the AiF has been committed to supporting co-operative industrial research in close co-operation with the Federal Ministry of Economics and Technology (BMWi). Within this framework, competing companies in the same sector of industry cooperate under the umbrella of the AiF in joint precompetitive research. Since 1978, the AiF has furthermore been acting as project management agency for company-specific measures by the Federal Government designed to support R&D in SMEs. For individual companies, such support is directly relevant to competition.

Currently, the AiF acts as project management agency for the BMWi under the support programmes *PROgramme INNOvation skills of small and medium-sized enterprises* (PRO INNO) and the *R&D personnel funding* programme line in the BMWi programme for *Funding and Promoting research, development and innovation in SMEs and extramural industrial research institutions in the new Länder* (formerly PFO). In 1999, the BMWi launched the new initiative *Future technologies for small and medium-sized enterprises* (ZUTECH). The objective of the initiative is to translate new findings from basic research into advanced technology solutions which are tailored to the needs of small and medium-sized enterprises. Selection of projects which are characterised by interdisciplinary and cross-sector co-operation of several AiF research associations is based on competitive principles.

As project management agency of the Federal Ministry of Education and Research (BMBF), the AiF manages the programme on application-oriented R&D at *Fachhochschulen*, because an intensification of such activities at *Fachhochschulen* is mainly to the benefit of SMEs.

On an international level, the AiF mainly acts as National Contact Point for SME-specific R&D measures by the European Union and it established contacts with SME partners in Central and Eastern Europe.

1.6 Organisations for the promotion of young talent in the higher education sector

Stiftung der Deutschen Wirtschaft e.V.
Studienförderwerk Klaus Murmann
Breite Str. 29
10178 Berlin
Tel.: 030-2033-0; Fax: 030-2033-1555
E-mail: studienfoerderwerk.sdw@bda-online.de
Internet: www.sdw.org

Founded:
The oldest organisations for the promotion of young talent – the Friedrich Ebert Foundation and the Studienstiftung des deutschen Volkes (German National Merit Foundation) – were founded in the 1920s, further organisations were founded in the 1950s, 1970s and the two most recent ones in the 1990s.

Members:
The association of organisations for the promotion of young talent has the following members:
– Studienstiftung des deutschen Volkes
– Cusanuswerk – Bischöfliche Studienförderung
– Evangelisches Studienwerk Villigst
– Hans Böckler Foundation
– Stiftung der Deutschen Wirtschaft für Qualifizierung und Kooperation-Studienförderwerk Klaus Murmann
– Konrad Adenauer Foundation
– Heinrich Böll Foundation
– Friedrich Ebert Foundation
– Rosa Luxemburg Foundation
– Friedrich Naumann Foundation
– Hanns Seidel Foundation

Tasks:
With their material and non-material support of particularly talented and motivated undergraduate and doctoral students, the eleven nation-wide organisations for the promotion of young talent are making an important contribution to the training of highly qualified young scientists, which are indispensable to research. Individual supervision and support in subject-related as well as personal issues is of particular importance.

Information on the self-understanding, the focuses of the individual organisations and their work as a whole is accessible on the Internet homepage at www.begabtenfoerderung.de. This address also gives access to the presentations of the individual organisations.

Structure:
The organisations and their financing foundations – in particular the political foundations – have been established under private law. Together, they form the association of organisations for the promotion of young talent, which, since the beginning of the 1970s, has proven its worth both in internal discussions and co-ordination between the organisations themselves and as discussion partner of politics and science administration, particularly of the BMBF.

Financing:
The foundations are financing the basic structure of the individual organisations in different ways with regard to type and scope. The vast majority of funds awarded to undergraduate and doctoral students comes from the BMBF budget. These funds are awarded by the organisations according to uniform guidelines in the form of fellowships, family and living abroad allowances, books allowances and other grants supporting undergraduate and doctoral studies.

After a phase of declining Federal grants, funds have been increased since 1998/99 at a rate by far exceeding the rates of increase of the Federal and BMBF budgets (cf. following table).

Addresses of the organisations for the promotion of young talent (as of January 2000)

Studienstiftung des deutschen Volkes e.V.
Mirbachstraße 7
53173 Bonn
Tel.: 0228-82096-0; Fax: 0228-82096-67
E-mail: SDV@studienstiftung.de; Internet: www.studienstiftung.de

Heinrich-Böll-Stiftung e.V.
Rosenthaler Straße 40/41
10178 Berlin
Tel.: 030-28534-0; Fax: 030-28534-109
E-mail: info@boell.de; Internet: www.boell.de

Cusanuswerk
– Bischöfliche Studienförderung –
Baumschulallee 5
53115 Bonn
Tel.: 0228-98384-0; Fax: 0228-98384-99
E-mail: cusanuswerk@t-online.de
Internet: www.cusanuswerk.de

Friedrich-Ebert-Stiftung e.V.
Godesberger Allee 149
53175 Bonn
Tel.: 0228-883-0; Fax: 0228-883-697
E-mail: auskunft@fes.de
Internet: www.fes.de

Evangelisches Studienwerk e. V.
Haus Villigst
Iserlohner Straße 25
58239 Schwerte
Tel.: 02304-755-0; Fax: 02304-755-250
E-mail: info@evstudienwerk.de
Internet: www.evstudienwerk.de

Rosa-Luxemburg-Stiftung e.V.
Franz-Mehring-Platz 1
10243 Berlin
Tel.: 030-29784221; Fax: 030-29784222
E-mail: info@rosa-luxemburg.org or
studienwerk@rosaluxemburgstiftung.de
Internet: www.bundesstiftung-rosa-luxemburg.de

Hans-Böckler-Stiftung
Bertha-von-Suttner-Platz 1
40227 Düsseldorf
Tel.: 0211-7778-0; Fax: 0211/7778-210
E-mail: zentrale@boeckler.de
Internet: www.boeckler.de

Friedrich-Naumann-Stiftung
Weberpark Alt-Nowawes 67
14482 Potsdam-Babelsberg
Tel.: 0331-7019-349; Fax: 0331-7019-222
E-mail: fnst.bf@t-online.de
Internet: www.fnst.de

Stiftung der Deutschen Wirtschaft e.V. –
Studienförderwerk Klaus Murmann
Breite Str. 29
10178 Berlin
Tel.: 030-2033-0; Fax: 030-2033-1555
E-mail: studienfoerderwerk.sdw@bda-online.de
Internet: www.sdw.org

Hanns-Seidel-Stiftung e.V.
– Förderwerk –
Lazarettstraße 33
80636 München
Tel.: 089-1258-0; Fax: 089-1258-403
E-mail: info@hss.de
Internet: www.hss.de

Konrad-Adenauer-Stiftung e.V.
Rathausallee 12
53757 St. Augustin
Tel.: 02241-246-0; Fax: 02241-246-669
E-mail: zentrale-wd@wd.kas.de
Internet: http://www.kas.de

BMF funds for the promotion of young talent in the higher education sector 1990–2000

Year	Study support		Postdoctoral support	
	Funds	Grant recipients	Funds	Grant recipients
1990	66 060.000	9 982	24 814.000	1 961
1991	78 379.000	11 554	30 159.000	2 225
1992	86 124.000	12 489	35 587.000	2 727
1993	83 836.000	12 252	37 262.000	2 759
1994	72 825.000	11 731	35 707.000	2 416
1995	75 440.000	11 227	37 790.000	2 342
1996	73 521.000	10 832	38 768.000	2550
1997	69 006.000	10 903	39 994.000	2479
1998	67 272.000	10 258	37 798.000	2283
1999	72 152.000	11 415	39 708.000	2346
2000	75 ,95.000	.	45 410.000	.

Source: BMBF

2. Research organisations

2.1 Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V.
(MPG – Max Planck Society for the Advancement of Science)

Hofgartenstraße 2, 80539 München
Tel.: 089-2108-0; Fax: 089-2108-1111
E-mail: (name)@mp-gv.mpg.de; Internet: http://www.mpg.de

Founded:
In 1948 as successor to the Kaiser-Wilhelm-Gesellschaft of 1911 as non-profit research organisation in the legal form of a registered association with its registered seat in Berlin; the President's office and the Administrative Headquarters are located in Munich.

Members:
The MPG statutes stipulate the following:
– Supporting Members (e.g. natural or legal persons paying a membership fee)
– Scientific Members (scientific members of the institutes, scientific members emeritus as well as scientific members from abroad)
– Ex officio Members (members of the Senate as well as those directors of institutes who are not scientific members of institutes)
– Honorary Members (researchers and promoters of science appointed by the General Meeting).

Financing:
Basic funding from the Federal Government and the *Länder* at a ratio of 50:50; more than DM1.7 billion in 2000; the Max Planck Institute for Plasma Physics (IPP) is funded as a Helmholtz Centre, i.e. 90 percent of its budget are provided by the Federal Government and 10 percent by the host *Länder*. This basic funding is supplemented by project funds as well as private grants and membership fees, donations and fees for services offered.

Structure:
The MPG is a research organisation with currently 79 research institutions in 74 institutes as well as laboratories, research centres and research groups of different sizes, structure and objectives. As self-governing organisation of German science it guarantees its leading scientists a high degree of scientific and organisational autonomy with regard to the choice of research topics and the implementation of research.

The central decision-making and supervisory body of the MPG is the *Senate*. It consists of Senators elected by the *General Meeting* as well as of Senators by virtue of their office. It elects the *President* and, from anmong its members, the members of the *Executive Committee*. Furthermore, it resolves on the founding and disbanding of institutes and divisions and the appointment of Scientific Members and directors. It also draws up the total budget as well as the annual report and the annual statement of accounts.

Tasks:
In the German multi-track system of support for research institutions, it is not the MPG's task to cover all areas of science and all topics on a nation-wide level, but to *focus on cutting-edge research* and to fulfil a complementary function, in particular with regard to university research.

The MPG pursues these objectives by
– offering particularly good working conditions in institutes to outstanding researchers in particularly important or future-oriented, internationally competitive areas of basic research (research function),
– taking up new research topics, both in areas where different scientific disciplines meet and which are not yet addressed by university research (initiative and catalyst function) and in research areas which can only be tackled successfully by an interdisciplinary organisation (interdisciplinary function),
– implementing research projects which require very large or specific facilities or considerable financial resources so that they cannot, or not yet, be addressed by higher education institutions, or by making available research resources for joint use with other research organisations (support and complementary function),
– enabling younger people to receive academic or other training qualifying for a profession at a high scientific and technical level (promotion of young scientists).

Within the framework of its tasks, the MPG attaches great importance to close cooperation with higher education institutions and research institutions in Germany and abroad.

Institution	Main tasks
Baden-Württemberg	
Max-Planck-Institut für Astronomie 69117 Heidelberg, Königstuhl 17 Tel.: 0 62 21-5 28-0 Fax: 0 62 21-5 28-2 46 http://www.mpia-hd.mpg.de	• Structure of the Galaxy and stellar origins
Max-Planck-Institut für Biologie 72076 Tübingen, Corrensstraße 38/42 Tel.: 0 70 71-6 01-750 Fax: 0 70 71-6 01-759 http://www.bio.tuebingen.mpg.de	• Genetics of evolution; population paleogenetics; origin of the immune system; leishmanias and trypanosomes
Max-Planck-Institut für Entwicklungsbiologie 72076 Tübingen, Spemannstraße 35 Tel.: 0 70 71-6 01-3 74 Fax: 0 70 71-6 01-3 00 http://www.eb.tuebingen.mpg.de	• Cellular and molecular neuroembryology; morphogenesis with drosophila and zebrafish; early development of xenopus; morphogenesis of bacterial cells
Max-Planck-Institut für Festkörperforschung 70569 Stuttgart, Heisenbergstraße 1 Tel.: 07 11-6 89-0 Fax: 07 11-6 89-10 10 http://www.mpi-stuttgart.mpg.de	• Physical and chemical characteristics of inorganic solid matter, in particular semiconductors
Max-Planck-Institut für Immunbiologie 79108 Freiburg, Stübeweg 51 Tel.: 07 61-51 08-0 Fax: 07 61-51 08-221 http://www.immunbio.mpg.de	• Cellular immune system; cellular adhesion molecules as morpho-regulators; mouse embryonic development; evolution of the adaptive immune system
Max-Planck-Institut für Kernphysik 69117 Heidelberg, Saupfercheckweg 1 Tel.: 0 62 21-5 16-0 Fax: 0 62 21-5 16-6 01 http://www.mpi-hd.mpg.de	• Atomic and nuclear heavy ion physics; structure and interaction of hadronic systems and their constituents; quantum-mechanical multiparticle systems with chaotic dynamics
Max-Planck-Institut für biologische Kybernetik 72076 Tübingen, Spemannstraße 38 Tel.: 0 70 71-6 01-5 00 Fax: 0 70 71-6 01-5 20 http://www.kyb.tuebingen.mpg.de	• Intake and processing of information in the visual system of insects and vertebrates; perception of space and form; physiological mechanisms of visual perception and cognition
Max-Planck-Institut für medizinische Forschung 69120 Heidelberg, Jahnstraße 29 Tel.: 0 62 21-4 86-0 Fax: 0 62 21-4 86-3 51 http://www.mpimf-heidelberg.mpg.de	• Molecular mechanisms of muscular contraction; structure, regulation and function of ion channels; vesicle and membrane transport; hormone release in endocrine cells and transmitter release in nerve cells; molecular basis of signalling between cells of the central and peripheral nervous system

Institution	Main tasks
Max-Planck-Institut für Metallforschung 70174 Stuttgart, Seestraße 92 Tel.: 07 11-20 95-0 Fax: 07 11-20 95-3 20 http://www.mpi-stuttgart.mpg.de	• Materials science of metals, their alloys and of ceramics
Vogelwarte Radolfzell 78315 Radolfzell, Schloßallee 2 Tel.: 0 77 32-15 01-0 Fax: 0 77 32-15 01-69 http://erl.ornithol.mpg.de	• cf. Forschungsstelle für Ornithologie der Max-Planck-Gesellschaft, Andechs/Bayern
Max-Planck-Institut für ausländisches und internationales Strafrecht 79100 Freiburg, Günterstalstraße 73 Tel.: 07 61-70 81-1 Fax: 07 61-70 81-2 94 http://www.iuscrim.mpg.de	• German and foreign criminal law, criminal procedure and prisons, comparative criminal law, international cooperation in criminal matters (including extradition and mutual assistance), international criminal law; law and medicine; criminal law problems in reunified Germany and comparative study of criminal prosecution in coming to terms with the past; • Social control via criminal law, including empirical study of penal sanctions; imprisonment and victimology; organised crime and internal security; interdisciplinary approach to comparative law and criminological projects
Max-Planck-Institut für ausländisches öffentliches Recht und Völkerrecht 69120 Heidelberg, Im Neuenheimer Feld 535 Tel.: 0 62 21-4 82-1 Fax: 0 62 21-4 82-2 88 http://www.mpiv-hd.mpg.de	• General and regional international law, law of international organisations, in particular the United Nations, law of the European Communities, international legal relations and legal situation of the Federal Republic of Germany, constitutional and administrative law in other countries, comparative public law.
Max-Planck-Institut für Zellbiologie 68526 Ladenburg b. Heidelberg, Rosenhof Tel.: 0 62 03-1 06-0 Fax: 0 62 03-1 06-1 22	• Regulation of protein and nucleic acid biosynthesis; biological function of intermediate filaments and nuclear lamina; interrelation of bacteria and plant cells
Bayern/Bavaria	
Max-Planck-Institut für Astrophysik 85748 Garching, Karl-Schwarzschild-Straße 1 Tel.: 0 89-32 99-00 Fax: 0 89-32 99-32 35 http://www.mpa-garching.mpg.de	• Stellar structure and evolution
Max-Planck-Institut für Biochemie 82152 Martinsried, Am Klopferspitz 18a Tel.: 0 89-85 78-1 Fax: 0 89-85 78-37 77 http://www.biochem.mpg.de	• Structural analysis of biological macromolecules; structure and analysis of neuronal membrane systems; protein plication; mechanisms of cell cycle regulation; light energy transformation and bioenergetics of photosynthetic organisms; matrixproteins; pathology of cancer development and maturity-onset diabetes
Max-Planck-Institut für Neurobiologie 82152 Martinsried, Am Klopferspitz 18a Tel.: 0 89-85 78-1 Fax: 0 89-85 78-35 41 http://www.neuro.mpg.de	• Neurobiochemistry; neurophysiology; neuromorphology; neuroimmunology

Institution	Main tasks
Forschungsstelle für Ornithologie der Max-Planck-Gesellschaft 82346 Andechs, Von-der-Tann-Straße 7 Tel.: 0 81 52-3 73-111 Fax: 0 81 52-3 73-133 http://www.erl.ornithol.mpg.de	• Physiology and ecophysiology of bird migration; biological rhythms; population genetics and evolution biology; population dynamics
Max-Planck-Institut für ausländisches und internationales Patent-, Urheber- und Wettbewerbsrecht 80539 München, Marstallplatz 1 Tel.: 0 89-2 42 46-0 Fax: 0 89-2 42 46-5 01 http./www.intellecprop.mpg.de	• Research into foreign and international patent, utility and trademark law, copyright and design law, competition and cartel law; • Systematic compilation of the law of international treaties in the areas of industrial property rights and copyright; • Comments on planned revisions of international treaties and on the conclusion of new agreements, taking into consideration the problems of developing countries in particular; • Cooperation in harmonising law in the international and European context and in the development of the law of the European Union; • Research into basic issues of industrial property protection and copyright in the context of economic, social and technological developments.
Max-Planck-Institut für Physik (Werner-Heisenberg-Institut) 80805 München, Föhringer Ring 6 Tel.: 0 89-3 23 54-0 Fax: 0 89-3 22 67 04 http://www.mppmu.mpg.de	• Structure of matter; properties and interrelations of elementary particles
Max-Planck-Institut für extraterrestrische Physik 85748 Garching, Giessenbachstraße Tel.: 0 89-32 99-00 Fax: 0 89-32 99-35 69 http://www.mpe-garching.mpg.de	• Astronomical observations in spectral regions of infrared, X-ray and gamma radiation
Max-Planck-Institut für Plasmaphysik (IPP) 85748 Garching, Boltzmannstraße 2 Tel.: 0 89-32 99-01 Fax: 0 89-32 99-22 00 http://www.ipp.mpg.de	• Basic plasmaphysics work for developing a fusion reactor
Max-Planck-Institut für Psychiatrie (Deutsche Forschungsanstalt für Psychiatrie) 80804 München, Kraepelinstraße 2 und 10 Tel.: 0 89-3 06 22-1 Fax: 0 89-3 06 22-6 05 http://www.mpipsykl.mpg.de	• Suicide studies; eating disorders; addiction; neurocardiology; neurology and neuroradiology; kinetic disorders; clinical psychology and neuropsychology; neurophysiology, physiology of sleep; psychopharmacology; neuropsychopharmacology; behavioural neuroendocrinology; behavioural pharmacology; clinical chemistry; clinical and molecular neuroendocrinology; clinical neuroimmunology
Max-Planck-Institut für psychologische Forschung 80799 München, Amalienstraße 33 Tel.: 0 89-3 86 02-0 Fax: 0 89-3 86 02-199 http://www.mpipf-muenchen.mpg.de	• Behavioural and cognitive development; • Cognition and action: experimental studies on cognitive mechanisms of action control; mechanisms mediating between perception and action

Institution	Main tasks
Max-Planck-Institut für Quantenoptik 85748 Garching, Hans-Kopfermann-Straße 1 Tel.: 0 89-3 29 05-0 Fax: 0 89-3 29 05-2 00 http://www.mpq.mpg.de	• Interaction of light and matter; laser experiments in atomic physics, spectroscopy, chemistry, plasma physics
Max-Planck-Institut für ausländisches und internationales Sozialrecht 80799 München, Amalienstraße 33 Tel.: 0 89-3 86 02-0 Fax: 0 89-3 86 02-490 http://www.mpipf-muenchen.mpg.de	• Development and testing of methods for research in the area of foreign and international social law as well as comparative social law; • Work on a number of specialised topics, in particular on the social risks of illness, need of care, invalidity, old age, unemployment and basic social security/social welfare
Berlin	
Max-Planck-Institut für Bildungsforschung 14195 Berlin, Lentzeallee 94 Tel.: 0 30-8 24 06-0 Fax: 0 30-8 24 99 39 http://www.mpib-berlin.mpg.de	• Adaptive behaviour and cognition; • Education, work and social development; • Educational research and education systems; • Psychology and human development
Fritz-Haber-Institut der Max-Planck-Gesellschaft 14195 Berlin, Faradayweg 4-6 Tel.: 0 30-84 13-30 Fax: 0 30-84 13-31 55 http://www.fhi-berlin.mpg.de	• Properties of solid surface structures; physical and chemical processes between solids and gases or fluids; catalysis
Max-Planck-Institut für molekulare Genetik 14195 Berlin, Ihnestraße 63–73 Tel.: 0 30-84 13-0 Fax: 0 30-84 13-13 94 http://www.mpimg-berlin-dahlem.mpg.de	• Molecular genetic analysis of the vertebrate genome and human hereditary diseases; evolution and epidemiology of penicillin resistance in pneumococcus; epidemiology of N. meningitis; developmental biology of Physcomitrella patens
Max-Planck-Institut für Infektionsbiologie 10117 Berlin, Monbijoustraße 2 Tel.: 0 30-284 60-140 Fax: 0 30-284 60-141 http://www.mpiib-berlin.mpg.de	• Vaccine development; immune response; autoimmunity; allergy; infection mechanisms; virulence factors; pathogenicity mechanisms
Max-Planck-Institut für Wissenschaftsgeschichte 10117 Berlin, Wilhelmstraße 44 Tel.: 0 30-2 26 67-0 Fax: 0 30-2 26 67-2 99 http://www.mpiwg-berlin.mpg.de	• History of epistemic categories that shape scientific investigation and its standards for explanation: history of the varying forms and standards of substantiation, history of rival forms of facticity, and historical studies of different perceptions and specific scientific manifestations of objectivity; • Structural changes in knowledge systems in the natural sciences: historical reconstruction of thinking in classical civilisations; reconstruction of the origins of classical mechanics; structural changes in sciences with developed disciplinary structures and integrated theoretical basis; • Conditions of scientific innovation: history and epistemology of experimental practices; history of epistemic objects and spaces; the historical pragmatics of concept formation and the uses of theory in the life sciences

Institution	Main tasks
Brandenburg	
Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut) 14476 Golm, Am Mühlenberg, Haus 5 Tel 0331-5677-0 Fax 0331-5677-298 http://www.aei-potsdam.mpg.de	• Physical basis and mathematical methods of the general theory of relativity; quantum field theory, theory of gravitational waves
Max-Planck-Institut für Kolloid- und Grenzflächenforschung 14476 Golm, Am Mühlenberg, Haus 2 Tel.: 0331-56 79-0 Fax: 0331-56 79-602 http://www.aei-potsdam.mpg.de	• Supramolecular structures of polymers, tensides and lipids
Max-Planck-Institut für molekulare Pflanzenphysiologie 14476 Golm, Am Mühlenberg 1 Tel.: 03 31-5678-0 Fax: 03 31-5678-408 http://www.mpimp-golm.mpg.de	• Analysis of processes involved in the synthesis and storage of carbohydrates in higher plants; studies of cell wall biosynthesis, of ion absorption via root hairs, of stomata development and distribution
Bremen	
Max-Planck-Institut für marine Mikrobiologie 28359 Bremen, Celsiusstraße 1 Tel.: 04 21-20 28-50 Fax: 04 21-20 28-5 80 http://www.mpi-bremen.de	• Bacterial and geochemical transformation of matter at marine locations; studies of diversity, structure and distribution of natural microbial populations in the sea and in other water systems
Hamburg	
Max-Planck-Institut für Meteorologie 20146 Hamburg, Bundesstraße 55 Tel.: 0 40-4 11 73-0 Fax: 0 40-4 11 73-2 98 http://www.cpfs.mpg.de	• Long-term climatic changes and the global climate system
Arbeitsgruppen für strukturelle Molekularbiologie der Max-Planck-Gesellschaft am DESY 22607 Hamburg, c/o DESY, Notkestraße 85, Gebäude 25 b Tel.: 0 40-89 98-28 01 Fax: 0 40-89 71 68-10 http://www.mpasmb-hamburg.mpg.de	• Protein dynamics; ribosome structure; cyto-skeleton
Max-Planck-Institut für ausländisches und internationales Privatrecht 20148 Hamburg, Mittelweg 187 Tel.: 0 40-4 19 00-0 Fax: 0 40-4 19 00-2 88 http://www.mpipriv-hh.mpg.de	• Private, commercial and economic law: European company and group company law, European and international banking and capital market law, corporate governance in the triad: Europe – USA – Japan, economic law of international telecommunications, traffic and transport law • Comparative law and legal unification: the harmonisation of European private law, the transformation of the systems of central, eastern and south-east Europe, loan collateral and insolvency law, International Encyclopedia of Comparative Law, foreign legal systems and country divisions

Institution	Main tasks
	• International private law: European international private law, international and European law of civil procedure, international law of bankruptcy, international competition law
Hessen/Hesse	
Max-Planck-Institut für Biophysik 60596 Frankfurt/Main, Kennedyallee 70 Tel.: 0 69-63 03-1 Fax: 0 69-63 03-2 44 http://www.biophys.mpg.de	• Structural and functional studies of membrane proteins
Max-Planck-Institut für Hirnforschung 60528 Frankfurt, Deutschordenstraße 46 Tel.: 069-9 67 69-0 Fax: 069-9 67 69-4 33 http://www.mpih-frankfurt.mpg.de	• Biochemistry of synaptic vesicles and membrane proteins; neuronal differentiation; axonal path finding and synaptic formation; neuronal basis of perception; structural and functional organisation of the cortex; structure and function of the retina
Max-Planck-Institut für terrestrische Mikrobiologie 35043 Marburg, Karl-von-Frisch-Straße Tel.: 0 64 21-1 78-0 Fax: 0 64 21-1 78-9 99 http://www.uni-marburg-de/mpi/	• Biochemistry and ecophysiology of anaerobic micro-organisms; microbiology and biogeochemistry of trace gases in soils and wetlands
Max-Planck-Institut für physiologische und klinische Forschung, W. G. Kerckhoff-Institut 61231 Bad Nauheim, Parkstraße 1 Tel.: 0 60 32-7 05-1 Fax: 0 60 32-7 05-2 11 http://www.kerckhoff.mpg.de/default.html	• Regulation of blood vessel development; coagulation and tumour necrosis; gene expression in myocardial cells of normal and ischaemic mammal hearts and in cardiac diseases of humankind; integrative physiology of nervous and hormonal regulation of autonomous functions in homeotherms
Max-Planck-Institut für europäische Rechtsgeschichte 60489 Frankfurt/Main, Hausener Weg 120 Tel.: 0 69-7 89 78-0 Fax: 0 69-7 89 78-1 69 http://www.mpier.uni-frankfurt.de	• Roman Law • Byzantine Law • Ius Commune in the Middle Ages and the Early Modern Period • Legal Humanism • History of Legislation • Law during the Industrial Revolution • Contemporary Legal History
Mecklenburg-Vorpommern/Western Pomerania	
Max-Planck-Institut für demografische Forschung 18057 Rostock, Doberaner Straße 114 Tel.: 03 81-20 81-0 Fax: 03 81-20 81-2 19 http://www.demogr.mpg.de	• Social and biological determinants of mortality developments • Fertility and family dynamics in contemporary Europe • Further development of mathematical and statistical methods in demography • Family demography and ageing of societies • Work on the historic development of demographic thought
Max-Planck-Institut für Plasmaphysik Teilinstitut Greifswald: 17489 Greifswald, Walther-Rathenau-Straße 49a Tel.: 0 38 34-5 15-4 01 Fax: 0 38 34-5 15-4 44	• cf. MPI für Plasmaphysik Garching

Institution	Main tasks
Niedersachsen/Lower Saxony	
Max-Planck-Institut für Aeronomie 37191 Katlenburg-Lindau, Max-Planck-Straße 2 Tel.: 0 55 56-9 79-0 Fax: 0 55 56-9 79-2 40 http://www.mpae.gwdg.de	• Atmosphere and magnetosphere of planets and comets in the solar system; physics of the sun
Max-Planck-Institut für biophysikalische Chemie (Karl-Friedrich-Bonhoeffer-Institut) 37077 Göttingen, Am Faßberg 11 Tel.: 05 51-2 01-0 Fax: 05 51-2 01-12 22 http://www.mpipbc.gwdg.de	• Protein transport; development and differentiation processes in mammals and drosophila; synaptic transmission; release of neurotransmitters and hormones; dynamics of molecules in crystals, fluids and gases; organisation of cellular architecture
Max-Planck-Institut für experimentelle Endokrinologie 30625 Hannover, Feodor-Lynen-Straße 7 Tel.: 05 11-53 59-0 Fax: 05 11-53 59-1 48	• Molecular developmental biology in vertebrates; analysis of genetically caused developmental abnormalities in humans and related animal models; effect mechanisms of retinoids (vitamin A derivatives); molecular mechanisms of circadian rhythms in mammals
Max-Planck-Institut für Geschichte 37018 Göttingen, Hermann-Föge-Weg 11 Tel.: 05 51-49 56-0 Fax: 05 51-49 56-170 http://www.geschichte.mpg.de	• History of institutions and constitutions as well as social and mentality history in the Middle Ages • History of science and theory of historic findings • Transformation processes from Early Modern Times to "Modernity" • Social production and distribution of knowledge • Historic anthropology as well as everyday and micro history • Historic specialised computer sciences
Max-Planck-Institut für experimentelle Medizin 37075 Göttingen, Hermann-Rein-Straße 3 Tel.: 05 51-8 99-0 Fax: 05 51-38 99-3 89 http://www.mpiem.gwdg.de	• Neurotransmitter receptors; structure-function relation of genetically modified ion channels; structure and function of synapses, synaptogenesis, mechanisms of secretion, neuro-transmission, neurogenetics
Max-Planck-Institut für Strömungsforschung 37073 Göttingen, Bunsenstraße 10 Tel.: 05 51-51 76-0 Fax: 05 51-51 76-7 04 http://www.mpisf.mpg.de	• Interactions of molecular systems under the inclusion of clusters and solid matter surfaces
Nordrhein-Westfalen/North Rhine-Westphalia	
Max-Planck-Institut für Eisenforschung GmbH 40237 Düsseldorf, Max-Planck-Straße 1 Tel.: 02 11-67 92-1 Fax: 02 11-67 92-2 68 http://www.mpie-duesseldorf.mpg.de	• Structure and characteristics of steel and related materials; processes of production, forming and testing
Max-Planck-Institut für Gesellschaftsforschung 50676 Köln, Paulstraße 3 Tel.: 02 21-27 67-0 Fax: 02 21-27 67-5 55 http://www.mpi-fg-koeln.mpg.de	• Analysis of response of national regulation systems to process-es of international economic and institutional integration, in the area of state policy as well as in industrial relations

Institution	Main tasks
Max-Planck-Institut für Kohlenforschung (rechtsfähige Stiftung) 45470 Mülheim an der Ruhr, Kaiser-Wilhelm-Platz 1 Tel.: 02 08-3 06-1 Fax: 02 08-3 06-29 80 http://www.mpi-muelheim.mpg.de	• Organic and metal organic chemistry; homogeneous and heterogeneous catalysis; carbon chemistry
Max-Planck-Institut für Mathematik 53225 Bonn, Gottfried-Claren-Straße 26 Tel.: 02 28-4 02-0 Fax: 02 28-4 02-2 77 http://www.mpim-bonn.mpg.de	• Algebraic groups and arithmetic subgroups; number theory, algebraic geometry; complex analysis; algebraic topology
Max-Planck-Institut für neurologische Forschung 50931 Köln, Gleueler Straße 50 Tel.: 02 21-47 26-0 Fax: 02 21-47 26-2 98 http://www.mpin-koeln.mpg.de	• Investigations by positron emission tomography (PET) in strokes, brain tumours, dementia and epilepsy; development of therapeutic strategies; pathophysiology, pathobiochemistry and therapy of experimental brain infarcts; resuscitation of the nervous system following cardiac arrest
Max-Planck-Institut für molekulare Physiologie 44227 Dortmund, Otto-Hahn-Straße 11 Tel.: 02 31-1 33-0 Fax: 02 31-1 33-26 99 http://www.mpi-dortmund.mpg.de	• Structure-function relationships of proteins; analysis of the cell physiological and molecular basis of the function of epithelial cells; structural and functional studies of small GTP-binding proteins and their mutations
Max-Planck-Institut für Radioastronomie 53121 Bonn, Auf dem Hügel 69 Tel.: 02 28-5 25-0 Fax: 02 28-5 25-2 29 http://www.mpifr-bonn.mpg.de	• The early development phases of the universe, the nucleus of radiogalaxies and quasars
Projektgruppe „Recht der Gemeinschaftsgüter“ der Max-Planck-Gesellschaft 53115 Bonn, Poppelsdorfer Allee 45 Tel.: 02 28-9 14 16-0 Fax: 02 28-9 14 16-55	• Waste management law and policy – law, policy and economy of network goods - multilevel governance
Max-Planck-Institut für Strahlenchemie 45470 Mülheim an der Ruhr, Stiftstraße 34–36 Tel.: 02 08-3 06-0 Fax: 02 08-3 06-39 51 http://www.mpi-muelheim.mpg.de/mpistr_home.html	• Photochemistry; photobiology; metal proteins
Max-Planck-Institut für Züchtungsforschung 50829 Köln, Carl-von-Linné-Weg 10 Tel.: 02 21-50 62-0 Fax: 02 21-50 62-5 13 http://www.mpiz-koeln.mpg.de	• Biochemistry of pathogen recognition in plants; molecular plant genetics; analysis of flower induction and flower development; plant breeding and yield physiology; genetic basis of plant breeding

Institution	Main tasks
Rheinland-Pfalz/Rhineland Palatinate	
Max-Planck-Institut für Chemie (Otto-Hahn-Institut) 55128 Mainz, Joh.-Joachim-Becher-Weg 27 Tel.: 0 61 31-3 05-0 Fax: 0 61 31-3 05-3 88 http://www.mpch-mainz.mpg.de	• Trace elements in the atmosphere; isotopic composition of meteorites and lunar rocks; geochemistry
Max-Planck-Institut für Polymerforschung 55128 Mainz, Ackermannweg 10 Tel.: 0 61 31-3 79-0 Fax: 0 61 31-3 79-1 00 http://www.mpip-mainz.mpg.de	• Structure, ordering phenomena and dynamics of macromolecular materials; basic material science in application of organic materials
Saarland	
Max-Planck-Institut für Informatik 66123 Saarbrücken, Im Stadtwald Tel.: 06 81-93 25-0 Fax: 06 81-93 25-9 99 http://www.mpi-sb.mpg.de	• Efficient algorithms for computer systems
Sachsen/Saxony	
Max-Planck-Institut für evolutionäre Anthropologie 04103 Leipzig, Inselstraße 22–26 Tel.: 03 41-99 52-0 Fax: 03 41-99 52-1 19 http.//www.eva.mpg.de	• Genetic and linguistic diversity of the human species • Evolution of cultural and social behaviour of human beings and other primates • Cognitive evolution of human and non-human primates • Historic anthropology of the past 100,000 years
Max-Planck-Institut für Mathematik in den Naturwissenschaften 04103 Leipzig, Inselstraße 22–26 Tel.: 03 41-99 59-50 Fax: 03 41-99 59-6 58 http://www.mis.mpg.de	• Mathematical modelling of scientific phenomena (e.g. diffusion and reaction processes, microstructures, gravitation processes)
Max-Planck-Institut für neuropsychologische Forschung 04103 Leipzig, Stephanstraße 1a Tel.: 03 41-99 40-00 Fax: 03 41-99 40-101 http://www.cns.mpg.de	• Neurocognition of language and memory; clinical neuropsychology; method development in magnetic resonance tomography and in magnetoencephalography
Max-Planck-Institut für Physik komplexer Systeme 01187 Dresden, Nöthnitzer Straße 38 Tel.: 03 51-8 71-0 Fax: 03 51-8 71-19 99 http://www.mpipks-dresden.mpg.de	• Electronic correlation in large molecules and solids; non-linear dynamics of physical processes

Institution	Main tasks
Max-Planck-Institut für chemische Physik fester Stoffe 01187 Dresden, Bayreuther Straße 40, Haus 16 Tel.: 03 51-4 63-63 61 Fax: 03 51-4 63-72 79 http://www.cpfs.mpg.de	• Preparation, structure and thermodynamic, magnetic and transport characteristics of particular solids
Max-Planck-Institut für molekulare Zellbiologie und Genetik (im Aufbau) Standort: Dresden Verwaltung: 69126 Heidelberg, Im Eichwald 18/33 Tel.: 0 62 21-3 59 09-0 Fax: 0 62 21-3 59 09-8	• Morphogenesis of cells; cell division and microtubuli; biogenesis of secretory organella of neurones; exo- and endocytosis

Sachsen-Anhalt/Saxony-Anhalt

Institution	Main tasks
Max-Planck-Institut für Dynamik komplexer technischer Systeme 39120 Magdeburg, Leipziger Straße 44, ZENIT-Gebäude Tel.: 0391-61 17-5 06 Fax: 0391-61 17-5 01 http://www.mpi-magdeburg.mpg.de	• Complex processes on materials transformation and materials division; environmental process engineering; traffic engineering
Forschungsstelle „Enzymologie der Proteinfaltung" der Max-Planck-Gesellschaft 06120 Halle/Saale, Weinbergweg 22 Tel.: 03 45-5 52-28 01 Fax: 03 45-5 51 19 72 http://www.enzyme-halle.mpg.de	• Dynamics of conformational changes in proteins; catalysis mechanisms and biological function of folding helper enzymes
Max-Planck-Institut für ethnologische Forschung 06108 Halle, Leipziger Straße 91 Tel.: 0345-29 27-0 Fax: 0345-29 27-102 http://www.eth.mpg.de	• Comparative research in peaceful and non-peaceful relations between peoples or groups of peoples
Max-Planck-Institut für Mikrostrukturphysik 06120 Halle/Saale, Weinberg 2 Tel.: 03 45-55 82-50 Fax: 03 45-55 11-2 23 http://www.mpi-halle.mpg.de	• Structures, properties and interrelations of small dimension materials

Schleswig-Holstein

Institution	Main tasks
Max-Planck-Institut für Limnologie 24306 Plön, August-Thienemann-Straße 2 Tel.: 0 45 22-7 63-0 Fax: 0 45 22-7 63-3 10 http://www.mpil-ploen.mpg.de	• Mechanisms in physiological ecology, evolutionary biology and population genetics on the development of communities in lakes; structure and function of small running waters; tropical ecology

Institution	Main tasks
Thüringen/Thuringia	
Max-Planck-Institut für Biogeochemie 07745 Jena, Tatzendpromenade 1a Tel.: 0 36 41-64-0 Fax: 0 36 41-64-37 10 http://www.bgc-jena.mpg.de	• Global cycles (carbon, oxygen, hydrogen, nitrogen)
Max-Planck-Institut für chemische Ökologie 07745 Jena, Tatzendpromenade 1a Tel.: 0 36 41-64-0 Fax: 0 36 41-64-36 71 http://www.ice.mpg.de	• Interaction of plants with herbivores and pathogens: Identification of plant genes for synthesis, storage, recognition and metabolism of chemical signalling substances; biology, chemistry and biochemistry of volatile signalling substances
Max-Planck-Institut zur Erforschung von Wirtschaftssystemen 07745 Jena, Kahlaische Straße 10 Tel.: 0 36 41-6 86-5 Fax: 0 36 41-6 86-9 90 http://www.mpiew-jena.mpg.de	• Studies on regulation policy and applied institution economics: social market economy; German monetary union; analyses on the European integration process • Evolutionary economics: conceptional foundations and interdisciplinary transfer possibilities; driving forces of economic, technological and institutional change; collective influence on individual learning processes at different levels of economy and society; methodological foundations of discourse on economic history; evolutionary approaches for a theory on economic cycles, economic growth, factors of production, welfare and progress concepts as well as the theory of institutional change
Ausland/Abroad	
Bibliotheca Hertziana – Max-Planck-Institut I-00187 Rom, Palazzo Zuccari, Via Gregoriana, 28 Tel.: 00 39 06-69 99 31 Fax: 00 39-06-69 99 33 33 http://www.biblhertz.it	• Art of the 4th–14th century • Late Classical Antiquity • Architecture, urbanistics, customers in Rome, 15th–18th century. • Architecture outside of Rome, 15th–18th century • Sculpture, 15th–18th century; • Painting, drawing, art theory, 15th–18th century
Max-Planck-Institut für Psycholinguistik NL-6525 XD Nijmegen, Wundtlaan 1 Tel.: 00 31-24-35 21-9 11 Fax: 00 31-24-35 21-2 13 http://www.mpi.nl	• Language development; language comprehension; language production; language and cognition

Financial and staff resources of the Max-Planck-Gesellschaft *

– Budget A –

Total expenditure (DM million)				Total staff (full-time equivalent)			
1996 Actual	**1997** Budget	**1998** Budget	**1999** Budget	**1996**	**1997**	**1998** Actual as of June 30	**1999**
1865.8	1707.6	1761.6	1889.8	10 763	11 175	11 620	11 690
including:				*of which:*			
Instit. support of the Federal Government (including HSP/HEP)				(Established) posts			
730.5	765.2	793	830.9	7217	7488	7917	8079
				Annex staff			
				2961	2982	3011	2883
External funds				Externally funded staff			
215.0	85.8	95.3	120.3	586	706	692	734

* Without IPP.

Source: MPG

Expenditure of the Max-Planck-Gesellschaft by research areas *

Research area	Expenditure 1998 – Budget DM million	1998 – Budget *in %*	1999 ** – Budget DM million	1999 ** – Budget *in %*
Chemistry	188.7	*10.7*	172.9	*9.2*
Physics	384.2	*21.8*	391.9	*20.8*
Astronomy and astrophysics	158.9	*9.0*	175.1	*9.3*
Atmospheric sciences, geosciences	76.0	*4.3*	87.0	*4.6*
Mathematics	18.2	*1.0*	23.3	*1.2*
Computer sciences	11.9	*0.7*	13.2	*0.7*
Technical/engineering sciences	9.7	*0.6*	15.4	*0.8*
Biologically oriented research	597.9	*33.9*	637.4	*33.7*
Medical oriented research	138.0	*7.8*	144.4	*7.6*
Law	61.2	*3.5*	69.8	*3.7*
History	32.7	*1.9*	35.5	*1.9*
Social sciences	68.3	*3.9*	110.0	*5.8*
Economics	15.8	*0.9*	13.8	*0.7*
Total	1761.6	*100.0*	1 889.8**)	*100.0*

* Without IPP.

** Only those external funds are included which were known at the time of budgeting.

Source: MPG/IVa31

2.2 Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.

(FhG – Fraunhofer Society for the Advancement of Applied Research)

Leonrodstraße 54, 80636 München
Tel.: 0 89-12 05-01; Fax: 0 89-12 05-3 17
E-mail: info@zv.fhg.de; Internet: http://www.fhg.de

Founded:
In 1949 as non-profit association for the advancement of applied research.

Members:
Companies and private fund providers (721 altogether).

Financing:
The FhG currently operates 48 research institutions with a total expenditure of more than DM1.37 billion, of which over DM600 million are provided jointly by the Federal Government (BMBF) and the *Länder*, DM695 million are to be provided from the FhG's own earnings and special funding.

a) Contract research institutes (1999: 43):
   64 percent own earnings, 36 percent success-related basic support – 90 percent provided by the Federal Government/BMBF and 10 percent by the *Länder*.
b) Defence-related research institutes (1999: 4):
   100 percent basic and project support by the Federal Government/BMVg

Construction investment in institutes financed jointly by the Federal Government and the *Länder* are usually financed by the Federal Government and the host *Land* in equal shares.

Structure:
The affairs of the Fraunhofer-Gesellschaft are managed by the Executive Board, which is supported by the Central Administration. The Senate is elected by the General Assembly and decides on research policy matters and on research and extension plans as well as on the establishment, dissolution or merger of institutes. The Scientific-Technological Council provides basic scientific and technological advice and support to the organs of the Fraunhofer-Gesellschaft. Research is performed by the Fraunhofer institutes. The heads of the institutes and the organs of the Fraunhofer-Gesellschaft are advised by the institutes' Boards of Trustees, who are appointed by the Executive Board.

Tasks:
a) Contract research

– For industry: Small, medium-sized and large companies in industry and the service sector benefit from the competences of the Fraunhofer-Gesellschaft within the framework of contract research and collaborative projects. The Fraunhofer-Gesellschaft develops applicable, innovative solutions and contributes to the broad use of new technologies. In particular for small and medium-sized companies without R&D capacities of their own, the Fraunhofer-Gesellschaft is an important supplier of innovative know-how.
– For government and society: On behalf of and supported by the Federal Government and the *Länder*, the Fraunhofer institutes carry out strategic research projects. The aim is to promote the development of cutting-edge and key technologies or innovations in areas of particular public interest, such as environmental protection, energy technologies and preventive health care. Within the framework of the European Union, the Fraunhofer-Gesellschaft participates in the relevant technology programmes.
– Own research projects (financed from basic funding) to maintain scientific quality, secure market opportunities and develop new research areas.

Several Fraunhofer institutes cooperate as required, in order to implement also complex system solutions. For example, within the framework of co-operative alliances. Fraunhofer institutes working on related topics co-ordinate precompetitive research and identification of a common strategy; currently (1999) there are co-operative alliances on the topics of microelectronics, materials/components, surface technology and production technology.

b) Defence research

– Departmental research for the BMVg (100 percent basic and project funding by the BMVg).

It is planned to merge the Gesellschaft für Mathematik und Datenverarbeitung GMD (National Research Centre for Information Technology) and its eight institutes with the FhG in order to pool the expertise of both institutions in the area of information and communication technologies and to produce synergy by means of common strategic orientation of the institutes. This merger is to take place in steps within a five-year transition period, with a planned transfer of GMD operations to the FhG by January 1, 2002, at the latest.

Institution	Main tasks
Baden-Württemberg	
Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-00; Fax: 07 11-9 70-13 99 E-Mail: info@ipa.fhg.de Internet: http://www.ipa.fhg.de	• Company organisation and structural planning • Production systems and maintenance • Assembly and handling systems • Use of industrial robots • Production processes and surface technology, automation of testing procedures
Fraunhofer-Institut für Grenzflächen- und Bioverfahrenstechnik IGB Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-00; Fax: 07 11-9 70-42 00 E-Mail: info@igb.fhg.de Internet: http://www.igb.fhg.de	• Technical issues of interfacial engineering, surface characterisation and modification, coating (e.g. plasma polymerisation) • Bioprocess development • Bioreactors • Aerobic and anaerobic waste water treatment • Genetic engineering
Fraunhofer-Institut für Arbeitswirtschaft und Organisation IAO Nobelstraße 12 c, 70569 Stuttgart Tel.: 07 11-9 70-01; Fax: 07 11-9 70-22 99 E-Mail: info@iao.fhg.de Internet: http://www.iao.fhg.de	• Service industry • Information systems, software technology and management • virtual reality and human engineering • R&D management and rapid product development • human resources and production management
Fraunhofer-Institut für Bauphysik IBP Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-00; Fax: 07 11-9 70-33 95 E-Mail: info@ibp.fhg.de Internet: http://www.ibp.fhg.de	• Thermal insulation and protection against moisture in construction; low-energy houses • Daylight technology; energy systems in buildings • New building materials and building systems; recycling issues; outdoor testing of building products • Building and room acoustics; noise reduction; technical and room acoustics
Fraunhofer-Institut für Raum und Bau IRB Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-25 00; Fax: 07 11-9 70-25 08 E-Mail: info@irb.fhg.de Internet: http://www.irb.fhg.de	• Information and documentation for the building industry, regional planning, urban development and housing construction • Databases, bibliographies on specific topics, building research reports
Technologie-Entwicklungsgruppe Stuttgart TEG Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-35 00; Fax: 07 11-9 70-39 99 E-Mail: info@teg.fhg.de Internet: http://www.teg.fhg.de	• Optimisation of development times by simultaneous engineering, planning methodology and simulation techniques • Planning of logistic materials flow systems
Fraunhofer-Institut für Physikalische Meßtechnik IPM Heidenhofstraße 8, 79110 Freiburg Tel.: 07 61-88 57-0; Fax: 07 61-88 57-2 24 E-Mail: info@ipm.fhg.de Internet: http://www.ipm.fhg.de	• Integrated optical components and gas sensors • Optical spectroscopy and optical systems • Optical metrology engineering • Microsensors and microsystems, bioanalytics • Laser exposure systems • Non-touch optical distance and ID measuring systems

Institution	Main tasks
Fraunhofer-Institut für Werkstoffmechanik IWM Wöhlerstraße 11–13, 79108 Freiburg Tel.: 07 61-51 42-0; Fax: 07 61-51 42-1 10 E-Mail: info@iwm.fhg.de Internet: http://www.iwm.fhg.de	• Physical and mechanical behaviour of building components and constructions under static and dynamic stress • Evaluation of macro- and microstructures by means of experimental and theoretical numerical methods • Development and optimisation of manufacturing, machining and coating processes
Fraunhofer-Institut für Solare Energiesysteme ISE Oltmannsstraße 5, 79100 Freiburg Tel.: 07 61-45 88-0; Fax: 07 61-45 88-1 00 E-Mail: info@ise.fhg.de Internet: http://www.ise.fhg.de	• Electrical and thermal solar energy systems • Thermal and optical systems • Semiconductor materials and technologies for solar cells, in particular crystalline silicon • Storage of electrical and thermal energy; fuel cells; microsystems in energy technology
Fraunhofer-Institut für Angewandte Festkörperphysik IAF Tullastraße 72, 79108 Freiburg Tel.: 07 61-51 59-0; Fax: 07 61-51 59-4 00 E-Mail: info@iaf.fhg.de Internet: http://www.iaf.fhg.de	• Materials research and process technologies (GaAs) • Components and circuit development (GaAs) • Optoelectronics • Infrared technology
Fraunhofer-Institut für Kurzzeitdynamik – Ernst-Mach-Institut EMI Eckerstraße 4, 79104 Freiburg Tel.: 07 61-27 14-0; Fax: 07 61-27 14-3 16 E-Mail: info@emi.fhg.de Internet:http://www.fhg.de/german/profile/emi.html	• Experimental and numerical analysis of shock waves in media, flow and burning processes, impact and penetration processes • Behaviour of structures under shock wave stress • Determination of dynamic material behaviour
Fraunhofer-Institut für Systemtechnik und Innovationsforschung ISI Breslauer Straße 48, 76139 Karlsruhe Tel.: 07 21-68 09-0; Fax: 07 21-68 91-52 E-Mail: info@isi.fhg.de Internet: http://www.isi.fhg.de	• Technology analysis and evaluation in the fields of energy, environment, production, communication and biotechnology • Technology foresight • Innovation strategies and policy • Research accompanying funding measures
Fraunhofer-Institut für Informations- und Datenverarbeitung IITB Fraunhoferstraße 1, 76131 Karlsruhe Tel.: 07 21-60 91-0; Fax: 07 21-60 91-4 13 E-Mail: info@iitb.fhg.de Internet: http://www.iitb.fhg.de	• Production control and management systems • Real-time image evaluation for quality control • Telematics systems, software platforms, Internet applications • Recognition and diagnosis systems, cognitive systems • Interaction systems, man-machine communication
Fraunhofer-Institut für Chemische Technologie ICT Joseph-von-Fraunhofer-Straße 7 76327 Pfinztal/Berghausen Tel.: 07 21-46 40-0; Fax: 07 21-46 40-1 11 E-Mail: info@ict.fhg.de, Internet: http://www.ict.fhg.de	• Energetic materials, high-energy polymers, polymer compounds, propellants, explosives • Energetic systems, reaction kinetics, gas generator systems • Polymer technology, rapid prototyping, rapid tooling • Environmental engineering, treatment and disposal of problematic waste, closed-loop system • Applied electrochemistry, high-performance batteries, electrochemical sensors

Institution	Main tasks
Bayern/Bavaria	
Fraunhofer-Institut für Verfahrenstechnik und Verpackung IVV Giggenhauser Straße 35, 85354 Freising Tel.: 0 81 61-4 91-0; Fax: 0 81 61-4 91-4 91 E-Mail: info@ivv.fhg.de Internet: http://www.ivv.fhg.de	• Physical-chemical analytics • Food technology, food quality • Process technology (new agricultural raw materials, new protein technologies, biodegradable packaging) • Material development (packaging material development, high-barrier layers, functional films) • Ecological aspects of packaging, process modelling
Fraunhofer-Einrichtung für Schaltung und Systeme der Kommunikationstechnik ESK Hansastraße 32, 80686 München Tel.: 0 89-5 47 59-0 00; Fax: 0 89-5 47 59-1 00 Internet: http://www.esk.fhg.de	• Systems for access and in-house communication
Fraunhofer-Institut für Mikroelektronische Schaltung und Systeme IMS Institutsteil München Hansastraße 27 d, 80686 München Tel.: 0 89-5 47 59-0 00; Fax: 0 89-5 47 59-1 00 E-Mail: mv@imsm.fhg.de	• Biochemical sensors • Micromechanical fluidics and actuators
Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM Institutsteil München Hansastraße 27 d, 80686 München Tel.: 0 89-5 47 59-0 00; Fax: 0 89-5 47 59-1 00	• Polytronic systems • Vertical integration technology
Fraunhofer-Patentstelle für die Deutsche Forschung PST Leonrodstraße 68, 80636 München Tel.: 0 89-12 05-02; Fax: 0 89-12 05-4 67 E-Mail: info@pst.fhg.de Internet: http://www.fhg.de/german/profile/pst.html	• Support in obtaining, maintaining and exploitating protective rights for researchers, research institutions without patent departments, freelancers, independent inventors and owners of small enterprises • Patent department of the Fraunhofer-Gesellschaft
Fraunhofer-Institut für Atmosphärische Umweltforschung IFU Kreuzeckbahnstraße 19 82467 Garmisch-Partenkirchen Tel.: 0 88 21-1 83-0; Fax: 0 88 21-7 35 73 E-Mail: info@ifu.fhg.de Internet: http://www.fhg.de/german/profile/ifu.html	• Transportation, spreading and transformation of trace substances in the troposphere • Climate-relevant trace substances • Regional pollution • Development of measuring techniques • UV-B radiation measuring
Fraunhofer-Institut für Integrierte Schaltungen IIS, Bereich Angewandte Elektronik Am Weichselgarten 3 91058 Erlangen-Tennenlohe Tel.: 0 91 31-7 76-0; Fax: 0 91 31-7 76-9 99 E-Mail: info@iis.fhg.de Internet: http://www.iis.fhg.de	• Design of application-specific circuits (ASICs; analogue/digital) • Analogue and digital circuits for very high frequencies • Circuits, systems and services in telecommunications • Image processing

Institution	Main tasks
Fraunhofer-Institut für Integrierte Schaltungen IIS, Bereich Bauelementetechnologie Schottkystraße 10, 91058 Erlangen Tel.: 0 91 31-7 61-0; Fax: 0 91 31-7 61-3 90 E-Mail: info@iis-b.fhg.de Internet: http://www.iis.fhg.de	• Design and modelling of process steps in semiconductor production • Development of process simulation programmes • Equipment for semiconductor production • Analysis for surface characterisation
Fraunhofer-Institut für Silicatforschung ISC Neunerplatz 2, 97082 Würzburg Tel.: 09 31-41 00-0; Fax: 09 31-41 00-1 99 E-Mail: info@isc.fhg.de Internet: http://www.isc.fhg.de	• Development of non-metallic inorganic materials (glass, ceramics, bonding materials) and inorganic-organic copolymers (ORMOCERs) and their technologies • Material synthesis using brines for the production of powders, fibres, layers for materials with special mechanical, thermal, electronic or photonic properties • In-situ measuring of properties in heat treatment processes
Fraunhofer-Arbeitsgruppe für Drahtlose Telekommunikations- und Multimediatechnik ADTM des Fraunhofer-Instituts für Integrierte Schaltungen IIS Am Weichselgarten 3 91058 Erlangen/Tennenlohe Tel.: 0 91 31-7 76-0; Fax 0 91 31-7 76-9 99 E-Mail: info@iis.fhg.de	• Multimedia communication • Mobile or portable terminal equipment • Coding procedures • Multimedia development tools • Digital broadcasting
Fraunhofer-Anwendungszentrum für Verkehrslogistik und Kommunikationstechnik AVK des Fraunhofer-Instituts für Integrierte Schaltungen IIS Theodorstraße 1, 90489 Nürnberg Tel.: 09 11-5 88 79-0; Fax: 09 11-5 88 79-33 E-Mail: klaus@avk.fhg.de Internet: http://www.avk.iis.fhg.de	• Transport logistics supported by communication technology • Integrated transport systems • Time-oriented management of production and business processes
Berlin	
Fraunhofer-Institut für Produktionsanlagen und Konstruktionstechnik IPK Pascalstraße 8–9, 10587 Berlin Tel.: 0 30-3 90 06-0; Fax: 0 30-3 91 10 37 E-Mail: info@ipk.fhg.de Internet: http://www.ipk.fhg.de	• Design technology (virtual product and process development, design and planning systems) • Planning technology (production planning and management, quality and environment management) • Process technology (pattern recognition, safety technology, monitoring and diagnosis) • Control technology (remote diagnostics, robot and installation control, handling and programming systems) • Transport and medical technology (vehicle design and manufacturing, telematics/medical manipulators and systems)
Fraunhofer-Institut für Software- und Systemtechnik ISST Institutsteil Berlin Mollstraße 1, 10178 Berlin Tel.: 0 30-243 06-100; Fax: 0 30-243 06-199 E-Mail: info@isst.fhg.de Internet: http://www.isst.fhg.de	• Internet/intranet technologies and management (technical infrastructures, system management, content management, application architectures) • Information services (distributed multimedia applications, data integration, meta-information) • Reliable technical systems (software technology for real-time systems (focus SW design), safeware technology/design for safety)

Institution	Main tasks
Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM Gustav-Meyer-Allee 25, Geb. 17 13355 Berlin Tel.: 0 30-4 64 03-1 00; Fax: 0 30-4 64 03-1 11 E-Mail: info@izm.fhg.de Internet: http://www.izm.fhg.de	• Evaluation of reliability of microelectronic components, in particular of assembly and interconnection technology • Numerical evaluation models in connection with laseroptical, radiographic and materials tests • Microsystems technology
Brandenburg	
Fraunhofer-Institut für Angewandte Polymerforschung IAP Geiselbergstraße 69, 14476 Golm Tel.: 03 31-5 68-11 12; Fax: 03 31-5 68-31 10 E-Mail: info@iap.fhg.de Internet: http://www.iap.fhg.de	• Synthetic polymers, controlled-release systems • Water-soluble polymers/polymer dispersions, water treatment • Polysaccharides (cellulose, starch) • Structure formation and structure characterisation (mechanical, optical characterisation) • Materials with particular physical properties • Renewable resources
Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM Außenstelle für Polymermaterialien und Composite EPC Kantstraße 55, 14513 Teltow, Tel.: 0 33 28-46-2 84; Fax: 0 33 28-46-2 82 E-Mail: mbauer@epc.izm.fhg.de Internet: http://www.epc.izmfhg.de	• Bonding techniques in assembly and interconnection technology in microelectronics
Fraunhofer-Anwendungszentrum für Logistiksystempla-nung – Informationssyteme des Fraunhofer-Instituts für Materialfluß und Logistik IML Universitätsplatz 3–4, 03044 Cottbus Tel.: 03 55-69-45 80; Fax: 03 55-69-48 00 E-Mail: info@ali.fhg.de Internet: http://www.ali.fhg.de	• Modelling and verification of process chains in material flow and inventory planning and in quality management • Tools and their application in procurement, production, disposal, distribution and transport logistics • Information systems in logistics covering all workspaces
Bremen	
Fraunhofer-Institut für Angewandte Materialforschung IFAM Bereich Endformnahe Fertigungstechnologien Wiener Straße 12, 28359 Bremen Tel.: 04 21-22 46-0; Fax: 04 21-22 46-300 E-Mail: info@ifam.fhg.de Internet: http://www.ifam.fhg.de	• Powder-metallurgical forming (pressing/sintering) and metal powder injection moulding • Light-weight structures of metallic foams, hollow ball structures, metal fibres • Production/processing of nano-scale metal powders • Forming by casting (pressure die casting, thixo and squeeze casting) • Development of functional powder-metalurgical materials • CAD-based rapid prototyping, virtual product development (CAE)
Fraunhofer-Institut für Angewandte Materialforschung IFAM Bereich Klebtechnik und Polymere Wiener Staße 12, 28359 Bremen Tel.: 04 21-22 46-400; Fax: 04 21-22 46-430 E-Mail: ktinfo@ifam.fhg.de Internet: http://www.ifam.fhg.de	• Basic principles of adhesion, development, formulation and characterisation of polymers (bonding agents, laminating and casting resins) • Plasma and surface technology • Micro-assembly, hybrid joining techniques • Joining in lightweight construction • Training and further training in the area of adhesive bonding technology

Institution	Main tasks
Hessen/Hesse	
Fraunhofer-Institut für Betriebsfestigkeit LBF Bartningstraße 47 64289 Darmstadt-Kranichstein Tel.: 0 61 51-7 05-1; Fax: 0 61 51-7 05-2 14 E-Mail: info@lbf.fhg.de Internet: http://www.lbf.fhg.de	• Measurement of supporting/safety-relevant components and structures with regard to strength, weight and production costs • Development and optimisation of numerical and experimental measuring techniques • Measurement, analysis and simulation of operating stress
Fraunhofer-Institut für Graphische Datenverarbeitung IGD Rundeturmstraße 6, 64283 Darmstadt Tel.: 0 61 51-1 55-0; Fax: 0 61 51-1 55-1 99 E-Mail: info@igd.fhg.de Internet: http://www.igd.fhg.de	• Document processing and communication • Animation and image communication, scientific-technological visualisation, virtual reality, augmented reality • Graphic information systems • Co-operative HyperMedia systems • Cognitive computing & medical imaging • Safety technology for graphic and communication systems
Fraunhofer-Anwendungszentrum für Graphische Datenverarbeitung in der Chemischen und Pharmazeutischen Industrie AGC des Fraunhofer-Instituts für Graphische Datenverarbeitung IGD Varrentrappstraße 40–42, Carl-Bosch-Haus, 60484 Frankfurt Tel.: 069-97 995-0; Fax: 0 69-97 995-299 E-Mail: info@agc.fhg.de	• Industry solutions for chemistry and life sciences by • Visualisation and animation technologies and technologies of virtual reality • Communication technologies and multimedia • Graphic database and data management technologies, graphic user interfaces
Mecklenburg-Vorpommern/Mecklenburg-Western Pomerania	
Fraunhofer-Institut für Graphische Datenverarbeitung IGD Institutsteil Rostock IGD-R Joachim-Jungius-Straße 11, 18059 Rostock Tel.: 03 81-40 24-1 10; Fax: 03 81-40 24-1 99 E-Mail: urban@rostock.igd.fhg.de Internet: http://www.rostock.igd.fhg.de	• Multimedia communication • Visualisation and interaction technologies • Mobile multimedia technologies
Fraunhofer-Anwendungszentrum für Großstrukturen in der Produktionstechnik AGP des Fraunhofer-Instituts für Produktionstechnik und Automatisierung IPA Joachim-Jungius-Straße 9, 18059 Rostock Tel.: 03 81-40 59-713; Fax: 03 81-40 59-694	• New joining and cutting technologies for large structures in shipbuilding/offshore technology, building construction and structural steel engineering, mechanical engineering, construction of aircraft and rail vehicles • Mechanisation/automation of production and assembly of large structures • Production-oriented information technology (job-site production)
Niedersachsen/Lower Saxony	
Fraunhofer-Institut für Toxikologie und Aerosolforschung ITA Nikolai-Fuchs-Straße 1, 30625 Hannover Tel.: 05 11-53 50-0; Fax: 05 11-53 50-1 55 E-Mail: info@ita.fhg.de Internet: http://www.ita.fhg.de	• Clinical pharmaceuticals research and development • Clinical inhalation • Tissue/environmental hygiene and consumer protection • Testing and registration of chemicals, biocides and pesticides • Medical biotechnology and molecular medicine

Institution	Main tasks
Fraunhofer-Institut für Holzforschung – Wilhelm-Klauditz-Institut WKI Bienroder Weg 54 E, 38108 Braunschweig Tel.: 05 31-21 55-0; Fax: 05 31-35 15 87 E-Mail: info@wki.fhg.de Internet: http://www.wki.fhg.de	• Development and optimisation of wood and composite materials • Process development for the wood materials and furniture industry • Recycling and disposal concepts for scrap-wood and matured timber • Surface technology/bonding chemistry • Component testing and analysis
Fraunhofer-Institut für Schicht- und Oberflächentechnik IST Bienroder Weg 54 E, 38108 Braunschweig Tel.: 05 31-21 55-0; Fax: 05 31-21 55-9 00 E-Mail: info@ist.fhg.de Internet: http://www.ist.fhg.de	• Development of mechanical-tribological, electrical and optical functional layers or layer systems • Techniques and systems for physical and plasma-activated chemical plating • Diamond technology • Atmospheric coating techniques • Layer characterisation and quality assurance
Nordrhein-Westfalen/North Rhine-Westphalia	
Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS Finkenstraße 61, 47057 Duisburg Tel.: 02 03-37 83-0; Fax: 02 03-37 83-2 66 E-Mail: info@ims.fhg.de Internet: http://www.imsdu.fhg.de	• Design and prototyping of analogue/digital circuits • Microsystems technology • Industrial electronics • Smart power • Microprocessor systems
Fraunhofer-Institut für Materialfluß und Logistik IML Joseph-von-Fraunhofer-Straße 2–4 44227 Dortmund Tel.: 02 31-97 43-0; Fax: 02 31-97 43-2 11 E-Mail: info@iml.fhg.de Internet: http://www.iml.fhg.de	• Planning, simulation and design of logistic systems • Development, construction and prototype realisation of material flow components and systems for automating logistic processes • Design, organisation and controlling of logistic processes from a business management perspective
Fraunhofer-Institut für Produktionstechnologie IPT Steinbachstraße 17, 52074 Aachen Tel.: 02 41-89 04-0; Fax: 02 41-89 04-1 98 E-Mail: info@ipt.fhg.de Internet: http://www.ipt.fhgfhg.de	• Development of innovative production technologies such as rapid prototyping, laser beam machining and development of environmentally sound production systems • Precision, ultra-precision and micro-machining • Development, construction and assembly of production machines • Development of optoelectronic measuring systems • Method-based product and technology planning, development of quality management systems
Fraunhofer-Institut für Lasertechnik ILT Steinbachstraße 15, 52074 Aachen Tel.: 02 41-89 06-0; Fax: 02 41-89 06-1 21 E-Mail: info@ilt.fhg.de Internet: http://www.ilt.fhg.de	• Laser-based production technology • Process development and process management • Development and optimisation of laser systems for materials machining and flexible production • Laser measuring and testing technology • Development of multimedia training software

Institution	Main tasks
Fraunhofer-Institut für Umweltchemie und Ökotoxikologie IUCT Auf dem Aberg 1, 57392 Schmallenberg/Grafschaft Tel.: 0 29 72-3 02-0; Fax: 0 29 72-3 02-3 19 E-Mail: info@iuct.fhg.de Internet: http://www.iuct.fhg.de	• Registration of ecotoxicological effects of chemicals in the environment • Field trials (flowing water, aquatic microcosms and lysimeter studies) • Monitoring of biological decontamination of soil • Pilot studies on composting and landfill disposal • Molecular biotechnology, recombinant antibodies in plants for the development of pharmaceutical ingredients
Fraunhofer-Institut für Naturwissenschaftlich-Technische Trendanalysen INT Appelsgarten 2, 53879 Euskirchen Tel.: 0 22 51-18-1; Fax: 0 22 51-18-2 77 E-Mail: info@int.fhg.de Internet: http://www.int.fhg.de	• Gathering and analysing of information on long-term development trends in all key areas of technology; technology assessment and expert reports in specific fields of technology • Defence technology analyses as a basis for long-term planning in the Federal Armed Forces
Fraunhofer-Institut für Umwelt-, Sicherheits- und Energietechnik UMSICHT Osterfelder Straße 3, 46047 Oberhausen Tel.: 02 08-85 98-0; Fax: 02 08-85 98-2 90 E-Mail: we@umsicht.fhg.de Internet: http://www.umsicht.fhg.de	• Preventive environmental technology; industrial environmental protection /environmental management • Process and plant safety; process development; reactor calculation and safety • Energy process technology; energy supply; district heating and combined heat and power generation
Fraunhofer-Institut für Software- und Systemtechnik ISST Institutsteil Dortmund Joseph-von-Fraunhofer-Straße 20 44227 Dortmund Tel.: 02 31-97 00-7 00; Fax: 02 31-97 00-7 98 E-Mail: weber@do.isst.fhg.de Internet: http://www.isst.fhg.de	• Process management (methods and tools, process management application) • Information management (methods, tools, information management systems, integrated multimedia database applications) • Quality management (quality management in software development, quality assessment of software products, durability of software products)
Fraunhofer-Anwendungszentrum für Logistikorientierte Betriebswirtschaft ALB des Fraunhofer-Instituts für Materialfluß und Logistik IML Fürstenallee 11, 33102 Paderborn Tel.: 0 52 51-60 64 85; Fax: 0 52 51-60 64 82 E-Mail: whd@hni.uni-paderborn.de	• Modelling of production facilities and products and of their structuring with all data necessary for the evaluation of a logistics process • Modelling of logistics processes • Tools for the planning of logistics systems such as simulation systems
Rheinland-Pfalz/Rhineland-Palatinate	
Fraunhofer-Einrichtung für Experimentelles Software Engineering IESE Sauerwiesen 6, 67661 Kaiserslautern Tel.: 0 63 01-7 07-0; Fax: 0 63 01-7 07-2 00 E-Mail: info@iese.fhg.de Internet: http://www.iese.fhg.de	• Research and development for continuous quality improvement of software products and software development processes: • Process modelling, measuring programmes, experience factory, learning organisation • Requirement engineering, reengineering, domain-specific software architectures • Software development for product lines, object-oriented software development, cleanroom engineering • Systematic inspection techniques, software testing

Institution	Main tasks
Saarland	
Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren IZFP Universität, Gebäude 37, 66123 Saarbrücken Tel.: 06 81-3 02 38-01; Fax: 06 81-3 95 80 E-Mail: info@izfp.fhg.de Internet: http://www.izfp.fhg.de	• Testing equipment and systems • Quality and process assurance • Process and operation testing (automated non-destructive testing methods) • Determination of intrinsic material properties based on ultrasound and micromagnetic, electromagnetic and thermal interaction • Integration of non-destructive testing methods into production processes and existing QM systems
Fraunhofer-Institut für Biomedizinische Technik IBMT Ensheimer Straße 48, 66386 St. Ingbert Tel.: 0 68 94-9 80-0; Fax: 0 68 94-9 80-4 00 E-Mail: info@ibmt.fhg.de Internet: http://www.ibmt.fhg.de	• Sensor systems/microsystems (biointerfaces, biocompatibility tests) • Ultrasound system technology and application technology (ultrasound measuring technology, microscopy, imaging systems) • Sensor production technology • Magnetic resonance (NMR, AFM, IR, EM, image processing)
Sachsen/Saxony	
Fraunhofer-Institut für Elektronenstrahl- und Plasmatechnik FEP Winterbergstraße 28, 01277 Dresden Tel.: 03 51-25 86-0; Fax: 03 51-25 86-1 05 E-Mail: info@fep.fhg.de Internet: http://www.fep.fhg.de	• Development of electron beam and plasma processes in production • Electron beam surface treatment • Procedures and systems for coating by means of plasma-activated high-rate evaporation and magnetron sputtering • Development of process-adapted electron beam and sputtering sources
Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Winterbergstraße 28, 01277 Dresden Tel.: 03 51-25 83-3 24; Fax: 03 51-25 83-3 00 E-Mail: info@iws.fhg.de Internet: http://www.iws.fhg.de	• Surface finishing of materials and components with laser beams and other high-performance energy sources • Laser-beam macro- and micro-machining of materials • Application of diode lasers in the high-performance diode lasers application centre • Materials and process development for layers in the nanometer to millimetre range • Ultra-precision and high-rate coating
Fraunhofer-Institut für Keramische Technologien und Sinterwerkstoffe IKTS Winterbergstraße 28, 01277 Dresden Tel.: 03 51-25 53-5 19; Fax: 03 51-25 53-6 00 E-Mail: info@ikts.fhg.de Internet: http://www.ikts.fhg.de	• Stress-relevant development of materials, technologies and ceramic components • High-performance systems in the areas of structural ceramics, functional ceramics, cermets • Process technology solutions for powder development, powder processing, forming, sintering, process and materials characterisation • System-oriented design and finishing of components/functional models

Institution	Main tasks
Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik IWU Reichenhainer Straße 88, 09126 Chemnitz Tel.: 03 71-53 97-400; Fax: 03 71-53 97-4 04 E-Mail: info@iwu.fhg.de Internet: http://www.iwu.fhg.de	• Process design, monitoring, control and simulation as well as constructive development, primarily for: • body and chassis elements • tool and mould making • machinetools and manufacturing equipment
Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS **Institutsteil Dresden IMS2** Grenzstraße 28, 01109 Dresden Tel.: 03 51-88 23-0; Fax: 03 51-88 23-2 66 E-Mail: info@imsdd.fhg.de Internet: http://www.imsdd.fhg.de	• Results, reliability and scaling of CMOS technology • Process and component simulations • Sensor development • Analogue-digital circuit technology • Design methodology, specifically for sensors and signal processing
Fraunhofer-Institut für Integrierte Schaltungen IIS **Außenstelle für Automatisierung des Schaltkreis- und Systementwurfs EAS** Zeunerstraße 38, 01069 Dresden Tel.: 03 51-46 40-7 00; Fax: 03 51-46 40-7 03 E-Mail: info@eas.iis.fhg.de	• Development of tools for VLSI and system design • Circuit development • Simulation of circuits and systems
Fraunhofer-Institut für Informations- und Datenverarbeitung IITB **Teilinstitut für Verkehrs- und Infrastruktursysteme IITB-IVI** Zeunerstraße 38, 01069 Dresden Tel.: 03 51-46 40-6 10; Fax: 03 51-46 40-6 13 E-Mail: wilfert@ivi.iitb.fhg.de Internet: http://www.ivi.iitb.fhg.de	• Traffic information systems, traffic management systems and traffic guidance systems (traffic telematics) • Multimedia traffic and transport systems • Process management, optimisation and control in energy and supply systems as well as in process technology
Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung IFAM **Außenstelle für Pulvermetallurgie und Verbundwerkstoffe EPW** Winterbergstraße 28, 01277 Dresden Tel.: 03 51-25 37-3 00; Fax: 03 51-25 37-3 99 E-Mail: kieback@epw.ifam.fhg.de	• Fibre metallurgy (PM fast cooling, fibre production and application, MMC composites) • High-temperature materials (intermetallides, metallic HT materials, composites) • Hollow ball structures for light-weight construction
Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren IZFP **Außenstelle für Akustische Diagnose und Qualitätssicherung EADQ** Krügerstraße 22, 01326 Dresden Tel.: 03 51-2 64 82-0; Fax: 03 51-2 64 82-18 E-Mail: pridoehl@eadq.izfp.fhg.de	• Application of active and passive acoustic methods • X-ray and neutron analysis • Testing devices and systems (equipment construction) • Microtechnological quality assurance
Fraunhofer-Anwendungszentrum für Verarbeitungsmaschinen und Verpackungstechnik AVV des Fraunhofer-Instituts für Verfahrenstechnik und Verpackung IVV Räcknitzhöhe 35a, 01217 Dresden Tel.: 03 51-436-14-30; Fax: 03 51-436-14-59 E-Mail: all@avv.fhg.de	• Analysis, development and optimisation of processing and packaging machines • Analysis and optimisation of processing equipment in the materials processing and packaging industry

Institution	Main tasks
Sachsen-Anhalt/Saxony-Anhalt	
Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF Sandtorstraße 22, 39106 Magdeburg Tel.: 03 91-40 90-0; Fax: 03 91-40 90-3 45 E-Mail: info@iff.fhg.de Internet: http://www.iff.fhg.de	• Process automation/control systems • Control of assembly and handling technology • Production logistics, production planning and management • Factory management/planning/ecology
Fraunhofer-Institut für Werkstoffmechanik IWM **Institutsteil Halle IWM-H** Heideallee 19, 06120 Halle/Saale Tel.: 03 45-5 58 89-0; Fax: 03 45-55 89-1 01 E-Mail: ka@iwmh.fhg.de	• Analysis of microscopic structures and processes in material deformation and failure • Modelling of mechanical behaviour of materials and microsystems
Schleswig-Holstein	
Fraunhofer-Institut für Siliziumtechnologie ISIT Fraunhoferstraße 1, 25524 Itzehoe Tel.: 0 48 21-17-0; Fax 0 48 21-17-42 50 E-Mail: info@isit.fhg.de Internet: http://www.isit.fhg.de	• Power-MOS processes/systems and pilot production • Micromechanical components • Hybrid integration • HL production equipment
Thüringen/Thuringia	
Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF Schillerstraße 1, 07745 Jena Tel.: 0 36 41-8 07-0; Fax: 0 36 41-8 07-6 05 E-Mail: info@iof.fhg.de Internet: http://www.iof.fhg.de	• Thin films for optical and microelectronic components and sensors • Optical/mechanical precision systems and holographic-optical elements for measuring, testing and production processes, precision mechanics • Optical measuring technology • Microoptics, integrated optics
Fraunhofer-Anwendungszentrum für Systemtechnik AST des Fraunhofer-Instituts für Informations- und Datenverarbeitung IITB Ehrenbergstraße 11, 98693 Ilmenau Tel.: 03677-6 68-6 25; Fax: 03677-6 68-626 E-Mail: wst@systemtechnik.tu-ilmenau.de	• Energy management (electrical/district heating/gas) • Management of water supply and sewage systems • Information systems for technology and environment
Fraunhofer-Institut für Integrierte Schaltungen IIS-A Außenstelle für Elektronische Medientechnologie AEMT Helmholtzplatz 2, 98693 Ilmenau Tel.: 0 36 77-69 57 27; Fax: 03677-69 12 55 E-Mail: bdg@iis.fhg.de	• Media content, music recognition, MPEG-7 • Autocoding, transmission of autosignals via the Internet • Entertainment electronics technology, home cinema, media technology for the home studio

Financial and staff resources of the Fraunhofer-Gesellschaft

Total expenditure (DM million)				Total staff – full time equivalent			
1997 Actual	**1998** Actual	**1999** Budget/estimate	**2000** Budget/estimate	**1997**	**1998** Actual as of 30 June	**1999**	**2000** Budget/estimate
1316	1314	1400	1480	6773	6996	7110	7260
of which:				*of which:*			
Basic funding from the Federal Government (including HSP/HEP)				(Established) Posts			
493	463	520	555	2040	2201	2170	2135
				Additional staff			
				1517	1492	1560	1645
External funds				Externally funded staff			
721	764	780	800	3010	3303	3380	3480

Source: FhG

Expenditure[1] of the Fraunhofer-Gesellschaft by research area

– 1998 –

Research area	Staff [2] FTE *	Expenditure [1] DM million
Materials technology, component behaviour	1 084	225
Production technology, manufacturing technology	862	221
Information and communication technology	689	139
Microelectronics, microsystems technology	1075	277
Sensor systems, testing technology	398	82
Process technology	554	103
Energy and building technology, environmental and health research	529	108
Technical-economic studies, information brokerage	313	52
Total	**5504**	**1207**

* FTE Full time equivalent.

1 Without expansion investments.

2 Without additional staff.

Source: FhG

3. German higher education institutions

Higher education institutions in Germany are all higher education institutions accredited by *Land* law – regardless of their source of funding. They contribute to the fostering and development of science and art by means of research, teaching and studies and prepare students for occupations which require the application of scientific findings and methods or creative ability in the artistic field.

Currently, there are 344 higher education institutions in Germany, 75 of which are not funded by the government.

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Fachhochschule Aachen Kalverbenden 6, 52066 Aachen	0241	6009-0	6009-1090	http://www.fh-aachen.de/
Rheinisch-Westfälische Technische Hochschule Aachen Postfach, 52056 Aachen Templergraben 55, 52062 Aachen	0241	80-1	8888100	http://www.rwth-aachen.de
Fachhochschule Aalen Hochschule für Technik und Wirtschaft Postfach 1728, 73428 Aalen Beethovenstraße 1, 73430 Aalen	07361	576-0	576-250	http://www.fh-aalen.de
Fachhochschule Albstadt-Sigmaringen Hochschule für Technik und Wirtschaft Postfach 1254, 72481 Sigmaringen Anton-Günther-Straße 51, 72488 Sigmaringen	07571	732-0	732-229	http://www.fh-albsig.de
Fachhochschule Amberg-Weiden Hochschule für Technik und Wirtschaft Postfach 14 62, 92204 Amberg Kaiser-Wilhelm-Ring 23, 92224 Amberg	09621	482-0	482-110	http://www.fh-amberg-weiden.de
Hochschule Anhalt (FH) Hochschule für angewandte Wissenschaften Postfach 14 58, 06354 Köthen Bernburger Straße 55, 06366 Köthen	03496	67-0	212152 oder 21 20 81	http://www.hs-anhalt.de
Fachhochschule Ansbach Postfach 1616, 91507 Ansbach Residenzstraße 8, 91522 Ansbach	0981	4877-0	4877-102	http://www.fh-ansbach.de
Fachhochschule Augsburg Baumgartnerstraße 16, 86161 Augsburg	0821	5586-0	5586-222	http://www.fh-augsburg.de
Universität Augsburg Postfach, 86135 Augsburg Universitätsstraße 2, 86159 Augsburg	0821	598-1	598-5505	http://www.uni-augsburg.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Internationale Fachhochschule Bad Honnef Rommersdorfer Straße 78–82, 53604 Bad Honnef	02224	9605-0	9605-50	http://www.ifh-bad-honnef.de
Otto-Friedrich-Universität Bamberg Postfach, 96045 Bamberg Kapuzinerstraße 16, 96047 Bamberg	0951	8630	8631005	http://www.uni-bamberg.de
Universität Bayreuth Postfach, 95440 Bayreuth Universitätsstraße 30, 95447 Bayreuth	0921	55-0	55-5290	http://www.uni-bayreuth.de
Philosophisch-Theologische Hochschule der Salesianer Don Boscos Benediktbeuern – Theologische Fakultät Don-Bosco-Straße 1, 83671 Benediktbeuern	08857	88-201/202	88-249	http://www.pth-bb.de
Alice-Salomon-Fachhochschule für Sozialarbeit und Sozialpädagogik Berlin Alice-Salomon-Platz 5, 12627 Berlin	030	99245-0	99245-245	http://www.asfh-berlin.de
E.A.P. Europäische Wirtschaftshochschule Berlin Heubnerweg 6, 14059 Berlin	030	32007-0	32007-111	http://www.eap.net
Evangelische Fachhochschule Berlin Fachhochschule für Sozialarbeit und Sozialpädagogik Postfach 37 02 55, 14132 Berlin Teltower Damm 118–122, 14167 Berlin	030	84582-0	84582-122	http://www.evfh-berlin.de
Fachhochschule für Technik und Wirtschaft Berlin Postfach, 10313 Berlin Treskowallee 8, 10318 Berlin	030	5019-0	5090134	http://www.fhtw-berlin.de
Fachhochschule für Verwaltung und Rechtspflege Berlin Alt-Friedrichsfelde 60, 10315 Berlin	030	9021-0	9021-4006/ 4057	http://www.fhvr.berlin.de
Fachhochschule für Wirtschaft Berlin Badensche Straße 50–51, 10825 Berlin	030	85789-0	85789-199	http://www.fhw-berlin.de
Freie Universität Berlin Kaiserswerther Straße 16–18, 14195 Berlin	030	838-1	838-73167	http://www.fu-berlin.de
Hochschule der Künste Berlin Postfach 12 05 44, 10595 Berlin Ernst-Reuter-Platz 10, 10587 Berlin	030	3185-0	3185-2635; 3185-2758	http://www.hdk-berlin.de
Hochschule für Musik „Hanns Eisler" Berlin Charlottenstraße 55, 10117 Berlin	030	20309-2420	20309-2408	http://www.hfm-berlin.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Schauspielkunst „Ernst Busch“ Schnellerstraße 104, 12439 Berlin	030	639975-0	639975-75	
Humboldt-Universität zu Berlin Postfach, 10099 Berlin Unter den Linden 6, 10117 Berlin	030	2093-0	2093-2770	http://www.hu-berlin.de
Katholische Fachhochschule Berlin (KFB) staatlich anerkannte Fachhochschule für Sozialwesen Köpenicker Allee 39–57, 10318 Berlin	030	501010-0	501010-88	http://www.kfb-berlin.de
Steinbeis-Hochschule-Berlin Gürtelstraße 29 A, 10247 Berlin	030	293309-0	293309-20	http://www.stw.de/shb
Technische Fachhochschule Berlin Luxemburger Straße 10, 13353 Berlin	030	4504-1	4504-2705	http://www.tfh-berlin.de
Technische Universität Berlin Straße des 17. Juni 135, 10623 Berlin	030	314-0	314-23222	http://www.tu-berlin.de
Kunsthochschule Berlin-Weißensee Hochschule für Gestaltung Bühringstraße 20, 13086 Berlin	030	47705-0	47705-290	http://www.kh-berlin.de
Kirchliche Hochschule Bethel Postfach 13 01 40, 33544 Bielefeld Remterweg 45, 33617 Bielefeld	0521	144-3948	144-3961	http://www.bethel.de/kiho
Fachhochschule Biberach Hochschule für Bauwesen und Wirtschaft Postfach 1260, 88382 Biberach Karlstraße 11, 88400 Biberach	07351	582-0	582-119	http://www.fh-biberach.de
Fachhochschule Bielefeld Postfach 10 11 13, 33511 Bielefeld Kurt-Schumacher-Straße 6, 33615 Bielefeld	0521	106-01	106-2600	http://www.fh-bielefeld.de
Universität Bielefeld Postfach 10 01 31, 33501 Bielefeld Universitätsstraße 25, 33615 Bielefeld	0521	106-00	106-5844, -6464	http://www.uni-bielefeld.de
Fachhochschule Bingen Berlinstraße 109, 55411 Bingen	06721	409-0	409-100	http://www.fh-bingen.de
Fachhochschule Bochum Postfach 10 07 41, 44707 Bochum Universitätsstraße 150, 44801 Bochum	0234	32-10001	32-14219	http://www.fh-bochum.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Technische Fachhochschule Georg Agricola für Rohstoff, Energie und Umwelt zu Bochum – Staatlich anerkannte Fachhochschule der DMT Herner Straße 45, 44787 Bochum	0234	968-02	968-3359	http://www.tfh-bochum.de
Ruhr-Universität Bochum Postfach, 44780 Bochum Universitätsstraße 150, 44801 Bochum	0234	322-01	32-14201	http://www.ruhr-uni-bochum.de
Fachhochschule für das öffentliche Bibliothekswesen Bonn Posfach 1267, 53002 Bonn Wittelsbacherring 9, 53115 Bonn	0228	7258-0	7258-189	http://www.t-online.de/ fhoebb-/index.htm
Rheinische Friedrich-Wilhelms-Universität Bonn Postfach, 53012 Bonn Regina-Pacis-Weg 3, 53113 Bonn	0228	73-0	73-1780	http://www.uni-bonn.de
Fachhochschule Bonn-Rhein-Sieg Postfach, 53754 Sankt Augustin Grantham-Allee 20, 53757 Sankt Augustin	02241	865-0	865-609	http://www.fh-rhein-sieg.de
Fachhochschule Brandenburg Postfach 21 32, 14737 Brandenburg Magdeburger Straße 50, 14770 Brandenburg	03381	355-0	355-199	http://www.fh-brandenburg.de
Hochschule für Bildende Künste Braunschweig Postfach 2538, 38015 Braunschweig Johannes-Selenka-Platz 1, 38118 Braunschweig	0531	391-9122	391-9292	http://www.hbk-bs.de
Technische Universität Carolo-Wilhelmina zu Braunschweig Postfach 33 29, 38023 Braunschweig Pockelsstraße 14, 38106 Braunschweig	0531	391-0	391-4577	http://www.tu-bs.de
Fachhochschule Braunschweig/Wolfenbüttel Salzdahlumer Straße 46/48, 38302 Wolfenbüttel	05331	939-0	939-118	http://www.fh-wolfenbuettel.de
Hochschule Bremen Neustadtswall 30, 28199 Bremen	0421	5905-0	5905-2292	http://www.hs-bremen.de
Hochschule für Künste Am Wandrahm 23, 28195 Bremen	0421	3019-0	3019-119	http://www.HFK-BREMEN.DE
International University Bremen Postfach 750561, 28725 Bremen Campus Ring 1, 28759 Bremen	0421	200-40	200-4113	http://www.iu-bremen.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Universität Bremen Postfach 33 04 40, 28334 Bremen Bibliotheksstraße 1, 28359 Bremen	0421	218-1	218-4259	http://www.uni-bremen.de
Hochschule Bremerhaven An der Karlstadt 8, 27568 Bremerhaven	0471	4823-0	4823-555	http://www.hs-bremerhaven.de
International University in Germany Bruchsal GmbH – staatlich anerkannte wissenschaftliche Hochschule – Postfach 1550, 76605 Bruchsal Campus 3, 76646 Bruchsal	07251	700-0	700-150	http://www.i-u.de
Technische Universität Chemnitz Postfach, 09107 Chemnitz Straße der Nationen 62, 09111 Chemnitz	0371	531-0	531-1342	http://www.tu-chemnitz.de
Technische Universität Clausthal Postfach 12 53, 38670 Clausthal-Zellerfeld Adolph-Roemer-Straße 2 A, 38678 Clausthal-Zellerfeld	05323	72-0	72-3500	http://www.tu-clausthal.de
Fachhochschule Coburg Postfach 1652, 96406 Coburg Friedrich-Streib-Straße 2, 96450 Coburg	09561	317-0	317-273	http://www.fh-coburg.de
Brandenburgische Technische Universität Cottbus Postfach 10 13 44, 03013 Cottbus Universitätsplatz 3–4, 03044 Cottbus	0355	69-0	69-2156	http://www.tu-cottbus.de
Evangelische Fachhochschule Darmstadt Zweifalltorweg 12, 64293 Darmstadt	06151	8798-0	8798-58	http://www.efh-darmstadt.de
Private FernFachhochschule Darmstadt staatlich genehmigt Postfach 10 01 64, 64201 Darmstadt Ostendstraße 3, 64319 Pfungstadt	06157	806-404	806-401	http://www.privatfh-da.de
Fachhochschule Darmstadt Haardtring 100, 64295 Darmstadt	06151	16-02	16-8949	http://www.fh-darmstadt.de
Technische Universität Darmstadt Postfach, 64277 Darmstadt Karolinenplatz 5, 64289 Darmstadt	06151	16-0	16-5489	http://www.tu-darmstadt.de
Fachhochschule Deggendorf Postfach 13 20, 94453 Deggendorf Edlmairstraße 6 + 8, 94469 Deggendorf	0991	3615-0	3615-299	http://www.fh-deggendorf.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name **Location**	**Dialling code**	**Phone**	**Fax**	**Internet**
Hochschule für Musik Detmold Neustadt 22, 32756 Detmold	05231	975-0	975-972	http://www.hfm-detmold.de
Fachhochschule Dortmund Postfach 10 50 18, 44047 Dortmund Sonnenstraße 96, 44139 Dortmund	0231	9112-0	9112-313	http://www.fh-dortmund.de
International School of Management ISM Dortmund Otto-Hahn-Straße 37, 44227 Dortmund	0231	975139-0	975139-39	http://www.ism-dortmund.de
Universität Dortmund Postfach, 44221 Dortmund August-Schmidt-Straße 4, 44227 Dortmund	0231	755-1	755-5150	http://www.uni-dortmund.de
Evangelische Hochschule für Soziale Arbeit Dresden (FH) Postfach 20 01 43, 01191 Dresden Semperstraße 2 A, 01069 Dresden	0351	46902-0	4715993	http://www.ehs-dresden.de
Hochschule für Bildende Künste Dresden Postfach, 01288 Dresden Güntzstraße 34, 01307 Dresden	0351	44020	4590025	http://www.hfbk-dresden.de
Hochschule für Kirchenmusik der Evangelisch- Lutherischen Landeskirche Sachsens Käthe Kollwitz Ufer 97, 01309 Dresden	0351	31864-0	31864-22	http://www.home.t-online.de/ home/hfkimudd
Hochschule für Musik „Carl Maria von Weber“ Dresden Postfach 12 00 39, 01001 Dresden Wettiner Platz 13, 01067 Dresden	0351	4923-60	4923-657	http://www.hfmdd.de
Palucca Schule Dresden – Hochschule für Tanz Postfach 200275, 01192 Dresden Basteiplatz 4, 01277 Dresden	0351	25906-0	25906-11	http://palucca.smwk.de
Hochschule für Technik und Wirtschaft Dresden (FH) Postfach 12 07 01, 01008 Dresden Friedrich-List-Platz 1, 01069 Dresden	0351	462-3101	462-2185	http://www.htw-dresden.de
Technische Universität Dresden Postfach, 01062 Dresden Mommsenstraße 13, 01069 Dresden	0351	463-0	4710294	http://www.tu-dresden.de
Gerhard-Mercator-Universität – Gesamthochschule Duisburg Postfach, 47048 Duisburg Lotharstraße 65, 47057 Duisburg	0203	379-0	379-3333	http://www.uni-duisburg.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Fachhochschule Düsseldorf Universitätsstraße, Geb. 23.31, 40225 Düsseldorf	0211	811-1	811-4916	http://www.fh-duesseldorf.de
Robert-Schumann-Hochschule Düsseldorf Fischerstraße 110, 40476 Düsseldorf	0211	4918-0	4911618	http://www.rsh-duesseldorf.de
Kunstakademie Düsseldorf Eiskellerstraße 1, 40213 Düsseldorf	0211	1396-0	1396-225	
Heinrich-Heine-Universität Düsseldorf Universitätsstraße 1, 40225 Düsseldorf	0211	81-00	342229	http://www.uni-duesseldorf.de
Fachhochschule Eberswalde Postfach 10 03 26, 16203 Eberswalde Alfred-Möller-Straße, 16225 Eberswalde	03334	65-0	65-425	http://www.fh-eberswalde.de
Katholische Universität Eichstätt Postfach, 85071 Eichstätt Ostenstraße 26, 85072 Eichstätt	08421	93-0	93-1796	http://www.ku-eichstaett.de
Nordakademie Staatlich anerkannte private Fachhochschule mit dualen Studiengängen Köllner Chaussee 11, 25337 Elmshorn	04121	4090-0	4090-40	http://www.nordakademie.de
Fachhochschule Erfurt Postfach 683, 99013 Erfurt Altonaer Straße 25a, 99085 Erfurt	0361	6700-700/701	6700-703	http://www.fh-erfurt.de
Pädagogische Hochschule Erfurt Postfach 307, 99006 Erfurt Nordhäuser Straße 63, 99089 Erfurt	0361	737-0	737-1999	http://www.ph-erfurt.de
Theologische Fakultät Erfurt Postfach 62, 99002 Erfurt Domstraße 10, 99084 Erfurt	0361	59077-0	59077-20	http://www.uni-erfurt.de/theol.
Universität Erfurt Postfach 307, 99006 Erfurt Nordhäuser Straße 73, 99089 Erfurt	0361	737-0	737-5009	http://www.uni-erfurt.de
Friedrich-Alexander-Universität Erlangen-Nürnberg Postfach 35 20, 91023 Erlangen Schloßplatz 4, 91054 Erlangen	09131	85-0	85-22131	http://www.uni-erlangen.de
Fachhochschule für Ökonomie und Management (FOM) Staatlich anerkannte Fachhochschule für Berufstätige Herkulesstraße 32, 45127 Essen	0201	81004-25	81004-310	http://www.FOM.DE

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Folkwang-Hochschule Essen Postfach 44 28, 45224 Essen Klemensborn 39, 45239 Essen	0201	4903-0	4903-288	http://www.folkwang.uni-essen.de
Universität – Gesamthochschule Essen Postfach, 45117 Essen Universitätsstraße 2, 45141 Essen	0201	183-1	183-2151	http://www.uni-essen.de
Fachhochschule Esslingen Hochschule für Sozialwesen Flandernstraße 101, 73732 Esslingen	0711	397-49	397-4595	http://www.hfs-esslingen.de
Fachhochschule Esslingen Hochschule für Technik Kanalstraße 33, 73728 Esslingen	0711	397-3000	397-3007	http://www.fht-esslingen.de
Fachhochschule Flensburg Kanzleistraße 91–93, 24943 Flensburg	0461	805-1	805-511	http://www.fh-flensburg.de
Universität Flensburg Mürwiker Straße 77, 24943 Flensburg	0461	3130-0	38543	http://www.uni-flensburg.de
Europa-Universität Viadrina Frankfurt (Oder) Postfach 1786, 15207 Frankfurt (Oder) Große Scharrnstraße 59, 15230 Frankfurt (Oder)	0335	5534-0	5534-305	http://www.euv-frankfurt-o.de
Fachhochschule Frankfurt am Main Nibelungenplatz 1, 60318 Frankfurt am Main	069	1533-0	1533-2400	http://www.fh-frankfurt.de
Hochschule für Bankwirtschaft (HfB) Private Fachhochschule der Bankakademie Postfach 10 03 41, 60003 Frankfurt am Main Sternstraße 8, 60318 Frankfurt am Main	069	95946-27	95946-28	http://www.hfb.de
Staatliche Hochschule für Bildende Künste (Städelschule) Frankfurt am Main Dürerstraße 10, 60596 Frankfurt am Main	069	605008-0	605008-66	http://www.staedelschule.frankfurt-main.de
Hochschule für Musik und Darstellende Kunst Frankfurt am Main Eschersheimer Landstraße 29–39, 60322 Frankfurt am Main	069	154007-0	154007-108	
Philosophisch-Theologische Hochschule frankfurt.de Sankt Georgen Frankfurt am Main Offenbacher Landstraße 224, 60599 Frankfurt am Main	069	6061-0	6061-307	http://www.st-georgen.uni-

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Johann Wolfgang Goethe-Universität Frankfurt am Main Postfach 111932, 60054 Frankfurt am Main Senckenberganlage 31, 60325 Frankfurt am Main	069	798-1	798-28383	http://www.uni-frankfurt.de
Technische Universität Bergakademie Freiberg Postfach, 09596 Freiberg Akademiestraße 6, 09599 Freiberg	03731	39-0	22195	http://www.tu-freiberg.de
Evangelische Fachhochschule Freiburg Hochschule für Soziale Arbeit, Diakonie und Religionspädagogik Bugginger Straße 38, 79114 Freiburg	0761	47812-0	47812-30	http://www.efh-freiburg.de
Staatliche Hochschule für Musik Freiburg im Breisgau Postfach, 79095 Freiburg Schwarzwaldstraße 141, 79102 Freiburg	0761	31915-0	31915-42	http://www.mh-freiburg.de
Katholische Fachhochschule Freiburg – staatlich anerkannt – Hochschule für Sozialwesen, Religionspädagogik und Pflege Karlstraße 63, 79104 Freiburg	0761	200-486	200-444	http://www.kfh-Freiburg.de
Pädagogische Hochschule Freiburg Kunzenweg 21, 79117 Freiburg	0761	682-1	682-402	http://www.uni-freiburg.de/ph/phhome
Albert-Ludwigs-Universität Freiburg im Breisgau Postfach, 79085 Freiburg Fahnenbergplatz, 79085 Freiburg/Breisgau	0761	203-0	203-8866	http://www.uni-freiburg.de
Theologische Hochschule Friedensau An der Ihle 5 A, 39291 Friedensau	03921	916-0	916-120	http://www.ThH-Friedensau.de
Fachhochschule Fulda Postfach 12 69, 36012 Fulda Marquardstraße 35, 36039 Fulda	0661	9640-0	9640-199	http://www.fh-fulda.de
Theologische Fakultät Fulda Domplatz 2, 36037 Fulda	0661	87-220	87-224	http://www.bistum.fulda.net/kircheaktiv/tff.htm
Fachhochschule Furtwangen Hochschule für Technik und Wirtschaft Postfach 1152, 78113 Furtwangen Gerwigstraße 11, 78120 Furtwangen	07723	920-0	920-610	http://www.fh-furtwangen.de
Fachhochschule Gelsenkirchen Postfach, 45877 Gelsenkirchen Neidenburger Straße, 45897 Gelsenkirchen	0209	9596-0	9596-445	http://www.fh-gelsenkirchen.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Justus-Liebig-Universität Gießen Postfach 11 14 40, 35359 Gießen Ludwigstraße 23, 35390 Gießen	0641	99-0	99-12659	http://www.uni-giessen.de
Fachhochschule Gießen-Friedberg Wiesenstraße 14, 35390 Gießen	0641	309-0	309-2901	http://www.fh-giessen.de
Private Fachhochschule Göttingen Weender Landstraße 3–7, 37073 Göttingen	0551	54700-0	54700-190	http://www.pfh-goettingen.de
Georg-August-Universität Göttingen Postfach 37 44, 37027 Göttingen Wilhelmsplatz 1, 37073 Göttingen	0551	39-0	39-9612	http://www.Uni-Goettingen.DE
Ernst-Moritz-Arndt-Universität Greifswald Postfach, 17487 Greifswald Domstraße 11, 17489 Greifswald	03834	86-0	86-1105	http://www.uni-greifswald.de
FernUniversität – Gesamthochschule Hagen Postfach, 58084 Hagen Feithstraße 152, 58097 Hagen	02331	987-01	987-330	http://www.fernuni-hagen.de
Evangelische Hochschule für Kirchenmusik Emil-Abderhalden-Straße 10, 06108 Halle	0345	21969-0	21969-29	http://www.verwaltung.uni-halle.de/studium/kumutxt.htm
Burg Giebichenstein Hochschule für Kunst und Design Halle Postfach 20 02 52, 06003 Halle Neuwerk 7, 06108 Halle	0345	7751-50	7751-569	http://www.burg-halle.de
Martin-Luther-Universität Halle-Wittenberg Postfach, 06099 Halle/S. Universitätsplatz 10, 06108 Halle/S.	0345	552-0	55-27075	http://www.uni-halle.de
Bucerius Law School – Hochschule für Rechtswissenschaft Jungiusstraße 6, 20355 Hamburg	040	41336870	41336700	http://www.law-school.de
Evangelische Fachhochschule für Sozialpädagogik der „Diakonenanstalt des Rauhen Hauses" Hamburg Horner Weg 170, 22111 Hamburg	040	65591-180	65591-228	http://www.rauheshaus.de/fachhochschule
Fern-Fachhochschule Hamburg Holstenwall 5, 20355 Hamburg	040	35094-252	35094-229	http://www.fern-fh.de
Fachhochschule Hamburg Postfach 760380, 22053 Hamburg Winterhuder Weg 29, 22085 Hamburg	040	42863-0	42863-3905, -3217	http://www.fh-hamburg.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Bildende Künste Hamburg Lerchenfeld 2, 22081 Hamburg	040	42832-3255	42832-2279	http://www.kunsthochschule. uni-hamburg.de
Hochschule für Musik und Theater Hamburg Harvestehuder Weg 12, 20148 Hamburg	040	42848-0	42848-2666	http://www.rrz.uni-hamburg.de/hfmt
Hochschule für Wirtschaft und Politik Hamburg Von-Melle-Park 9, 20146 Hamburg	040	42838-2180	42838-4150	http://www.hwp.uni-hamburg.de
Universität Hamburg Edmund-Siemers-Allee 1, 20146 Hamburg	040	42838-1	42838-2449	http://www.uni-hamburg.de
Universität der Bundeswehr Hamburg Postfach 70 08 22, 22039 Hamburg Holstenhofweg 85, 22043 Hamburg	040	6541-1	6541-2702	http://www.unibw-hamburg.de
Technische Universität Hamburg-Harburg Postfach, 21071 Hamburg Schwarzenbergstraße 95, 21073 Hamburg	040	42878-0	42878-2040	http://www.tu-harburg.de
Evangelische Fachhochschule Hannover Postfach 60 03 63, 30612 Hannover Blumhardtstraße 2, 30625 Hannover	0511	5301-0	5301-195	http://www.efh-hannover.de
Fachhochschule Hannover Postfach 92 02 51, 30441 Hannover Ricklinger Stadtweg 118, 30459 Hannover	0511	9296-0	9296-120	http://www.fh-hannover.de
Fachhochschule für die Wirtschaft staatlich anerkannt Freundallee 15, 30173 Hannover	0511	28483-70	28483-72	http://www.fhdw.bib.de
GISMA – German International Graduate School of Management and Administration GmbH Feodor-Lynen-Straße 27, 30625 Hannover	0511	54609-0	54609-54	
Hochschule für Musik und Theater Hannover Emmichplatz 1, 30175 Hannover	0511	3100-1	3100-200	http://www.hmt-hannover.de
Medizinische Hochschule Hannover Postfach, 30623 Hannover Carl-Neuberg-Straße 1, 30625 Hannover	0511	532-1	532-6008	http://www.MH-HANNOVER.DE
Tierärztliche Hochschule Hannover Postfach 71 11 80, 30545 Hannover Bünteweg 2, 30559 Hannover	0511	953-6	953-8050	http://www.tiho-hannover.de
Universität Hannover Postfach 6009, 30060 Hannover Welfengarten 1, 30167 Hannover	0511	762-0	762-3456	http://www.uni-hannover.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule Harz Hochschule für angewandte Wissenschaften (FH) Friedrichstraße 57–59, 38855 Wernigerode	03943	659-0	659-109	http://www.fh-harz.de
Fachhochschule Heidelberg – Staatlich anerkannte Fachhochschule der SRH-Gruppe – Postfach 10 14 09, 69004 Heidelberg Bonhoefferstraße 1, 69123 Heidelberg	06221	88-2567	88-2787	http://www.fh-heidelberg.de
Hochschule für Kirchenmusik der Evangelischen Landeskirche in Baden Hildastraße 8, 69115 Heidelberg	06221	27062	21876	http://www.hfk-heidelberg.de
Hochschule für Jüdische Studien Heidelberg Friedrichstraße 9, 69117 Heidelberg	06221	22576	167696	http://www.HJS.Uni-HEIDELBERG.DE
Pädagogische Hochschule Heidelberg Keplerstraße 87, 69120 Heidelberg	06221	477-0	477-432	http://www.ph-heidelberg.de
Ruprecht-Karls-Universität Heidelberg Postfach 10 57 60, 69047 Heidelberg Grabengasse 1, 69117 Heidelberg	06221	54-0	54-2147	http://www.rektorat.uni-heidelberg.de
Fachhochschule Heilbronn Hochschule für Technik und Wirtschaft Max-Planck-Straße 39, 74081 Heilbronn	07131	504-0	252470	http://www.fh-heilbronn.de
Hochschule für Kirchenmusik der Evangelischen Kirche von Westfalen Parkstraße 6, 32049 Herford	05221	991450	830809	
Fachhochschule Hildesheim/Holzminden/ Göttingen Hochschule für abgewandte Wissenschaft und Kunst Hohnsen 4, 31134 Hildesheim	05121	881-0	881-125	http://www.fh-hildesheim.de
Universität Hildesheim Postfach 10 13 63, 31113 Hildesheim Marienburger Platz 22, 31141 Hildesheim	05121	883-0	883-177	http://www.uni-hildesheim.de
Fachhochschule Hof Postfach 3368, 95003 Hof Alfons-Goppel-Platz 1, 95028 Hof	09281	40930-0	409400	http://www.fh-hof.de
Universität Hohenheim Postfach, 70593 Stuttgart Schloß, 70599 Stuttgart	0711	459-0	459-3960	http://www.uni-hohenheim.de
Europa Fachhochschule Fresenius Limburger Straße 2, 65510 Idstein	06126	9352-0	9352-10	http://www.FH-FRESENIUS.DE

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Technische Universität Ilmenau Postfach 100565, 98684 Ilmenau Max-Planck-Ring 14, 98693 Ilmenau	03677	69-0	69-1701	http://www.tu-ilmenau.de
Fachhochschule Ingolstadt Postfach 21 04 54, 85051 Ingolstadt Esplanade 10, 85049 Ingolstadt	0841	9348-0	9348-200	http://www.fh-ingolstadt.de
Märkische Fachhochschule Iserlohn Postfach 20 61, 58590 Iserlohn Frauenstuhlweg 31, 58644 Iserlohn	02371	566-0	566-274 (Iserlohn), 02331/9874914 (Hagen)	http://www.mfh-iserlohn.de
Fachhochschule und Berufskollegs NTA Prof.Dr. Grübler gemein. GmbH Postfach 1453, 88308 Isny/Allgäu Seidenstraße 12–35, 88316 Isny/Allgäu	07562	9707-0	9707-71	http://www.fh-isny.de
Fachhochschule Jena Postfach 10 03 14, 07703 Jena Carl-Zeiss-Promenade 2, 07745 Jena	03641	205-100 + 615163	205-101	http://www.fh-jena.de
Friedrich-Schiller-Universität Jena Postfach, 07740 Jena Fürstengraben 1, 07743 Jena	03641	93-00	93-1682; -1689	http://www.uni-jena.de
Fachhochschule Kaiserslautern Postfach 15 73, 67604 Kaiserslautern Morlauterer Straße 31, 67657 Kaiserslautern	0631	3724-0	3724-105	http://www.fh-kl.de
Universität Kaiserslautern Postfach 30 49, 67653 Kaiserslautern Gottlieb-Daimler-Straße, 67663 Kaiserslautern	0631	205-0	205-3200	http://www.uni-kl.de
Staatliche Akademie der Bildenden Künste Karlsruhe Postfach 111209, 76042 Karlsruhe Reinhold-Frank-Straße 67, 76133 Karlsruhe	0721	85018-0	848150	
Fachhochschule Karlsruhe Hochschule für Technik Postfach 24 40, 76012 Karlsruhe Moltkestraße 30, 76133 Karlsruhe	0721	925-0	925-2000	http://www.fh-karlsruhe.de
Staatliche Hochschule für Gestaltung Karlsruhe Durmersheimer Straße 55, 76185 Karlsruhe	0721	9541-0	9541-206	http://www.hfg-karlsruhe.d
Staatliche Hochschule für Musik Karlsruhe Postfach 60 40, 76040 Karlsruhe Wolfartsweierer Straße 7a, 76131 Karlsruhe	0721	6629-0	6629-266	http://www.karlsruhe.de/ Kultur/Musikhochschule

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Pädagogische Hochschule Karlsruhe Postfach 11 10 62, 76060 Karlsruhe Bismarckstraße 10, 76133 Karlsruhe	0721	925-3	925-4000	http://www.ph-karlsruhe.de
Universität Fridericiana zu Karlsruhe (Technische Hochschule) Postfach 6980, 76128 Karlsruhe Kaiserstraße 12, 76131 Karlsruhe	0721	608-0	608-4290	http://www.uni-karlsruhe.de
Universität Gesamthochschule Kassel Postfach, 34109 Kassel Mönchebergstraße 19, 34125 Kassel	0561	804-0	804-7233	http://www.uni-kassel.de
Fachhochschule Kempten Hochschule für Technik und Wirtschaft Postfach 16 80, 87406 Kempten Immenstädter Straße 69, 87435 Kempten	0831	2523-0	2523-104	http://www.fh-Kempten.de
Fachhochschule Kiel Sokratesplatz 1, 24149 Kiel	0431	210-0	210-1900	http://www.fh-kiel.de
Muthesius-Hochschule Fachhochschule für Kunst und Gestaltung Lorentzendamm 6–8, 24103 Kiel	0431	5198-400	5198-408	http://www.muthesius.de
Christian-Albrechts-Universität zu Kiel Postfach, 24098 Kiel Olshausenstraße 40, 24118 Kiel	0431	880-00	880-7333, -1355	http://www.uni-kiel.de
Fachhochschule Koblenz Finkenherd 4, 56075 Koblenz	0261	9528-0	9528-567	http://www.fh-koblenz.de
WHU Koblenz Wissenschaftliche Hochschule für Unternehmensführung Otto-Beisheim-Hochschule Burgplatz 2, 56179 Vallendar	0261	6509-0	6509-509	http://www.whu.edu
Universität Koblenz-Landau Postfach 18 64, 55008 Mainz Isaac-Fulda-Allee 3, 55124 Mainz	06131	37460-0	37460-40	http://www.uni-ko-ld.de
Deutsche Sporthochschule Köln Postfach, 50927 Köln Carl-Diem-Weg 6, 50933 Köln	0221	4982-1	4982-833	http://www.DSHS-koeln.de
Fachhochschule Köln Claudiusstraße 1, 50678 Köln	0221	8275-1	8275-3131	http://www.fh-koeln.de
Hochschule für Musik Köln Dagobertstraße 38, 50668 Köln	0221	912818-0	131204	http://www.mhs-koeln.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Kunsthochschule für Medien Köln Peter-Welter-Platz 2, 50676 Köln	0221	20189-0	20189-17	http://www.khm.de
Rheinische Fachhochschule Köln Hohenstaufenring 16–18, 50674 Köln	0221	20302-0	20302-49	http://www.rfh-koeln.de
Universität zu Köln Postfach, 50923 Köln Albertus-Magnus-Platz, 50931 Köln	0221	470-0	470-5151	http://www.Uni-Koeln.de
Fachhochschule Konstanz Hochschule für Technik, Wirtschaft und Gestaltung Postfach 10 05 43, 78405 Konstanz Brauneggerstraße 55, 78462 Konstanz	07531	206-0	206-400	http://www.fh-konstanz.de
Universität Konstanz Postfach, 78457 Konstanz Universitätsstraße 10, 78457 Konstanz	07531	88-0	88-3688	http://www.uni-konstanz.de
Süddeutsche Hochschule für Berufstätige Staatlich anerkannte Fachhochschule der AKAD Hohbergweg 15–17, 77933 Lahr	07821	9149-0	23413	http://www.akad.de
Fachhochschule Landshut Hochschule für Wirtschaft – Sozialwesen – Technik Am Lurzenhof 1, 84036 Landshut	0871	506-0	506-506	http://www.fh-landshut.de
Fachhochschule Lausitz Postfach 15 38, 01958 Senftenberg Großenhainer Straße 57, 01968 Senftenberg	03573	85-0	85-209	http://www.fh-lausitz.de
Deutsche Telekom Fachhochschule Leipzig Postfach 71, 04251 Leipzig Gustav-Freytag-Straße 43–45, 04277 Leipzig	0341	3062-0	3015069	http://www.fh-telekom-leipzig.de
Handelshochschule Leipzig Jahnallee 59, 04109 Leipzig	0341	985160	4773243	http://www.hhl.de
Ostdeutsche Hochschule für Berufstätige Leipzig Gutenbergplatz 1 E, 04103 Leipzig	0341	2261930	2261939	http://www.akad.de
Hochschule für Grafik und Buchkunst Leipzig Postfach 10 08 05, 04008 Leipzig Wächterstraße 11, 04107 Leipzig	0341	2135-0	2135-166	http://www.hgb-leipzig.de
Hochschule für Musik und Theater „Felix Mendelssohn Bartholdy“ Leipzig Postfach 10 08 09, 04008 Leipzig Grassistraße 8, 04107 Leipzig	0341	2144-55	2144-503	http://www.hmt-leipzig.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Technik, Wirtschaft und Kultur Leipzig (FH) Postfach 30 00 66, 04251 Leipzig Karl-Liebknecht-Straße 132, 04277 Leipzig	0341	307-60	307-6380	http://www.htwk-leipzig.de
Universität Leipzig Postfach 100 920, 04009 Leipzig Ritterstraße 26, 04109 Leipzig	0341	97-108	97-30099	http://www.uni-leipzig.de
Fachhochschule Lippe Liebigstraße 87, 32657 Lemgo	05261	702-0	702-222	http://www.fh-lippe.de
Fachhochschule Lübeck Stephensonstraße 3, 23562 Lübeck	0451	500-0	500-5100	http://www.fh-luebeck.de
Musikhochschule Lübeck Große Petersgrube 17–29, 23552 Lübeck	0451	1505-0	1505-300/-301	http://www.mh-luebeck.de
Medizinische Universität zu Lübeck Ratzeburger Allee 160, 23538 Lübeck	0451	500-0	500-3016	http://www.mu-luebeck.de
Pädagogische Hochschule Ludwigsburg Postfach 220, 71602 Ludwigsburg Reuteallee 46, 71634 Ludwigsburg	07141	140-0	140-434	http://www.ph-ludwigsburg.de
Evangelische Fachhochschule Ludwigshafen Hochschule für Sozial- und Gesundheitswesen Postfach 21 06 28, 67006 Ludwigshafen Maxstraße 29, 67059 Ludwigshafen	0621	59113-0	59113-59	http://www.EVPFALZ.DE/ efh-ludwigshafen/EFHL_start.html
Fachhochschule Ludwigshafen Hochschule für Wirtschaft Ernst-Boehe-Straße 4, 67059 Ludwigshafen	0621	5203-0	622-467	http://www.fh-ludwigshafen.de
Universität Lüneburg Postfach, 21332 Lüneburg Scharnhorststraße 1, 21335 Lüneburg	04131	78-0	78-1091	http://www.uni-lueneburg.de
Fachhochschule Magdeburg Breitscheidstraße 2, 39114 Magdeburg	0391	88630	8864-104	http://www.fh-magdeburg.de
Otto-von-Guericke-Universität Magdeburg Postfach 4120, 39016 Magdeburg Universitätsplatz 2, 39106 Magdeburg	0391	67-01	67-11156	http://www.uni-magdeburg.de
Fachhochschule Mainz Postfach 1967, 55009 Mainz Seppel-Glückert-Passage 10, 55116 Mainz	06131	2392-0	2392-12	http://www.FH-Mainz.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Katholische Fachhochschule Mainz Postfach 23 40, 55013 Mainz Saarstraße 3, 55122 Mainz	06131	28944-0	28944-50	
Johannes Gutenberg-Universität Mainz Postfach, 55099 Mainz Saarstraße 21, 55122 Mainz	06131	39-20	39-22919	http://www.uni-mainz.de
Fachhochschule Mannheim Hochschule für Sozialwesen Ludolf-Krehl-Straße 7–11, 68167 Mannheim	0621	3926-0	3926-222	http://www.fhs-mannheim.de
Fachhochschule Mannheim Hochschule für Technik und Gestaltung Windeckstraße 110, 68163 Mannheim	0621	292-6111	292-6420	http://www.fh-mannheim.de
Staatliche Hochschule für Musik und Darstellende Kunst Mannheim N 7, 18, 68161 Mannheim	0621	292-3514	292-2072	http://www.muho-mannheim.de
Universität Mannheim Schloß, 68131 Mannheim	0621	181-0	181-1010	http://www.uni-mannheim.de
Philipps-Universität Marburg Biegenstraße 10, 35032 Marburg/L.	06421	28-20	28-22500	http://www.uni-marburg.de/welcome.html
Fachhochschule Merseburg Geusaer Straße, 06217 Merseburg	03461	46-0	46-2370	http://www.fh-merseburg.de
Hochschule Mittweida (FH) Postfach 1451, 09644 Mittweida Technikumplatz 17, 09648 Mittweida	03727	58-0	58-1379	http://www.htwm.de
Evangelische Fachhochschule für Religionspädagogik und Gemeindediakonie Moritzburg Bahnhofstraße 9, 01468 Moritzburg	035207	84-300	84-310	http://www.fhs-moritzburg.de
Akademie der Bildenden Künste München Akademiestraße 2, 80799 München	089	3852-0	3852-206	http://www.adbk.mhn.de
Fachhochschule München Postfach 20 01 13, 80001 München Lothstraße 34, 80335 München	089	1265-0	1265-1490	http://www.fh-muenchen.de
Hochschule für Fernsehen und Film Frankenthaler Straße 23, 81539 München	089	68957-0	68957-189	http://www.hff-muc.de
Hochschule für Musik und Theater München Arcisstraße 12, 80333 München	089	289-03	289-27419	http://www.musikhochschule-muenchen.mhn.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Philosophie Kaulbachstraße 31, 80539 München	089	2386-2300	2386-2302	http://www.hfph.mwn.de
Katholische Stiftungsfachhochschule München Preysingstraße 83, 81667 München	089	48092-271	4801907	http://www.ksfh.de
Technische Universität München Postfach, 80290 München Arcisstraße 21, 80333 München	089	289-22200	289-23399	http://www.tu-muenchen.de
Ludwig-Maximilians-Universität München Geschwister-Scholl-Platz 1, 80539 München	089	2180-0	2180-2322	http://www.uni-muenchen.de
Universität der Bundeswehr München Postfach, 85577 Neubiberg Werner-Heisenberg-Weg 39, 85579 Neubiberg	089	6004-1	6004-3560	http://www.unibw-muenchen.de
Fachhochschule Münster Postfach 3020, 48016 Münster Hüfferstraße 27, 48149 Münster	0251	83-0	83-64060	http://www.fh-muenster.de
Kunstakademie Münster Hochschule für Bildende Künste Postfach 42 47, 48024 Münster Scheibenstraße 109, 48153 Münster	0251	97217-0	791674	http://www.kunstakademie-muenster.de
Philosophisch-Theologische Hochschule Münster Kirchlich und staatlich anerkannte Hochschule in freier Trägerschaft der Rheinisch-Westfälischen Kapuzinerprovinz Hörsterplatz 4, 48147 Münster	0251	48256-0	48256-19	http://www.muenster.org/pth
Westfälische Wilhelms-Universität Münster Schloßplatz 2, 48149 Münster	0251	83-0	83-24831	http://www.uni-muenster.de
Fachhochschule Neu-Ulm Steubenstraße 17, 89231 Neu-Ulm	0731	9762-0	9762-299	http://www.fh-neu-ulm.de
Fachhochschule Neubrandenburg Postfach 11 01 21, 17041 Neubrandenburg Brodaer Straße 2, 17033 Neubrandenburg	0395	5693-0	5693-199	http://www.fh-nb.de
Augustana-Hochschule Neuendettelsau Postfach 20, 91561 Neuendettelsau Waldstraße 11, 91564 Neuendettelsau	09874	509-0	509-95	http://www.augustana.de
Fachhochschule Niederrhein Postfach 28 50, 47728 Krefeld Reinarzstraße 49, 47805 Krefeld	02151	822-0	822-555	http://www.fh-niederrhein.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Katholische Fachhochschule Norddeutschland Postfach 13 65, 49362 Vechta Abt. Vechta, Driverstraße 23, 49377 Vechta	04441	9226-0	5140	http://www.kath-fh-nord.de
Fachhochschule Nordhausen Postfach 10 07 10, 99727 Nordhausen Weinberghof 4, 99734 Nordhausen	03631	420-0	420-810	http://www.fh-nordhausen.de
Fachhochschule Nordhessen Im Kurpark 1, 37242 Bad Sooden-Allendorf	05652	917083	917081	http://www.diploma.de
Fachhochschule Nordostniedersachsen Postfach 15 80, 21305 Lüneburg Volgershall 1, 21339 Lüneburg	04131	677-0	677-511	http://www.fh-lueneburg.de
Katholische Fachhochschule Nordrhein-Westfalen Wörthstraße 10, 50668 Köln	0221	973147-0	973147-13	http://www.kfhnw.de
Akademie der Bildenden Künste Nürnberg Bingstraße 60, 90480 Nürnberg	0911	9404-0	9404-150	http://www.adbk-nuernberg.de
Evangelische Fachhochschule Nürnberg Bärenschanzstraße 4, 90429 Nürnberg	0911	27253-6	27253-799	http://www.evfh-nuernberg.de
Georg-Simon-Ohm-Fachhochschule Nürnberg Postfach 21 03 20, 90121 Nürnberg Keßlerplatz 12, 90489 Nürnberg	0911	5880-0	5880-8309	http://www.fh-nuernberg.de
Hochschule für Musik Nürnberg/Augsburg Spitalgasse 10, 90403 Nürnberg	0911	231-8441	231-8442	http://www.kubiss.de/ bildung/info/musikhochschule
Fachhochschule Nürtingen Hochschule für Wirtschaft, Landwirtschaft und Landespflege Postfach 13 49, 72603 Nürtingen Neckarsteige 6–10, 72622 Nürtingen	07022	201-0	201-303	http://www.fh-nuertingen.de
Staatlich anerkannte Fachhochschule für Kunsttherapie Sigmaringer Straße 15, 72622 Nürtingen	07022	93336-0	93336-23	http://www.fh-nuertingen.de
Lutherische Theologische Hochschule Oberursel Altkönigstraße 150, 61440 Oberursel	06171	24340	926178	http://www.selk.de/lthh
European Business School Oestrich-Winkel Schloß Reichartshausen, 65375 Oestrich-Winkel	06723	69-0	69-133	http://www.ebs.de
Hochschule für Gestaltung Offenbach Postfach 10 08 23, 63008 Offenbach Schloßstraße 31, 63065 Offenbach	069	80059-0	880791	http://www.hfg-offenbach.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Fachhochschule Offenburg Hochschule für Technik und Wirtschaft Badstraße 24, 77652 Offenburg	0781	205-0	205-214/-333	http://www.fh-offenburg.de
Fachhochschule Oldenburg/Ostfriesland/ Wilhelmshaven Constantiaplatz 4, 26723 Emden	04921	807-0	807-647	http://www.fho-emden.de
Carl von Ossietzky Universität Oldenburg Postfach, 26111 Oldenburg Ammerländer Heerstraße 114–118, 26129 Oldenburg	0441	798-0	798-3000	http://www.uni-oldenburg.de
Fachhochschule Osnabrück Postfach 1940, 49009 Osnabrück Caprivistraße 30A, 49076 Osnabrück	0541	969-2104	969-2066	http://www.fh-osnabrueck.de
Universität Osnabrück Postfach, 49069 Osnabrück Neuer Graben/Schloß, 49074 Osnabrück	0541	969-0	969-4888	http://www.uni-osnabrueck.de
Freie Kunst-Studienstätte Ottersberg Postfach 1251, 28867 Ottersberg Am Wiestebruch 66–68, 28870 Ottersberg	04205	3949-0	3949-79	
Fachhochschule der Wirtschaft Fürstenallee 3–5, 33102 Paderborn	05251	301-181	301188	http://www.fhdw.de
Theologische Fakultät Paderborn Kamp 6, 33098 Paderborn	05251	121-6	121-700	
Universität-Gesamthochschule Paderborn Postfach, 33095 Paderborn Warburger Straße 100, 33098 Paderborn	05251	60-0	60-2519	http://www.uni-paderborn.de
Universität Passau Postfach, 94030 Passau Dr.-Hans-Kapfinger-Straße 22, 94032 Passau	0851	509-0	509-1005	http://www.uni-passau.de
Fachhochschule Pforzheim Hochschule für Gestaltung, Technik und Wirtschaft Tiefenbronner Straße 65, 75175 Pforzheim	07231	28-5	28-6666	http://www.fh-pforzheim.de
Fachhochschule Potsdam Postfach 60 06 08, 14406 Potsdam Pappelallee 8–9, 14469 Potsdam	0331	580-00	580-2999	http://www.fh-potsdam.de
Universität Potsdam Postfach 60 15 53, 14415 Potsdam Am Neuen Palais 10, 14469 Potsdam	0331	977-0	972163	http://www.uni-potsdam.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Film und Fernsehen „Konrad Wolf" Potsdam-Babelsberg Postfach 90 01 31, 14437 Potsdam Karl-Marx-Straße 33/34, 14482 Potsdam	0331	7469-0	7469-202	http://www.hff-potsdam.de
Fachhochschule Ravensburg-Weingarten Postfach 12 61, 88241 Weingarten Doggenriedstraße, 88250 Weingarten	0751	501-0	49240	http://www.fh-weingarten.de
Fachhochschule Regensburg Postfach 12 03 27, 93025 Regensburg Prüfeninger Straße 58, 93049 Regensburg	0941	943-02	943-1422	http://www.fh-regensburg.de
Universität Regensburg Postfach, 93040 Regensburg Universitätsstraße 31, 93053 Regensburg	0941	943-01	943-2305	http://www.uni-regensburg.de
Hochschule für Berufstätige Rendsburg Staatlich anerkannte Fachhochschule der AKAD Kieler Straße 53, 24768 Rendsburg	04331	5227	28612	http://www.akad.de
Fachhochschule Reutlingen Hochschule für Technik und Wirtschaft Alteburgstraße 150, 72762 Reutlingen	07121	271-0	271-688	http://www.fh-reutlingen.de
Evangelische Fachhochschule Reutlingen- Ludwigsburg der Evangelischen Landeskirche Württemberg Ringelbachstraße 221, 72762 Reutlingen	07121	2414-0	2414-29	
Evangelische Fachhochschule Rheinland-Westfalen-Lippe Immanuel-Kant-Straße 18–20, 44803 Bochum	0234	36901-0	36901-100	http://www.efh-bochum.de
Deutsch-Ordens Fachhochschule Riedlingen Hochschule für Wirtschaft Robert-Bosch-Straße 23, 88499 Riedlingen	07371	9315-0	9315-15	http://www.deutscher-orden.de
Fachhochschule Rosenheim Hochschule für Technik und Wirtschaft Marienberger Straße 26, 83024 Rosenheim	08031	805-0	805-105	http://www.fh-rosenheim.de
Hochschule für Musik und Theater Rostock Am Bussebart 11, 18055 Rostock	0381	20206-21	20206-25	http://www.hmt.uni-rostock.de
Universität Rostock Postfach, 18051 Rostock Universitätsplatz 1, 18055 Rostock	0381	498-0	498-1107	http://www.uni-rostock.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Fachhochschule Rottenburg – Hochschule für Forstwirtschaft Schadenweilerhof, 72108 Rottenburg am Neckar	07472	951-0	951-200	http://www.fh-rottenburg.de
Hochschule für Kirchenmusik der Diözese Rottenburg-Stuttgart St.-Meinrad-Weg 6, 72108 Rottenburg	07472	9363-0	21337	http://www.home.t-online.de/home/hfk-rottenburg/
Hochschule der Bildenden Künste Saar Keplerstraße 3–5, 66117 Saarbrücken	0681	92652-0	5847-287	http://www.hbks.uni-sb.de
Hochschule des Saarlandes für Musik und Theater Bismarckstraße 1, 66111 Saarbrücken	0681	96731-0	96731-30	http://www.hmt.uni-sb.de
Hochschule für Technik und Wirtschaft des Saarlandes Goebenstraße 40, 66117 Saarbrücken	0681	5867-0	5867-122	http://www.htw-saarland.de
Katholische Hochschule für Soziale Arbeit Saarbrücken Rastpfuhl 12 a, 66113 Saarbrücken	0681	97132-0	9713240	http://www.Hochschule.Dioezese-Trier.de
Universität des Saarlandes Postfach 15 11 50, 66041 Saarbrücken Im Stadtwald, 66123 Saarbrücken	0681	302-0	302-2609	http://www.uni-saarland.de
Philosophisch-Theologische Hochschule SVD Sankt Augustin Theologische Fakultät Arnold-Janssen-Straße 30, 53754 Sankt Augustin	02241	237-222	237-204	http://www.steyler.de/hochschule.htm
Fachhochschule Schmalkalden Postfach 100452, 98564 Schmalkalden Blechhammer, 98574 Schmalkalden	03683	688-0	688-1999	http://www.fh-schmalkalden.de
Fachhochschule Schwäbisch Gmünd Hochschule für Gestaltung Postfach 13 08, 73503 Schwäbisch Gmünd Rektor-Klaus-Straße 100, 73525 Schwäbisch Gmünd	07171	6026-00	69259	http://www.hfg-gmuend.de
Pädagogische Hochschule Schwäbisch Gmünd Oberbettringer Straße 200, 73525 Schwäbisch Gmünd	07171	983-0	983-212	http://www.ph-gmuend.de
Universität – Gesamthochschule Siegen Postfach, 57068 Siegen Herrengarten 3, 57072 Siegen	0271	740-1	740-4899/-4911	http://www.uni-siegen.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Deutsche Hochschule für Verwaltungs-wissenschaften Speyer Postfach 14 09, 67324 Speyer Freiherr-vom-Stein-Straße 2, 67346 Speye	06232	654-0	654-208	http://www.dhv-speyer.de
Fachhochschule Stralsund Zur Schwedenschanze 15, 18435 Stralsund	03831	45-5	45-6680	http://www.fh-stralsund.de
Staatliche Akademie der Bildenden Künste Stuttgart Am Weißenhof 1, 70191 Stuttgart	0711	2575-0	2575-102	http://www.abk-stuttgart.de
Fachhochschule Stuttgart Hochschule für Bibliotheks- und Informationswesen (HBI) Wolframstraße 32, 70191 Stuttgart	0711	25706-0	25706-47	http://www.hbi-stuttgart.de
Fachhochschule Stuttgart Hochschule für Technik Postfach 10 14 52, 70013 Stuttgart Schellingstraße 24, 70174 Stuttgart	0711	121-0	121-2666	http://www.fht-stuttgart.de
Fachhochschule Stuttgart Hochschule für Druck und Medien Nobelstraße 10, 70569 Stuttgart	0711	685-2807	685-6650	http://www.hdm-stuttgart.de
Staatliche Hochschule für Musik und Darstellende Kunst Stuttgart Urbanstraße 25, 70182 Stuttgart	0711	212-0	212-4639	http://www.mh-stuttgart.de
Merz Akademie Hochschule für Gestaltung Stuttgart Staatlich anerkannte Fachhochschule Teckstraße 58, 70190 Stuttgart	0711	26866-0	26866-21	http://www.merz-akademie.de
Stuttgart Institute of Management and Technology (SIMT) Staatlich anerkannte wissenschaftliche Hochschule Filderhauptstraße 155, 70599 Stuttgart	0711	451001-0	451001-45	http://www.uni-simt.de und http://www.simt.net
Universität Stuttgart Postfach 10 60 37, 70049 Stuttgart Keplerstraße 7, 70174 Stuttgart	0711	121-0	121-2113	http://www.uni-stuttgart.de
Fachhochschule Trier Hochschule für Technik, Wirtschaft und Gestaltung Postfach 1826, 54208 Trier Schneidershof, 54293 Trier	0651	8103-0	8103-333	http://www.fh-trier.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Theologische Fakultät Trier Universitätsring 19, 54296 Trier	0651	201-3520	201-3951	http://www.uni-trier.de/uni/theo/
Universität Trier Universitätsring 15, 54286 Trier	0651	201-4251	201-4297	http://www.uni-trier.de
Staatliche Hochschule für Musik Trossingen Schultheiß-Koch-Platz 3, 78647 Trossingen	07425	9491-0	9491-48	http://www.mh-trossingen.de
Hochschule für Kirchenmusik der Evangelischen Landeskirche in Württemberg Gartenstraße 12, 72074 Tübingen	07071	925-997	925-998	http://www. Kirchenmusikhochschule.de
Eberhard-Karls-Universität Tübingen Wilhelmstraße 7, 72074 Tübingen	07071	29-0	29-5990	http://www.uni-tuebingen.de
Fachhochschule Ulm Hochschule für Technik Postfach 38 60, 89028 Ulm Prittwitzstraße 10, 89075 Ulm	0731	50-208	50-28270	http://www.fh-ulm.de
Universität Ulm Postfach, 89069 Ulm Albert-Einstein-Allee 5, 89081 Ulm	0731	502-01	502-2038	http://www.uni-ulm.de
Philosophisch-Theologische Hochschule Vallendar der Gesellschaft des Katholischen Apostolates (Pallottiner) Postfach 14 06, 56174 Vallendar Pallottistraße 3, 56179 Vallendar	0261	6402-0	6402-300	http://www.pthv.de
Hochschule Vechta Postfach 15 53, 49364 Vechta Driverstraße 22, 49377 Vechta	04441	15-1	15-444	http://www.Uni-Vechta.de
Private Fachhochschule für Wirtschaft und Technik Vechta/Diepholz Rombergstraße 40, 49377 Vechta	04441	915-0	915-109	http://www.fhwt.de
Fachhochschule Wedel Feldstraße 143, 22880 Wedel	04103	8048-0	8048-39	http://www.fh-wedel.de
Fachhochschule Weihenstephan Postfach, 85350 Freising Am Hofgarten 4, 85354 Freising	08161	71-3339	71-4207	http://www.fh-weihenstephan.de
Gustav-Siewerth-Akademie Staatlich anerkannte wissenschaftliche Hochschule Oberbierbronnen 1, 79809 Weilheim-Bierbronnen	07755	364	80109	http://www.siewerth-akademie

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Hochschule für Musik Franz Liszt Weimar Postfach 2552, 99406 Weimar Platz der Demokratie 2/3, 99423 Weimar	03643	555-0	555-117	http://www.uni-weimar.de/hfm
Bauhaus-Universität Weimar Postfach, 99421 Weimar Geschwister-Scholl-Straße 8, 99423 Weimar	03643	58-0	58-1120	http://www.uni-weimar.de
Pädagogische Hochschule Weingarten Kirchplatz 2, 88250 Weingarten	0751	501-0	501-200	http://www.ph-weingarten.de
Fachhochschule Westküste Hochschule für Wirtschaft und Technik Rungholtstraße 9, 25746 Heide	0481	8555-0	8555-920	http://www.fh-westkueste.de
Fachhochschule Wiesbaden Kurt-Schumacher-Ring 18, 65197 Wiesbaden	0611	9495-01	444696	http://www.fh-wiesbaden.de
Technische Fachhochschule Wildau Bahnhofstraße, 15745 Wildau	03375	508-0	500-324	http://www.tfh-wildau.de
Hochschule Wismar Fachhochschule für Technik, Wirtschaft und Gestaltung Postfach 1210, 23952 Wismar Philipp-Müller-Straße, 23966 Wismar	03841	753-0	753-383	http://www.hs-wismar.de
Private Universität Witten/Herdecke GmbH Alfred-Herrhausen-Straße 50, 58448 Witten	02302	926-0	926-407	http://www.uni-wh.de
Fachhochschule Worms Erenburgerstraße 19, 67549 Worms	06241	509-0	509-222	http://www.fh-worms.de
Kirchliche Hochschule Wuppertal Missionsstraße 9 b, 42285 Wuppertal	0202	2820-0	2820-101	http://www.kiho.uni-wuppertal.de
Bergische Universität – Gesamthochschule Wuppertal Postfach, 42097 Wuppertal Gaußstraße 20, 42119 Wuppertal	0202	439-1	439-2901	http://www.uni-wuppertal.de
Fachhochschule Würzburg – Schweinfurt – Aschaffenburg Münzstraße 12, 97070 Würzburg	0931	3511-0	3511-159	http://www.fh-wuerzburg.de
Hochschule für Musik Würzburg Hofstallstraße 6–8, 97070 Würzburg	0931	32187-0	32187-40	http://www.uni-wuerzburg.de/musikhochschule/hfm.htm
Bayerische Julius-Maximilians-Universität Würzburg Sanderring 2, 97070 Würzburg	0931	31-0	31-2600	http://www.uni-wuerzburg.de

Names, location, telephone and telefax numbers and Internet addresses of Germany higher education institutions

(in alphabetical order by name – for further information please contact www.hrk.de)

Name Location	Dialling code	Phone	Fax	Internet
Internationales Hochschulinstitut Zittau (IHI) Markt 23, 02763 Zittau	03583	7715-0	7715-34	http://www.ihi-zittau.de
Hochschule Zittau/Görlitz (FH) Postfach 1454, 02754 Zittau Theodor-Körner-Allee 16, 02763 Zittau	03583	61-0	510626	http://www.hs-zigr.de
Westsächsische Hochschule Zwickau (FH) Postfach 20 10 37, 08012 Zwickau Dr.-Friedrichs-Ring 2 A, 08056 Zwickau	0375	536-0	536-1011/-1127	http://www.fh-zwickau.de

4. Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (Hermann von Helmholtz Association of National Research Centres)

In Germany's diversified research environment, the 16 national research centres which currently form the Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (HGF) fulfil central tasks in basic research as well as in preventive research and research on key technologies. The Helmholtz Centres conduct most of their scientific work on their own responsibility.

– In basic research, the central task is making available expensive large-scale equipment including the necessary scientific and technical infrastructure. The equipment, e.g. elementary particle accelerators, synchrotron radiation facilities, heavy ion sources, are available not only to research groups of Centres concerned but also and in particular to German and international scientists from higher education institutions and other science organisations.
– Owing to their design and organisation (e.g. high degree of external users, temporary research groups), the Centres are able to develop – at the interface between different disciplines - innovative research areas which sometimes are directly linked to applications. In joint projects with industry, bridges are built between basic research and application, often with a long-term perspective.
– For this reason, research with large-scale equipment provides focuses for networking research across disciplinary, institutional and national borders. The Helmholtz Centres are involved in large international research projects in many different ways and represent German participants in international institutions (such as ILL, JET or ESRF). Due to their inclusion in collaborative research centres and postgraduate research groups and due to their close co-operation with universities, they also play a key role in the support of young scientists.
– The Helmholtz Centres' preventive research is oriented towards goals such as preserving a habitable environment for the world population, development of environmentally friendly technologies or in health research issues of national significance. Such preventive research is related to numerous political and social aspects reflected by international agreements on climate research, earth system research, space research or cancer research. Due to their long-term perspective and work structures which are not oriented to academic disciplines, research activities can reveal system interrelations, thus providing politics, society and industry with important orientation for sustainable development, e.g. with regard to climate, environment and public health.
– In the key technologies, the Helmholtz Centres' research taps future potential mainly for high technologies (e.g. in the areas of new materials, microsystems technology, nanotechnology, superconductivity, energy research and biotechnology). With 477 patent applications (1998), the Helmholtz Centres, together with large companies, rank among the top ten in international patent statistics.

The HGF is therefore the largest technology supplier in the government-funded research sector. Income under license agreements, which has increased considerably (DM27.4 million in 1998 /

DM19.4 million 1997), shows that the findings yielded by Helmholtz Centres are in demand among companies. Small and medium-sized companies and large companies are included in cooperation. In 1998, 40 spin-offs from Helmholtz Centres were established.

Owing to their ability to integrate researchers from companies and other science organisations under common research strategies, the Helmholtz Centres hold a special position in the German innovation system. As specialisation and work sharing increase, greater demands will be made on such integrated, trans-disciplinary work structures for the development of complex system solutions. Knowledge-oriented basic research, development and industrial application will increasingly be meshed, as can already be seen in dynamic areas, such as biotechnology, nanotechnology or information and communication technologies. This trend requires a new work sharing between companies and publicly funded research. The Helmholtz Centres, as a pillar of publicly funded research in Germany, provide a good basis for relevant efforts. (cf. Helmholtz-Handbuch 1999/2000 and Helmholtz Programmbudget 1999, published by HGF, Postfach 20 14 48, 53144 Bonn)

It is planned to merge the Gesellschaft für Mathematik und Datenverarbeitung GMD (National Research Centre for Information Technology) and its eight institutes with the FhG in order to pool the expertise of both institutions in the area of information and communication technologies and to produce synergy by means of common strategic orientation of the institutes. This merger is to take place in steps within a five-year transition period, with a planned transfer of GMD operations to the FhG by January 1, 2002, at the latest.

With a total budget of DM4.3 billion (1998), the Helmholtz Centres employed a total staff of some 21,760, of which some 4,590 were financed from nationally and internationally raised external funds (some DM1,040 million in 1998). Basic funding of the Centres is provided by the Federal Government and the respective host *Land* at a ratio of 90:10. In 2000, the government funds provided amount to more than DM2.9 billion.

Institution	Main tasks
1. Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI) [1] *Stiftung des öffentlichen Rechts* Columbusstraße, 27568 Bremerhaven Tel.: 04 71-48 31-0; Fax: 04 71-48 31-1 49 E-Mail: awi-pr@awi-bremerhaven.de Internet: http://www.awi-bremerhaven.de Branch in Potsdam; Island stations on Heligoland and in List (Sylt)	• Research on the ocean-atmosphere-cryosphere system • Structures and processes in marine eco-systems of the polar regions and the European marginal seas • Reconstruction of the environmental and climate history of the Arctic and Antarctic Oceans • Meteorological, atmospheric chemistry and geophysical long-term measurements in the polar regions • marine natural product research
2. Stiftung Deutsches Elektronen- Synchrotron (DESY) *Stiftung des bürgerlichen Rechts* Notkestraße 85, 22603 Hamburg Tel.: 0 40-89 98-0; Fax: 0 40-89 98-32 82 E-Mail: desyinfo@desy.de Internet: http://www.desy.de Branch: Zeuthen	• Elementary particle physics • Synchrotron radiation application for structural research in biology, medicine physics and materials science • Research and development for new accelerator technologies
3. Stiftung Deutsches Krebsforschungszentrum (DKFZ) *Stiftung des öffentlichen Rechts* Im Neuenheimer Feld 280 69120 Heidelberg Tel.: 0 62 21-42-0; Fax: 0 62 21-42-29 95 E-Mail: webmaster@dkfz-heidelberg.de Internet: http://www.dkfz-heidelberg.de	• Cancer development and differentiation • Tumour cell regulation • Cancer risk factors and cancer prevention • Diagnostics and experimental therapy • Radiological diagnostics and therapy • Applied tumour virology • Tumour immunology • Genome research and bioinformatics
4. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Linder Höhe, 51147 Köln Tel.: 0 22 03-6 01-0; Fax: 0 22 03-6 73 10 E-Mail: pressestelle@dlr.de Internet: http://www.dlr.de Branches: Berlin, Bonn, Braunschweig, Göttingen, Lampoldshausen, Oberpfaffenhofen, Stuttgart	• Aeronautics • Space activities • Energy technology • Innovation in technology transfer • Transport research and transport technology

Institution	Main tasks
5. Forschungszentrum Jülich GmbH (FZJ) [2] 52425 Jülich Tel.: 0 24 61-61-0 Fax: 0 24 61-61-53 27 E-Mail: fzj@fz-juelich.de Internet: http://www.fz-juelich.de	• Structure of matter and materials research • Information technology • Life sciences • Preventive environmental research • Energy technology
6. Forschungszentrum Karlsruhe GmbH (FZK) Technik und Umwelt [3] Postfach 36 40, 76021 Karlsruhe Tel.: 0 72 47-82-0; Fax: 0 72 47-82-50 70 E-Mail: henning.moeller@pea.fzk.de Internet: http://www.fzk.de	• Environmental research • Energy research • Key technologies • Basic scientific research • Generic activities (technology transfer, system analysis and technology assessment)
7. Gesellschaft für Biotechnologische Forschung mbH (GBF) Mascheroder Weg 1, 38124 Braunschweig Tel.: 05 31-61 81-0; Fax: 05 31-61 81-5 12 E-Mail: info@gbf.de Internet: http://www.gbf.de	• Cytomics – molecular analysis and engineering of cells • Pathogenicity research and development of vaccines • New active agents • Environmental biotechnology • Bioprocess development and validation • Structure and function of biological macromolecules
8. Stiftung GeoForschungsZentrum Potsdam (GFZ) *Stiftung des öffentlichen Rechts* Telegrafenberg, 14473 Potsdam Tel.: 03 31-2 88-0; Fax: 03 31-2 88-10 02 E-Mail: postmaster@gfz-potsdam.de Internet: http://www.gfz-potsdam.de Branch: Niemegk	• Earth models and geopotential, variation of global phenomena such as earth rotation and its connection to climate variations • Active shelf edges and their significance for transportation processes in the earth's crust • Natural hazards, in particular earthquakes and volcanism • Climate and environment, reconstruction of paleo-climate and paleo-environment from continental sediments • Geotechnology • Equipment pools for expeditions and supply of special analytical equipment
9. GKSS-Forschungszentrum Geesthacht GmbH (GKSS) Max-Planck-Straße, 21502 Geesthacht Tel.: 0 41 52-87-0; Fax: 0 41 52-87-14 03 E-Mail: presse@gkss.de Internet: http://www.gkss.de Branch: Teltow	• Water and climate in coastal environments • Lightweight construction in transport and energy technology • Membranes in process technology • Strategic projects (neutron/synchrotron radiation, biotechnology/medical technology)
10. GMD-Forschungszentrum Informationstechnik GmbH Postfach 13 16, Schloß Birlinghoven 53754 Sankt Augustin Tel.: 0 22 41-14-0; Fax: 0 22 41-14-28 89 E-Mail: info@gmd.de Inernet: http://www.gmd.de Branches: Darmstadt, Berlin, Tokyo	• Design processes • Communication and cooperation procedures • Intelligent multimedia systems • Parallel computing • Technology transfer
11. GSF-Forschungszentrum für Umwelt und Gesundheit GmbH Ingolstädter Landstraße 1 85764 Neuherberg Tel.: 0 89-31 87-0; Fax: 0 89-31 87-33 22 E-Mail: oea@gsf.de Internet: http://www.gsf.de Branches: Munich, Wolfenbüttel-Remlingen	The research and development programme is divided into 10 research priorities covering the entire range of environmental research and the analysis of the effects of pollutants on ecosystems, animals and humankind to clinical research and epidemiological studies.

Institution	Main tasks
12. Gesellschaft für Schwerionenforschung mbH (GSI) Planckstraße 1, 64291 Darmstadt Tel.: 0 61 59-71-0; Fax: 0 61 59-71-27 85 E-Mail: presse@gsi.de Internet: http://www. gsi.de	• Nuclear physics • Atomic physics • Plasma physics • Materials research • Biophysics • Accelerator development
13. Hahn-Meitner-Institut Berlin GmbH (HMI) Glienicker Straße 100, 14109 Berlin Tel.: 0 30-80 62-0; Fax: 0 30-80 62-21 81 E-Mail: robertson@hmi.de Internet: http://www.hmi.de Branch: Berlin-Adlershof	• Solid-state physics: structure and dynamics of condensed matter • User service: a) Berlin Centre for Neutron Scattering at the research reactor BER II b) Ion beam application in the ion beam laboratory ISL-Berlin • Solar energy research, photovoltaics • Material analysis and modification with ion beams • Trace elements in health and nutrition
14. Max-Planck-Institut für Plasmaphysik (IPP) *eingetragener Verein* Boltzmannstraße 2 85748 Garching bei München Tel.: 0 89-32 99-01; Fax: 0 89-32 99-26 22 E-Mail: oeffentlichkeitsarbeit@ipp.mpg.de Internet: http://www.ipp.mpg.de Branches: Berlin, Greifswald	• Plasma physics research • Study of controlled nuclear fusion • Stellarator • ToKamak • Fusion-relevant surface physics and materials research
15. Stiftung Max-Delbrück-Centrum für Molekulare Medizin (MDC) *Stiftung des öffentlichen Rechts* Robert-Rössle-Straße 10 13125 Berlin-Buch Tel.: 0 30-9 40 60; Fax: 0 30-9 49 41 61 E-Mail: presse@mdc-berlin.de Internet: http://www.mdc-berlin.de	• Cardio-vascular research • Cancer research • Genetics, bioinformatics, structural biology • Cell growth and differentiation • Molecular and development neurobiology • Molecular therapy
16. UFZ-Umweltforschungszentrum Leipzig-Halle GmbH Permoserstraße 15, 04318 Leipzig Tel.: 03 41-2 35-0; Fax: 03 41-2 35-27 91 E-Mail: boehme@gf.ufz.de Internet: http://www.ufz.de Branches: Bad Lauchstädt, Halle/S., Magdeburg	• Pollution of soils, ground water and biosphere • Transport behaviour and location of pollutants • Pollutant load and impact on ecosystems • Landscape ecology • Regeneration of structures and processes in ecosystems • Counselling for reclamation agencies • Pollution and health

1 From 1999 onwards including the Bundesanstalt Helgoland (BAH), which was merged with the Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI).

2 Statistical data include the Institut für Biotechnologie, which is 100% financed by *Land* North Rhine-Westphalia.
Including funds for the decommissioning/dismantling of nuclear plants.

3 Including funds for WAK decommissioning and old facilities.

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
1. Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI) [1]	BMBF chapter 30 07 (90:10)	115.9 *95.9* *11.8*	151.5 *122.5* *11.7*	165.6 *129.5* *20.4*	174.0 *134.3* *22.8*	464 *239* *135* *90*	470 *233* *134* *103*	580 *336* *134* *110*	584 *329* *135* *120*
2. Stiftung Deutsches Elektronen-Synchrotron (DESY)	BMBF chapter 30 05 (90:10)	301.0 *251.3* *2.8*	302.1 *254.3* *3.8*	298.4 *258.1* *3.3*	301.1 *260.9* *2.8*	1438 *1203* *208* *27*	1443 *1191* *217* *35*	1429 *1157* *227* *45*	1352 *1151* *157* *45*
3. Stiftung Deutsches Krebsforschungszentrum (DKFZ)	BMBF chapter 30 05 (90:10)	199.6 *141.5* *42.4*	202.3 *140.9* *45.7*	213.1 *143.4* *53.8*	243.5 *152.8* *73.7*	1166 *715* *200* *252*	1237 *703* *227* *307*	1243 *687* *235* *320*	1260 *690* *240* *330*
4. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)	BMBF chapter 30 08 (90:10)	716.1 *388.4* *279.8*	793.6 *392.7* *330.5*	753.5 *396.0* *318.7*	798.7 *400.8* *357.0*	4044 *2245* *354* *1445*	4262 *2128* *347* *1787*	4060 *2057* *336* *1667*	3936 *2233* *144* *1558*
5. Forschungszentrum Jülich GmbH (FZJ) [2]	BMBF chapter 30 07 (90:10)	639.0 *448.7* *129.2*	622.6 *431.8* *130.6*	607.4 *428.3* *119.5*	630.1 *451.1* *116.8*	3707 *2791* *363* *554*	3612 *2711* *358* *544*	3591 *2646* *434* *511*	3669 *2677* *432* *560*
6. Forschungszentrum Karlsruhe GmbH (FZK) Technik und Umwelt [3]	BMBF chapter 30 07 (90:10)	777.8 *463.6* *270.2*	763.8 *463.4* *247.5*	919.6 *621.1* *223.2*	786.7 *484.0* *246.4*	3312 *2486* *329* *497*	3247 *2418* *311* *518*	3223 *2387* *294* *542*	3342 *2427* *335* *580*
7. Gesellschaft für Biotechnologische Forschung mbH (GBF)	BMBF chapter 30 06 (90:10)	67.1 *48.5* *13.1*	78.1 *54.4* *17.3*	70.3 *51.2* *12.7*	72.4 *53.3* *13.1*	444 *261* *69* *114*	438 *261* *39* *138*	453 *258* *41* *155*	456 *261* *40* *155*
8. Stiftung GeoForschungsZentrum Potsdam (GFZ)	BMBF chapter 30 07 (90:10)	96.1 *61.0* *26.3*	95.1 *57.0* *31.0*	83.3 *57.6* *18.9*	68.9 *57.2* *4.6*	505 *332* *66* *107*	506 *331* *71* *104*	500 *322* *71* *107*	521 *341* *70* *110*
9. GKSS-Forschungszentrum Geesthacht GmbH (GKSS)	BMBF chapter 30 05 (90:10)	124.4 *92.6* *19.1*	134.1 *100.6* *21.2*	136.7 *106.1* *17.5*	130.0 *97.6* *20.2*	701 *483* *150* *68*	663 *453* *139* *71*	650 *437* *131* *83*	689 *451* *166* *72*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
10. GMD-Forschungszentrum Informationstechnik GmbH	BMBF chapter 30 06 (90:10)	186.5 *114.0* *54.2*	175.2 *115.4* *59.4*	184.3 *116.3* *55.1*	189.1 *118.9* *56.9*	1120 *653* *165* *302*	1134 *628* *185* *321*	1120 *616* *198* *306*	1174 *639* *205* *330*
11. GSF-Forschungszentrum für Umweltund Gesundheit GmbH	BMBF chapter 30 05 (90:10)	226.7 *132.3* *57.3*	226.2 *133.7* *54.9*	215.5 *134.7* *55.1*	207.7 *137.7* *53.3*	1320 *920* *123* *277*	1345 *910* *123* *313*	1297 *895* *118* *285*	1279 *889* *96* *294*
12. Gesellschaft für Schwerionen-forschung mbH (GSI)	BMBF chapter 30 05 (90:10)	128.8 *112.4* *2.3*	130.0 *112.3* *3.2*	130.0 *113.1* *2.9*	131.9 *115.3* *2.5*	609 *471* *126* *12*	610 *463* *135* *12*	610 *451* *147* *12*	614 *442* *160* *12*
13. Hahn-Meitner-Institut Berlin GmbH (HMI)	BMBF chapter 30 05 (90:10)	117.6 *95.9* *8.8*	128.2 *101.5* *8.9*	125.9 *100.0* *11.7*	129.0 *104.3* *9.5*	708 *465* *178* *65*	694 *461* *169* *78*	697 *452* *178* *84*	708 *446* *188* *82*
14. Max-Planck-Institut für Plasmaphysik (IPP)	BMBF chapter 30 07 (90:10)	202.4 *111.6* *43.2*	251.0 *137.3* *42.9*	282.1 *147.7* *61.2*	293.8 *151.0* *65.8*	935 *782* *153* *0*	933 *788* *145* *0*	916 *797* *119* *0*	922 *804* *119* *0*
15. Stiftung Max-Delbrück-Centrum für Molekulare Medizin (MDC)	BMBF chapter 30 05 (90:10)	117.1 *79.7* *21.1*	118.5 *81.8* *20.8*	112.3 *83.4* *23.3*	122.0 *83.1* *23.3*	568 *343* *38* *187*	550 *343* *31* *175*	539 *337* *50* *152*	555 *335* *50* *170*
16. UFZ-Umweltforschungszentrum Leipzig-Halle GmbH	BMBF chapter 30 07 (90:10)	107.4 *76.5* *22.5*	101.6 *82.6* *9.9*	107.0 *87.2* *10.0*	108.0 *89.4* *9.0*	631 *425* *109* *97*	620 *421* *114* *85*	600 *412* *118* *70*	601 *411* *100* *90*

1 From 1999 onwards including the Bundesanstalt Helgoland (BAH), which was merged with the Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (AWI).

2 Statistical data include the Institut für Biotechnologie, which is 100% financed by *Land* North Rhine-Westphalia. Including funds for the decommissioning/dismantling of nuclear plants.

3 Including funds for WAK decommissioning and old facilities.

Source: Federal budgets and individual institutions

Rounding error

5. Blue List institutions

Due to their supraregional significance and the national scientific and political interest in their support, the Blue List institutions (BLE) are supported by the Federal Government and the *Länder* as independent research institutions and institutions with a service function for research; the basis for such support is Article 2 paragraph 1, nos. 5 and 6 of the "Rahmenvereinbarung zwischen Bund und Ländern über die gemeinsame Förderung der Forschung nach Artikel 91 b GG" (Skeleton Agreement of Federal and *Länder* Governments on the Joint Promotions of Research pursuant to Article 91 b Basic Law) of November 28, 1975.

Currently, the Blue List comprises 84[1] institutions in all *Länder*, 33 of which are located in the new *Länder*. As a general rule, funding is provided by the Federal Government and the *Länder* on a 50 : 50 basis (exceptions are made for example for institutions with a service function) with the participation of 10 federal government departments and of the Federal Government Commissioner for Cultural Affairs and the Media. The Blue List institutions currently have nearly 11500 employees (established posts, additional staff and externally funded staff), total expenditure in 2000 amounts to some DM1.3 billion, including basic funding by the Federal Government of more than DM650 million.

In 1995, the Gottfried Wilhelm Leibniz Science Association (WGL)was established to fulfil the tasks of a cross-institutional self-governing organisation. Nearly all Blue List institutions are members of the Association. The WGL represents the members' joint interests. The statutes of the WGL provide for five sections, i.e. humanities and educational research; economics and social sciences, regional development research; life sciences; mathematics, natural science and engineering as well as environmental sciences.

Within the framework of the re-structuring of the German research environment, the Blue List institutions are increasingly being included in a quality competition for funds.

In order to stimulate this process, the basic funding of Blue List institutions – with the exception of some museums and service institutions – is cut by 2.5 percent (some DM18 million) and the money transferred to the budget of the Deutsche Forschungsgemeinschaft (DFG), during an initial pilot phase of three years starting in 1998. The Bund-*Länder* Commission for Educational Planning and Research Promotion (BLK) has decided to continue with this system for a limited time. In return, the Blue List institutions are given an opportunity to obtain DFG funds, by engaging in unrestricted competition with higher education institutions. This new system will increase the creativity and performance of Blue List institutions, thus improving their scientific profile.

At the request of the Bund-*Länder* Commission for Educational Planning and Research Promotion, the Science Council started an evaluation in 1995 on the basis of its recommendations for re-structuring the Blue List institutions and as a prerequisite for further action. The evaluation will be concluded this year. In autumn 2000, the Science Council will present a final report, which will address general issues of the Blue List, explain prospects for further development and comment on the situation of the Blue List institutions within the German research system.

[1] Der Forschungs- und der Serviceteil des DIPF werden hier als eine Einrichtung gezählt.

Institute	Research tasks
Baden-Württemberg	
1. Deutsches Institut für Fernstudienforschung an der Universität Tübingen (DIFF) *Stiftung des bürgerlichen Rechts* Konrad-Adenauer-Straße 40 72072 Tübingen Tel.: 0 70 71-9 79-0; Fax: 0 70 71-9 79-1 00 E-Mail: diff.zentrale@uni-tuebingen.de Internet: http://www.diff.uni-tuebingen.de	• Learning with new media • Didactics of distance learning • Knowledge transfer and interdisciplinarity
2. Fachinformationszentrum Karlsruhe, Gesellschaft für wissenschaftlich-technische Information mbH (FIZ Ka) Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen Tel.: 0 72 47-8 08-1 00; Fax: 0 72 47-8 08-1 14 E-Mail: gfs@fiz-karlsruhe.de Internet: http://www.fiz-karlsruhe.de Branches: Berlin, Bonn	• Database production • Operation of the FIZ-computing centre (host) within the framework of STN International • Development and extension of information systems • Operation of an automatic full- text information system • Development of information services
3. Gesellschaft Sozialwissenschaftlicher licher Infrastruktureinrichtungen e.V. (GESIS) c/o Zentrum für Umfragen, Methoden und Analysen e.V. (ZUMA) (Vereinssitz), Postfach 12 21 55, 68072 Mannheim Tel.:06 21-12 46-0; Fax: 06 21-12 46-100 E-Mail: gesis@za.uni-koeln.de Internet: http://www.social-science-gesis.de Branches: Cologne, Bonn, Berlin	Service institution for research with the following statute-defined tasks: • Provision and acquisition of quantitative data and their preparation • Development and provision of factographic and bibliographic databases • Method development and advice • Permanent monitoring of developments in society
4. Institut für deutsche Sprache (IDS) *Stiftung des bürgerlichen Rechts* R 5, 6–13, 68161 Mannheim Tel.: 06 21-15 81-0; Fax: 06 21-15 81-2 00 E-Mail: stickel@ids-mannheim.de Internet: http://www.ids-mannheim.de	• Scientific research and documentation of the use and recent history of the German language • Linguistic data processing (text corpora; grammar database) • Cooperation with other institutions of similar orientation in Germany and abroad (research library, guest support)
5. Kiepenheuer-Institut für Sonnenphysik (KIS) *Rechtlich unselbständige Forschungs-einrichtung des Landes BW* Schöneckstraße 6, 79104 Freiburg Tel.: 07 61-3 19 80; Fax: 07 61-31 98-1 11 E-Mail: ovdluhe@kis.uni-freiburg.de Internet: http://www.kis.uni-freiburg.de Branch: Observatorio del Teide / Tenerife (Spain)	• Fine structure of convection and magnetic field of the surface of the sun • Structure of sun spots • The 22-year magnetic cycle • Corona of the sun • Instrumental development

Institute	Research tasks
Bayern/Bavaria	
6. Deutsche Forschungsanstalt für Lebensmittelchemie (DFA) *Stiftung des öffentlichen Rechts* Lichtenbergstraße 4, 85748 Garching Tel.: 0 89-2 89-1 32 65; Fax: 0 89-2 89-1 41 83 E-Mail: Peter.Schieberle@lrz.tu-muenchen.de Internet: http://www.dfa.leb.chemie.tu-muenchen.de	• Characterisation of aroma-relevant compounds in food (method development; relation to quality); • Structure/effect relations of biopolymers, in particular proteins (improvement of quality by technological processes); analysis of toxic substructures • Publication of nutrition-value tables • Development of flavourings and colourings
7. Deutsches Museum in München (DM) *Anstalt des öffentlichen Rechts* Museumsinsel 1, 80538 München Tel.: 0 89-2 17 93 13; Fax: 0 89-2 17 94 25 E-Mail: wpf@extern.lrz-muenchen.de Internet: http://www.deutsches-museum.de Branches: Oberschleißheim, Bonn	• History of natural sciences in the social context • National innovation systems in comparison • Historical traffic research • Education and research • Object and restoration research
8. Germanisches Nationalmuseum (GNM) *Stiftung des öffentlichen Rechts* Karthäusergasse 12, 90402 Nürnberg Tel.: 0 911-1 33 10; Fax: 09 11-1 33 12 00 E-Mail: info@gnm.de Internet: http://www.gnm.de	• Collection, development and study of the history of art and culture in the German-speaking area, in particular of performing arts as well as historic monuments • Preparation and organisation of special exhibitions • Publication of collection catalogues • Organisation of scientific meetings
9. ifo Institut für Wirtschaftsforschung e.V. München (ifo) Poschingerstraße 5, 81679 München Tel.: 0 89-92 24-0; Fax: 0 89-98 53 69 E-Mail: ifo@ifo.de Internet: http://www.ifo.de Branch: Dresden	• Continuous analysis and forecasting of economic trends, growth and structural change, collection, analysis and provision of data) • International comparison of institutions • Public finance and tax system • Labour market and social policy
10. Institut für Zeitgeschichte (IfZ) *Öffentliche Stiftung des bürgerlichen Rechts* Leonrodstraße 46b, 80636 München Tel.: 0 89-12 68 80; Fax: 0 89-1 23 17 27 Branches: Bonn, Berlin Internet: http://www.ifz-muenchen.de	German and European history in the 20th century: • Prehistory of the national socialist dictatorship • History of the national socialist dictatorship • Post-war history (files on the foreign policy of the Federal Republic of Germany; research projects on SOZ/GDR-history)
Berlin	
11. Berliner-Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung mbH (BESSY II) [1] Albert-Einstein-Straße 15, 12489 Berlin Tel.: 030-63 92 29 99; Fax.: 030-63 92 29 90 E-Mail: info@bessy.de Internet: http://www.bessy.de	• Construction, operation and further development of a storage ring as synchrotron radiation source • Provision of synchrotron radiation for research • Scientific service in the areas of semiconductors, microelectronics, biology, medicine, chemistry
12. Deutsches Bibliotheksinstitut (DBI) [2] *Anstalt des öffentlichen Rechts* Kurt-Schumacher-Damm 12-16, 13405 Berlin Tel.: 0 30-4 10 34-0; Fax: 0 30-4 10 34-1 00 E-Mail: beyersdorff@dbi-berlin.de Internet: http://www.dbi-berlin.de	• Databases with imaging and full-text storage • Retrieval languages and presentation of multimedia elements • Application of economic metadata in libraries • Use of digital media for children and young people

Institute	Research tasks
13. Deutsches Institut für Wirtschaftsforschung (DIW) *Eingetragener Verein* Königin-Luise-Straße 5, 14195 Berlin Tel.: 0 30-8 97 89-0; Fax: 0 30-8 97 89-2 00 E-Mail: postmaster@diw.de Internet: http://www.diw.de	• Observation, study and forecasting of national and international economic processes • Offering advice to politics, industry, science and administration • Research spectrum ranges from short-term economic trends and answering economic and financial questions to forecasting and evaluation of long-term changes both in the overall economy and in individual branches. Social change is the subject of budget inquiries of the Socio-economic Panel (SOEP) • In the DIW, six departments do research on economic cycles; world economy; economic structures and state; industry and technology; regional and traffic research; and energy, raw materials, environment. In addition, there is the Socio-economic Panel (SOEP) organised as a project group
14. Fachinformationszentrum Chemie GmbH (FIZ CHEMIE BERLIN) Franklinstraße 11, 10587 Berlin Tel.: 0 30-3 99 77-0; Fax: 0 30-3 99 77-1 14 E-Mail: info@fiz-chemie.de Internet: http://www.fiz-chemie.de	Provision of scientific and technical information services: • Chemistry information • Databases • Searches • Training
15. Ferdinand-Braun-Institut für Höchstfrequenztechnik (FBH) im Forschungsverbund Berlin e. V. Albert-Einstein-Straße 11, 12489 Berlin Tel.: 0 30-63 92-26 01; Fax: 0 30-63 92-26 02 E-Mail: fbh@fbh-berlin.de Internet: http://www.fbh-berlin.de	• GaAs high-power heterobipolar transistors for mobile communication • GaAs microwave ICs for sensors • Field-oriented simulation, CAD and high-frequency measuring technology • High-power, high-brilliance laser diodes • Galliumnitride electronics
16. Forschungsinstitut für Molekulare Pharmakologie (FMP) im Forschungsverbund Berlin e. V. Alfred-Kowalke-Straße 10, 10315 Berlin Tel.: 0 30-51 55 10; Fax: 0 30-51 55 12 91 E-Mail: biziat@fmp-berlin.de Internet: http://www.fmp-berlin.de	• Peptide chemistry, peptide pharmacology • NMR-supported structural research • Signal transduction / molecular medicine • Neurobiology • Molecular genetics
17. Heinrich-Hertz-Institut für Nachrichtentechnik Berlin GmbH (HHI) Einsteinufer 37, 10587 Berlin Tel.: 0 30-3 10 02-0; Fax: 0 30-3 10 02-2 13 E-Mail: contacts@hhi.de Internet: http://www.hhi.de	• Photonics networks • Mobile broadband systems • Electronic imaging for multimedia
18. Institut für Gewässerökologie und Binnenfischerei (IGB) im Forschungsverbund Berlin e.V. Müggelseedamm 310, 12587 Berlin Tel.: 0 30-64 18 16 02; Fax: 0 30-64 18 16 00 E-Mail: stein@igb-berlin.de Internet: http://www.igb-berlin.de	• Structure and function of aquatic systems • Time series for the development of optimisation strategies • Scientific foundations for the development of ecotechnologies and aquaculture • Development of concepts for the reclamation and restoration of damaged water ecosystems • Function of food networks from bacteria to fishes

Institute	Research tasks
19. Institut für Kristallzüchtung (IKZ) im Forschungsverbund Berlin e.V. Rudower Chaussee 6, 12489 Berlin Tel.: 0 30-63 92-30 00; Fax: 030-63 92-30 03 E-Mail: cryst@ikz-berlin.de Internet: http://www.ikz-berlin.de	• SiC-mono-crystals for high-temperature components and circuits, sensors and as substrates for emitters in the blue spectral region • Oxidic and fluoridic mono-crystals e.g. for laser applications, high-temperature pressure sensors and substrates for GaN and HTSL • Development of LPE techniques, in particular for growing on amorphous substrates • GaAs mono-crystals for ultrahigh frequency components • Further development of the silicon FZ-technology (modelling, growth under magnetic fields)
20. Institut für Zoo- und Wildtierforschung (IZW) im Forschungsverbund Berlin e.V. Alfred-Kowalke-Straße 17, 10315 Berlin Tel.: 0 30-5 16 81 01; Fax: 0 30-5 12 61 04 E-Mail: Kruegel@izw-berlin.de Branch: Niederfinow	• Morphological study of zoo and wild animals • Reproduction management for the preservation of biodiversity by means of sonographic and endocrinologic methods • Diseases of zoo and wild animals • Ethnological and chronobiological research (animal-environment relations) • Pilot studies with deer: wild ruminants and concentrate selectors
21. Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (MBI) im Forschungsverbund Berlin e.V. Rudower Chaussee 6 12489 Berlin-Adlershof Tel.: 0 30-63 92-15 05; Fax: 0 30-63 92-15 19 E-Mail: postmaster@mbi-berlin.de Internet: http://www.mbi-berlin.de	• New sources of ultra-short and ultra-intensive light pulses • Interdisciplinary applications in basic research and in the development of future key technologies • Provision of laser systems, measuring technology and know-how for external users (femtosecond-applications laboratories, high-field laser applications laboratories – laboratories for combined experiments with lasers and synchrotron radiation at BESSY II)
22. Paul-Drude-Institut für Festkörperelektronik (PDI) im Forschungsverbund Berlin e.V. Hausvogteiplatz 5-7, 10117 Berlin Tel.: 0 30-2 03 77-0; Fax: 0 30-2 03 77-2 01 E-Mail: ploeg@pdi-berlin.de Internet: http://pdi.wias-berlin.de	• Atom-controlled growth for tailor-made semiconductor nanostructures • Correlation of real interfaces and electronic properties • Materials development and materials integration for components • Elastic properties of nanostructured solids • Nanoanalytics and nanofacture
23. Weierstraß-Institut für Angewandte Analyse und Stochastik (WIAS) im Forschungsverbund Berlin e.V. Mohrenstraße 39, 10117 Berlin Tel.: 0 30-2 03 72-5 87; Fax: 0 30-2 04 49 75 E-Mail: sprekels@wias-berlin.de Internet: http://www.wias-berlin.de	• Semiconductor, nano- and optoelectronics • Phase transitions • Stochastics and statistics in business studies and engineering • Continuum mechanics
24. Wissenschaftszentrum Berlin für Sozialforschung gGmbH (WZB) Reichpietschufer 50, 10785 Berlin Tel.: 0 30-2 54 91-0; Fax: 0 30-2 54 91-6 84 E-Mail: wzb@wz-berlin.de Internet: http://www.wz-berlin.de	• Labour market and employment • Technology-work-environment • Social change, institutions, mediation processes • Market process and company development • Public health

Institute	Research tasks
Brandenburg	
25. Astrophysikalisches Institut Potsdam (AIP) *Stiftung des bürgerlichen Rechts* An der Sternwarte 16, 14482 Potsdam Tel.: 03 31-74 99-0; Fax: 03 31-74 99-3 62 E-Mail: direktor@aip.de Internet: http://www.aip.de:8080 Branch: Tremsdorf	• Extra-galactic astrophysics and cosmology • Cosmic magnetic fields, sun and stellar activity
26. Deutsches Institut für Ernährungsforschung Potsdam-Rehbrücke (DIfE) *Stiftung des öffentlichen Rechts* Arthur-Scheunert-Allee 114/116 14558 Bergholz-Rehbrücke Tel.: 03 32 00-88-0; Fax: 03 32 00-88-4 44 E-Mail: schulz@www.dife.de Internet: http://www.dife.de	• Nutritional metabolic imbalance (adipositas and metabolic syndrome, atherosclerosis, aminoacid metabolism) • Nutrition and malign degeneration • Nutrition and immunity (including food allergies) • Basis of neurobiologically oriented nutrition psychology
27. Institut für Agrartechnik Bornim e.V. (ATB) Max-Eyth-Allee 100, 14469 Potsdam-Bornim Tel.: 03 31-56 99-0; Fax: 03 31-56 99-8 49 E-Mail: atb@atb-potsdam.de Internet: http://www.atb-potsdam.de	• Processes for materials- or energy-oriented use of renewable resources • Sustainable soil use by locally differentiated cultivation • Environmentally sound recycling of residues and refuse • Environmentally sound and welfare-oriented keeping of farm animals • Quality assurance for agricultural and horticultural market products
28. Institut für Gemüse- und Zierpflanzenbau Großbeeren/Erfurt e.V. (IGZ) Theodor-Echtermeyer-Weg 1 14979 Großbeeren Tel.: 03 37 01-7 80; Fax: 03 37 01-5 53 91 E-Mail: igzev@t-online.de Internet: http://www.dainet.de/igz/ Branches: Kühnhausen bei Erfurt, Golzow (Oderbruch)	• Cultivation strategies for sustainable vegetable production • Integrated reproduction of ornamental plants • Basis for quality management • Expert systems for vegetable field cropping • Production strategies for greenhouse cultures
29. Institut für Innovative Mikroelektronik GmbH (IHP) *GmbH* Walter-Korsing-Straße 2 15230 Frankfurt/Oder Tel.: 03 35-56 25-0; Fax: 03 35-56 25-3 00 E-Mail: ihp@ihp-ffo.de Internet: http://www.ihp-ffo.de	• Innovations in wireless communication, networks and multimedia • System-oriented expansion of silicon-CMOS technologies by modular development • Low cost CMOS-compatible SiGe-HBT • Prototype demonstration at system and circuit level • Synergies of materials research, process technologies, circuit and system design
30. Institut für Regionalentwicklung und Strukturplanung e.V. (IRS) Flakenstraße 28–31, 15537 Erkner Tel.: 0 33 62-7 93-0; Fax: 0 33 62-7 93-1 11 E-Mail: regional@irs.los.shuttle.de Internet: http://www.los.shuttle.de/irs	• Regional development, area management • Conversion • Settlement structure • History of regional planning • Regional and planning culture

Institute	Research tasks
31. Potsdam-Institut für Klimafolgenforschung e. V. (PIK) Telegrafenberg, 14473 Potsdam Tel.: 03 31-2 88-25 00; Fax: 03 31-2 88-26 00 E-Mail: stock@pik-potsdam.de Internet: http://www.pik-potsdam.de	• Regionalisation of global climate forecasts and scenarios • Forecasting of climatic effects on natural and civilisation systems • Cost-benefit analyses of climate protection strategies • Disciplinary and integrated modelling of complex environment systems • Typification of dynamic patterns of global change
32. Zentrum für Agrarlandschafts- und Landnutzungsforschung e. V. (ZALF) Eberswalder Straße 84, 15374 Müncheberg Tel.: 03 34 32-8 20; Fax: 03 34 32-8 22 12 E-Mail: zalf@zalf.de Internet: http://www.zalf.de Branches: Eberswalde, Dedelow, Paulinenaue	• Basic landscape research • Development of possibilities for ecologically stable preservation and shaping of *land* use systems
Bremen	
33. Deutsches Schiffahrtsmuseum (DSM) *Stiftung des bürgerlichen Rechts* Hans-Scharoun-Platz 1 27568 Bremerhaven Tel.: 04 71-48 20 70; Fax: 04 71-48 20-7 55 E-Mail: postmaster@dsm.de Internet: http://dsm.de	• Pre-industrial navigation • German navigation in early modern times • Effects of industrialisation on merchant shipping • History of marine research and use
Hamburg	
34. Bernhard-Nocht-Institut für Tropenmedizin (BNI) [3] *Körperschaft des öffentlichen Rechts* Bernhard-Nocht-Straße 74, 20359 Hamburg Tel.: 0 40-42 81 8-0; Fax: 0 40-42 81 8-4 00 E-Mail: bni@bni.uni-hamburg.de Internet: www.bni.uni-hamburg.de Branch: Kumasi (Ghana)	• Infections with pathogens from the tropics • Parasitologic research • Parasite-host interaction • Virology and immunology • Genetic basis for resistance to infectious diseases
35. Deutsches Übersee-Institut (DÜI) *Stiftung des bürgerlichen Rechts* Neuer Jungfernstieg 21, 20354 Hamburg Tel.: 0 4042 83 5-593; Fax: 0 40-42 83 4-547 E-Mail: duei@uni-hamburg.de Internet: http://www.rrz.uni-hamburg.de/duei	• Globalisation; national controllability and social stabilisation • Formal and informal politics in international comparison • Political communication, old and new media • Crisis prevention and peace building • South-South relations
36. Heinrich-Pette-Institut für Experimentelle Virologie und Immunologie (HPI) an der Universiät Hamburg *Stiftung des bürgerlichen Rechts* Martinistraße 52, 20251 Hamburg Tel.: 0 40-4 80 51-0; Fax: 0 40-4 80 51-1 03 E-Mail: direktorium@hpi.uni-hamburg.de Internet: http://www.hpi-hamburg.de	• Structure and function of viruses • Pathogenesis and treatment of virus infections • Somatic gene therapy and immune therapy for malign diseases • Viral and cellular oncogenes and tumour suppressor genes • Mechanisms of embryonic cell differentiation and blood formation • Animal models of genetic and viral diseases • Infection and tumour immunology

Institute	Research tasks
37. Hamburgisches Welt-Wirtschafts-Archiv (HWWA) [4] *Stiftung öffentlichen Rechts* Neuer Jungfernstieg 21, 20354 Hamburg Tel.: 0 40-428 34-0; Fax: 0 40-428 34-451 E-Mail: hwwa@hwwa.de Internet: http://www.hwwa.de	• Library and press documentation • Information services on an economic basis • International macro-economy • European integration • World economy
Hessen/Hesse	
38. Deutsches Institut für Erwachsenenbildung e. V. (DIE) Hansaallee 150, 60320 Frankfurt/Main Tel.: 0 69-9 56 26-0; Fax: 0 69-9 56 26-1 74 E-Mail: schumann@die-frankfurt.de Internet: http://die-frankfurt.de	• Evaluation of concepts and curricula for adult education (planning and development) • Information and applications in the area of adult education • Development of training and counselling programmes for adult education
39. Deutsches Institut für Internationale Pädagogische Forschung (DIPF) *Stiftung des öffentlichen Rechts* Schloßstraße 29, 60486 Frankfurt/Main Tel.: 0 69-2 47 08-0; Fax: 0 69-2 47 08-4 44 E-Mail: dipf@dipf.de Internet: http://www.dipf.de Branch: Berlin	• Education information • Education history • Financing and control of the education system • Socio-cultural framework of the education system
40. Forschungsinstitut und Naturmuseum Senckenberg (FIS) *Gesellschaft durch landesherrliche Verfügung vom 17.08.1867 als juristische Person anerkannt gemäß Artikel 63 EGBGB* Senckenberganlage 25 60325 Frankfurt/Main Tel.: 0 69-75 42-0; Fax: 74 62 38 E-Mail: pcasper@sng.uni-frankfurt.de Internet: http://senckenberg.uni-frankfurt.de Branches: Biebergemünd, Hamburg; Messel, Wilhelmshaven, Weimar	• Systematics and phylogenesis of recent fossil animals and plants • Biogeography and paleobiogeography • Ecology, ecofaunistics and actuopaleontology • Biostratigraphy and chronostratigraphy • Sediment geology and actuogeology
41. Herder-Institut e.V. (HI) Gisonenweg 5–7, 35037 Marburg Tel.: 0 64 21-1 84-0; Fax: 0 64 21-1 84-1 39 E-Mail: herder@mailer.uni-marburg.de Internet: http://www.uni-marburg.de/herder-institut	Scientific service institution for historical Eastern and Central European research including special collections on German settlement areas in Central and Eastern Europe; literature database; edition projects; support of manual projects; scientific events
Mecklenburg-Vorpommern/Mecklenburg-Western Pomerania	
42. Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere, Dummerstorf (FBN) *Stiftung des öffentlichen Rechts* Wilhelm-Stahl-Allee 2, 18196 Dummerstorf Tel.: 03 82 08-6 85; Fax: 03 82 08-6 86 02 E-Mail: fbn@fbn-dummerstorf.de Internet: http://www.fbn-dummerstorf.de	• Basic biological research with farm animals • Molecular and cell biology • Nutrition, growth and reproductive physiology • Basis for stable performance, healthy genetic material, wellness & product quality • Population biology and biometric-statistical models

Institute	Research tasks
43. Institut für Niedertemperatur-Plasmaphysik e.V. an der Ernst-Moritz-Arndt-Universität Greifswald (INP) Friedrich-Ludwig-Jahn-Straße 19, 17489 Greifswald Tel.: 0 38 34-5 54-3 00; Fax: 0 38 34-5 54-3 01 E-Mail: verwaltung@inp-greifswald.de Internet: http://www.inp-greifswald.de	• Application-oriented basic research in low-temperature plasma physics • Electron kinetics in plasmas • Plasma radiation sources • Plasma-based process technology • Plasma-induced surface processes
44. Institut für Ostseeforschung Warnemünde an der Universität Rostock (IOW) 5) *Unselbständige Landeseinrichtung* Seestraße 15, 18119 Warnemünde Tel.: 03 81-5 19 70; Fax: 03 81-51 97 48 40 E-Mail : barbara.hentzsch@io-warnemünde.de Internet: http://www.io-warnemuende.de	• Marine ecosystem analysis • Physical oceanography • Marine chemistry • Biological oceanography • Marine geology
45. Leibniz-Institut für Atmosphärenphysik e.V. an der Universität Rostock (IAP) *Eingetragener Verein* Schloßstraße 6, 18225 Kühlungsborn Tel.: 03 82 93-6 80; Fax: 03 82 93-68 50 E-Mail: luebken@iap-kborn.d400.de Internet: http://www.iap-kborn.de Branch: Juliusruh (Rügen)	• Dynamic interrelations of troposphere, stratosphere and mesosphere • The atmosphere in Arctic regions • Interaction between solar UV-B radiation and the atmosphere
Niedersachsen/Lower Saxony	
46. Akademie für Raumforschung und Landesplanung (ARL) *Anstalt des öffentlichen Rechts* Hohenzollernstraße 11, 30161 Hannover Tel.: 05 11-3 48 42-0; Fax: 05 11-3 48 42-41 E-Mail: arl@arl-net.de Internet: http://www.arl-net.de	• Spatial effects of socio-demo-graphic change, economic and technological development • Regional and settlement development in Germany and Europe • Sustainable regional development • Planning law and planning procedures • Urban and regional networks
47. Deutsches Primatenzentrum GmbH (DPZ) Kellnerweg 4, 37077 Göttingen Tel.: 05 51-38 51-0; Fax: 05 51-38 51-2 28 E-Mail: ghunsma@www.dpz.gwdg.de Internet: http://www.dpz.gwdg.de	• Reproduction biology • Primate genetics • Virology and immunology • Veterinary medicine and primate breeding • Behavioural research / ecology
48. DSMZ – Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH Mascheroder Weg 1 B 38124 Braunschweig Tel.: 05 31-26 16-0; Fax: 05 31-26 16-4 18 E-Mail: help@dsmz.de Internet: http://www.dsmz.de	Collection-relevant research: • Methods of conservation • Identification and characterisation of biological material • Patent and safety deposits
49. Institut für den Wissenschaftlichen Film gGmbH (IWF) Nonnenstieg 72, 37075 Göttingen Tel.: 05 51-50 24-0; Fax: 05 51-50 24-4 00 E-Mail: iwf-goe@iwf.de Internet: http://www.iwf.de	• Multimedia presentation of knowledge • Visual anthropology • Microcinematography and time transformation • PC-based film sequencing • Media distributions, documentation and archiving • Media development and production

Institute	Research tasks
50. Institut für Erdöl- und Erdgasforschung (IfE) *Rechtsfähige Anstalt des öffentlichen Rechts* Walther-Nernst-Straße 7 38678 Clausthal-Zellerfeld Tel.: 0 53 23-7 11-1 00; Fax: 0 53 23-7 11-2 00 E-Mail: postmaster@ife-clausthal.de	• Optimisation of natural gas and oil production • Solution of material-related problems in the processing transport, and use of oil and natural gas • Minimisation of adverse environmental effects of the extraction, transport, processing and use of oil and natural gas
51. Niedersächsisches Landesamt für Bodenforschung – Geowissenschaftliche Gemeinschaftsaufgaben (GGA) *Landesanstalt* Stilleweg 2, 30655 Hannover Tel.: 05 11-6 43-34 96; Fax: 05 11-6 43-36 65 E-Mail: duerbaum@gga-hannover.de Internet: http://www.gga-hannover.de	• Analysis of the three-dimensional structure of geotechnically relevant subsoil as basis a for processes • Research of geogenic and environment-relevant physical processes in the geosphere • Development and operation of the geophysics specialised information system
52. Technische Informationsbibliothek Hannover (TIB) *Unselbständige Einrichtung des Landes Niedersachsen* Welfengarten 1 B, 30167 Hannover Tel.:05 11-7 62-22 68; Fax: 05 11-7 62-26 86 E-Mail: ubtib@tib.uni-hannover.de Internet: http://www.tib.uni-hannover.de	• Development of the TIB into an electronic / virtual library • Automation of document delivery • Production, processing and provision of electronic documents • Archiving (long-term protection) of electronic documents
Nordrhein-Westfalen/North Rhine-Westphalia	
53. Deutsches Bergbau-Museum Bochum (DBM) *GmbH* Am Bergbaumuseum 28, 44791 Bochum Tel.: 02 34-5 87 70; Fax: 02 34-5 87 71 11 E-Mail: slotta@lb.dmt.de Internet: http://www.bergbaumuseum.de	• Mining archaeology and archeometry • Mining history • Modern mining • Research, documentation and protection of cultural heritage (in the mining sector) • Paleoanthropology
54. Deutsche Zentralbibliothek für Landbauwissenschaften (ZBL) *Körperschaft des öffentlichen Rechts* Nußallee 15a, 53115 Bonn Tel.: 02 28-73 34 02; Fax: 02 28-73 32 81 E-Mail: zbl@ulb.uni-bonn.de Internet: http://www.dainet.de/zbl/zbl.htm	• Agricultural sciences • Nutritional science • Nature conservation • Domestic science and home economics • Horticulture • Environmental ecology
55. Deutsche Zentralbibliothek für Medizin (ZBM) *Körperschaft des öffentlichen Rechts* Joseph-Stelzmann-Straße 9, 50931 Köln Tel.: 02 21-4 78-56 00; Fax: 02 21-4 78-56 97 E-Mail: zbmed.zbmed@uni-koeln.de Internet: http://www.zbmed.de	Services for research in the areas of • Healthcare • Medicine • Pharmaceutics • Molecular biology • Cell biology
56. Diabetes-Forschungsinstitut an der Heinrich-Heine-Universtität Düsseldorf (DFI) *Eingetragener Verein* Auf'm Hennekamp 65, 40225 Düsseldorf Tel.: 02 11-33 82-2 60; Fax: 02 11-33 82-3 02 E-Mail: verwaltung@dfi.uni-duesseldorf.de Internet: http://www.dfi.uni-duesseldorf.de	• Immunology of type-I diabetes • Insulin resistance and type-II diabetes • Epidemiology of diabetes mellitus • Secondary diseases caused by diabetes mellitus

Institute	Research tasks
57. Forschungsinstitut für Kinderernährung (FKE) *Eingetragener Verein* Heinstück 11, 44225 Dortmund E-Mail: fke@fke.uni-dortmund.de Tel.: 02 31-79 22 10-0; Fax: 02 31-71 15 81	• Longitudinal study on nutrition, metabolism growth and development of children and young adults • Epidemiological studies on nutrition and health with children and young adults • Improved nutrition of premature babies and small for date babies • Development of preventive nutrition recommendations • Structural and functional aspects of glycoproteins and complex carbohydrates • Non-invasive measuring of ribonucleic acid and protein turnover
58. Institut für Arbeitsphysiologie an der Universität Dortmund (IFA) *Eingetragener Verein* Ardeystraße 67, 44139 Dortmund Tel.: 02 31-10 84-2 04; Fax: 02 31-10 84-3 26 E-Mail: arnoldf@arb-phys.uni-dortmund.de Internet: http://www.ifado.de	• Safeguarding people's ability to work by avoiding job- and working-environment-related impairment • Maintaining and improving performance and ability to work • Evaluation of impairments • Evaluation of situational and individual vulnerability of the human organism
59. Institut für Spektrochemie und angewandte Spektroskopie (ISAS) *Eingetragener Verein* Bunsen-Kirchhoff-Straße 11, 44139 Dortmund Tel.: 02 31-13 92-0; Fax: 02 31-13 92-1 20 E-Mail: klockow@isas-dortmund.de Internet: http://www.isas-dortmund.de Branch: Berlin-Adlershof	• Spectroscopic methods of environmental analytics • Element species analysis • Atmospheric trace elements and organic substances in water • Chemical sensors • Materials analysis, microanalysis and surface analysis
60. Medizinisches Institut für Umwelthygiene (MIU) an der Heinrich-Heine-Universität Düsseldorf *Eingetragener Verein* Auf`m Hennekamp 50, 40225 Düsseldorf Tel.: 02 11-3 38 90; Fax: 02 11-3 19 09 10 E-Mail: beyen@uni-duesseldorf.de	• Biological effects of fibre and non-fibre dust • Molecular toxicology • Immunotoxicology and allergology • Neurotoxicology and behavioural toxicology • Epidemiology and biomonitoring
61. Rheinisch-Westfälisches Institut für Wirtschafts-forschung (RWI) *Eingetragener Verein* Hohenzollernstraße 1–3, 45128 Essen Tel.:02 01-81 49-0; Fax: 02 01-81 49-2 00 E-Mail: rwi@rwi-essen.de Internet: http://www.rwi-essen.de	• Diagnoses and forecasts of cyclical and structural develop-ments in the German economy and in major industrialised countries • Analysis of the economy of the *Land* North Rhine-Westphalia in particular with regard to energy and steel • Analysis of the development in the crafts and retailing, SMEs and company size • European integration • Environmental economy • Analysis of the energy and steel sectors
62. Zoologisches Forschungsinstitut und Museum Alexander-Koenig (ZFMK) *Unselbständige Einrichtung des Landes Nordrhein-Westfalen* Adenauerallee 160, 53113 Bonn Tel.: 02 28-9 12 22 00; Fax: 02 28-9 12 22 02 E-Mail: c.naumann.zfmk@uni-bonn.de Internet: http://www.uni-bonn.de/~unb701	• Biodiversity research • Zoological systematics and phylogenesis • Tropical ecology • Basis of nature conservation • Biogeography

Institute	Research tasks
Rheinland-Pfalz/Rhineland Palatinate	
63. Forschungsinstitut für öffentliche Verwaltung (FÖV) bei der Deutschen Hochschule für Verwaltungswissenschaften Speyer *Nicht rechtsfähige Anstalt des öffentlichen Rechts* Freiherr-vom-Stein-Straße 2, 67324 Speyer Tel.: 0 62 32-6 54-3 87; Fax: 0 62 32-6 54-290 E-Mail: foev@dhv-speyer.de Internet: http://foev.dhv-speyer.de	• Citizens, state and tasks • Civil service and organisation • Planning and decision-making • Public finance and economic policy • Legislation and legal policy
64. Römisch-Germanisches Zentralmuseum (RGZM) – Forschungsinstitut für Vor- und Frühgeschichte *Stiftung des öffentlichen Rechts* Ernst-Ludwig-Platz 2, 55116 Mainz Tel.: 0 61 31-91 24-0; Fax: 0 61 31-91 24-1 99 E-Mail: rzentral@mainz-online.de Internet: http://home.rhein-Zeitung.de~rzentral/ Branches: Neuwied, Mayen, Tiflis (Georgia), Cairo (Egypt), Xian (PR China)	• Study of the earliest human beings in Eurasia • Research into the life of human beings in the Early Palaeolithic (16 000–11 000 BC) • Studies on Roman stone monuments in Upper Germania • Studies on Roman pottery workshops • Research on the genesis and structure of elites in prehistoric and early history societies • Studies on the Roman fleet • Vulcanology, archaeology and technology history as structural elements of landscape development in the Middle Rhine area
65. Zentralstelle für Psychologische Information und Dokumentation (ZPID) an der Universität Trier *Körperschaft des öffentlichen Rechts* Universitätsring 15, 54296 Trier Tel.: 06 51-2 01-28 77; Fax: 06 51-2 01-20 71 E-Mail: zpid@zpid.uni-trier.de Internet: http://www.zpid-psychologie.de	• Psychology • Bibliometry • Scientometry • Psychology on the Internet • Testing methods documentation • Literature documentation
Saarland	
66. Institut für Neue Materialien (INM) [6] Gemeinnützige GmbH Im Stadtwald, Gebäude 43, 66123 Saarbrücken Tel.: 06 81-93 00-313; Fax: 06 81-93 00-223 E-Mail: schmidt@inm-gmbh.de Internet: http://www.inm-gmbh.de	• Chemical nanotechnology • Surface technology • Ceramics • Glass • Application Centre NMO
Sachsen/Saxony	
67. Forschungszentrum Rossendorf e.V. (FZR) Postfach 51 01 19, 01314 Dresden Tel.: 03 51-2 60-0; Fax: 03 51-2 69 04 61 E-Mail: pobell@fz-rossendorf.de Internet: http://www.fz-rossendorf.de	• Biomedicine-chemistry • Environment • Materials research • Nuclear physics • Safety research

Institute	Research tasks
68. Institut für Festkörper- und Werkstoffforschung Dresden e.V. (IFW) Helmholtzstraße 20, 01069 Dresden Tel.: 03 51-46 59-0; Fax: 03 51-46 59-5 40 E-Mail: postmaster@ifw-dresden.de Internet: ttp://www.ifw-dresden.de	• Conjugated carbon systems • Functional alloys • Layer materials for electronics • Superconductivity and superconductors • Magnetism and magnetic materials
69. Institut für Länderkunde e.V. Leipzig (IfL) Schongauerstraße 9, 04329 Leipzig Tel.: 03 41-2 55 65 00; Fax: 03 41-2 55 65 98 E-Mail: IfL.@.IfL.uni-Leipzig.de Internet: www.uni-Leipzig.de/~IfL	• Theory and methods of regional geography • Regional geographic structures • Transformation and restructuring
70. Institut für Oberflächenmodifizierung e.V. (IOM) Permoserstraße 15, 04318 Leipzig Tel.: 03 41-2 35-23 08; Fax: 03 41-2 35-23 13 E-Mail: bigl@rz.uni-leipzig.de	• Analysis of interaction processes of low-energy electrons and ions as well as UV radiation • Development of methods, processes and technologies for the manufacture of functional surfaces and layers • Support of research and teaching at Leipzig university
71. Institut für ökologische Raumentwicklung e. V. Dresden (IÖR) Weberplatz 1, 01217 Dresden Tel.: 03 51-4 67 90; Fax: 03 51-4 67 92 12 E-Mail: raumentwicklung@pop3.tu-dresden.de Internet: http://www.tu-dresden.de/ioer/ioer.htm	• Strategies and instruments for a resource-protecting *land* use • Resource-saving, user-oriented building and housing – a basis for decision-making by municipalities and private individuals • Strategies for ensuring sustainable structural change • Requirements to be met by urban and regional development in the framework of European integration
72. Institut für Polymerforschung Dresden e.V. (IPF) Hohe Straße 6, 01069 Dresden Tel.: 03 51-46 58-0; Fax: 03 51-46 58-2 14/2 84 E-Mail: ipf@ipfdd.de Internet: http://www.ipfdd.de	Application-oriented basic research on the synthesis, modification, processing, characterisation and testing of polymer materials
73. Institut für Troposphärenforschung e.V. (IfT) Permoserstraße 15, 04318 Leipzig Tel.: 03 41-2 35 21; Fax: 03 41-2 35 23 61 E-Mail: jost@tropos.de Internet: http://www.tropos.de	• Transformation of trace elements in close-to-source areas • Vertical exchange in the troposphere • Interaction of aerosol, clouds and radiation
Sachsen-Anhalt/Saxony-Anhalt	
74. Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO) *Stiftung des öffentlichen Rechts* Theodor-Lieser-Straße 2, 06120 Halle Tel.: 03 45-2 92 81 10; Fax: 03 45-2 92 81 99 E-Mail: iamo@iamo.uni-halle.de Internet: http://www.iamo.de	• Re-orientation of agricultural and food policy and interrelation between institutions and political processes • Structural change in the agricultural and food sector and development of rural areas • Interregional integration efforts and EU integration • Risk protection and financial markets in the agricultural sector • Re-structuring of farms and competitiveness of farms

Institute	Research tasks
75. Institut für Pflanzenbiochemie (IPB) *Stiftung des öffentlichen Rechts* Weinberg 3, 06120 Halle Tel.: 03 45-55 82-0; Fax: 03 45-55 82-1 49 E-Mail: ipb@ipb.uni-halle.de Internet: http://www.ipb.uni-halle.de	• Structures and bioactivities of natural plant products • Structure, metabolism and modes of action of phytohormones • Signal transduction in stress-induced plant development • Physiology and biochemistry of the secondary metabolism • Interaction between plants and pathogens and symbionts
76. Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK) *Stiftung des öffentlichen Rechts* Corrensstraße 3, 06466 Gatersleben Tel.: 03 94 82-5-0; Fax: 03 94 82-5-139 E-Mail: muelen@ipk-gatersleben.de Internet: http://www.ipk-gatersleben.de Branches: Dresden-Pillnitz, Groß Lüsewitz, Gülzow, Malchow/Poel	• Resources research • Genome research • Molecular plant physiology/cell biology
77. Institut für Wirtschaftsforschung Halle (IWH) *Eingetragener Verein* Kleine Märker Straße 8, 06108 Halle Tel.: 03 45-77 53 60; Fax: 03 45-7 75 38 20 E-Mail: rph@iwh.halle.de Internet. http://www.iwh.halle.de	• Observation and analysis of the adaptation process in the new *Länder*, economic policy recommendations • Analysis of the structural, regional and local economic development in Germany • Development of the economic cycle in Germany • Labour market issues • Analysis of the economic development in the Central and Eastern European states
78. Leibniz-Institut für Neurobiologie Magdeburg (IfN) *Stiftung des öffentlichen Rechts* Brenneckestraße 6, 39118 Magdeburg Tel.: 03 91-6 26 32 18; Fax: 03 91-61 61 60 E-Mail: staak@ifn-magdeburg.de Internet: http://www.ifn-magdeburg.de	• Molecular mechanisms of communication between nerve cells • Cell physiological and biochemical mechanisms of memory development • Functional organisation and learning processes of the visual and auditory cortex • Learning processes and abnormalties in young children • Spatial and temporal analysis of higher cerebral functions with non-invasive imaging techniques
Schleswig-Holstein	
79. Deutsche Zentralbibliothek für Wirtschaftswissenschaften (ZBW), Kiel *Nicht rechtsfähige Forschungsanstalt des Landes Schleswig-Holstein* Düsternbrooker Weg 120, 24105 Kiel Tel: 04 31-88 14-1; Fax: 04 31-88 14-5 20 E-Mail: zbw@zbw.ifw-kiel.de Internet: http://www.uni-kiel.de/ifw/zbw/econis.htm	• Procurement and processing of specialised economic literature • Supra-regional literature supply • ECONIS database • Document delivery services • Indexing with standard thesaurus economy
80. Forschungszentrum Borstel (FZB) Zentrum für Medizin und Biowissenschaften *Stiftung des bürgerlichen Rechts* Parkallee 1–40, 23845 Borstel Tel.: 0 45 37-1 88-0; Fax: 0 45 37-1 88-2 44 E-Mail: fzb@fz-borstel.de Internet: http://www.fz-borstel.de	Infection and allergy in pneumology: • Type-I allergy, bronchial asthma • Infectious lung diseases • Bacterial infections • Septic processes • Granulomatous inflammations

Institute	Research tasks
81. Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel (IPN) *Nicht rechtsfähige Anstalt des öffentlichen Rechts des Landes Schleswig-Holstein* Olshausenstraße 62, 24098 Kiel Tel.: 04 31-8 80-31 21; Fax: 04 31-8 80-15 21 E-Mail: csec@ipn.uni-kiel.de Internet: http://www.ipn.uni-kiel.de	• Scientific teaching-learning research • Concepts for cross-disciplinary science teaching • Attitudes, interests and scientific education processes • Technology and its assessment natural science teaching • Environmental education and environmental action
82. Institut für Meereskunde an der Universität Kiel (IfM) *Anstalt des öffentlichen Rechts* Düsternbrooker Weg 20, 24105 Kiel Tel.: 04 31-5 97-0; Fax: 04 31-56 58 76 E-Mail: ifm@ifm.uni-kiel.de Internet: http://www.uni-kiel.de/ifw	Physics: • Obsrevation and modelling with regard to the role of the oceans within the climate system • Biogeochemical substance cycles, interaction with the ocean floor, carbon and sulphur cycle Biology: • Structure, function and dynamics of marine organisms, populations, communities and eco-systems
83. Institut für Weltwirtschaft an der Universität Kiel (IFW) *Nicht rechtsfähige Forschungsanstalt des Landes Schleswig-Holstein* Düsternbrooker Weg 120, 24105 Kiel Tel.: 04 31-88 14-1; Fax: 04 31-88 14-5 00 E-Mail: info@ifw.uni-kiel.de Internet: http://www.uni-kiel.de/ifw	• Growth, structural change and international work sharing • Environmental and resources economy • Regional planning • Developmental economy and global economic integration • Business cycle analysis
Thüringen/Thuringia	
84. Institut für Molekulare Biotechnologie e.V. Jena (IMB) Beutenbergstraße 11, 07745 Jena Tel.: 0 36 41-6 56-3 33; Fax: 0 36 41-6 56-3 35 E-Mail: hilgenfd@imb-jena.de Internet: http://www.imb-jena.de	• Structural biology • Evolutive biotechnology • Genome research • Biochemistry • Molecular biology

1 The Berliner-Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung mbH (BESSY II) was added to the Blue List on January 1, 2000.

2 The Deutsches Bibliotheksinstitut (DBI) was dissolved on January 1, 2000.

3 The Clinical Department of the Bernhard-Nocht-Institut für Tropenmedizin (BNI) has been estimated separately since 1998.

4 Since January 1, 1999 the HWWA-Institut für Wirtschaftsforschung has been supported as service institution with scientific competence. On July 1, 2000 the HWWA was re-established as a public law foundation and renamed "Hamburgisches Welt-Wirtschafts-Archiv".

5 Basic funding from the Federal Government includes funds of the BMBauV for the implementation of the administrative agreement BSH-IOW (1997: DM 5.4 million, 2000: DM 5.8 million).

6 The Institut für Neue Materialien (INM) was added to the Blue List on January 1, 1999.

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
Baden-Württemberg									
1. Deutsches Institut für Fernstudienforschung an der UniversitätTübingen (DIFF)	BMBF chapter 30 02 (50:50)	11.4 *4.3* *0.9*	11.2 *4.7* *1.7*	11.5 *4.8* *1.8*	11.1 *4.8* *0.9*	96 *74* *18* *4*	93 *72* *11* *10*	92 *69* *7* *16*	84 *69* *4* *11*
2. Fachinformationszentrum Karlsruhe, Gesellschaft für wissenschaftlich-technische Information mbH (FIZ Ka)	BMBF chapter 30 02 (85:15)	55.7 *19.6* *9.8*	57.1 *19.3* *10.7*	58.6 *17.8* *12.3*	59.2 *15.0* *10.0*	292 *224* *25* *43*	274 *219* *17* *39*	269 *214* *15* *41*	270 *217* *18* *35*
3. Gesellschaft Sozialwissenschaftlicher Infrastruktureinrichtungen e.V. (GESIS)	BMBF chapter 30 02 (80:20)	21.5 *16.4* *2.5*	*21.7* *17.1* *2.2*	*22.4* *17.2* *0.9*	*23.4* *18.0* *1.0*	165 *128* *31* *6*	166 *127* *32* *7*	165 *122* *37* *6*	166 *123* *37* *7*
4. Institut für deutsche Sprache (IDS)	BMBF chapter 30 02 (50:50)	14.6 *6.5* *1.5*	14.3 *6.5* *1.1*	15.5 *6.9* *1.6*	15.0 *7.0* *0.8*	123 *97* *21* *5*	109 *90* *18* *1*	113 *88* *20* *5*	121 *96* *21* *5*
5. Kiepenheuer-Institut für Sonnenphysik (KIS)	BMBF chapter 30 02 (50:50)	5.2 *2.4* *0.2*	5.7 *2.5* *0.2*	6.4 *2.7* *0.5*	7.0 *3.0* *0.4*	41 *33* *7* *1*	40 *33* *6* *2*	42 *33* *7* *2*	41 *33* *5* *3*
Bayern/Bavaria									
6. Deutsche Forschungsanstalt für Lebensmittelchemie (DFA)	BML chapter 10 02 (50:50)	5.4 *2.5* *1.1*	5.3 *2.5* *1.4*	5.1 *2.1* *1.4*	5.2 *2.3* *1.2*	43 *32* *3* *9*	45 *36* *3* *7*	43 *33* *0* *10*	44 *33* *2* *9*
7. Deutsches Museum in München (DM)	BKM chapter 04 05 (50:50)	52.4 *5.8* *9.4*	52.4 *5.8* *8.5*	55.5 *6.1* *4.7*	60.3 *6.1* *5.0*	374 *350* *18* *6*	399 *354* *30* *15*	394 *354* *30* *10*	405 *353* *40* *12*
8. Germanisches Nationalmuseum (GNM)	BKM chapter 04 05 (50:50)	26.1 *6.5* *1.7*	33.7 *8.6* *3.1*	26.9 *7.3* *6.3*	29.1 *8.0* *2.2*	176 *147* *11* *18*	186 *148* *13* *25*	191 *145* *14* *33*	192 *143* *14* *35*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
9. ifo Institut für Wirtschafts-forschung e.V. München (ifo)	BMF chapter 08 02 (50:50)	32.2 *6.9* *18.0*	31.1 *7.3* *16.8*	30.4 *7.5* *16.5*	26.7 *5.7* *10.5*	231 *123* *9* *108*	213 *122* *4* *91*	193 *121* *4* *72*	165 *77* *4* *65*
10. Institut für Zeitgeschichte (IfZ)	BMBF chapter 30 02 (50:50)	8.5 *3.1* *2.1*	8.6 *3.1* *2.2*	8.9 *3.2* *2.2*	10.0 *3.6* *2.7*	73 *49* *8* *17*	75 *49* *8* *19*	72 *48* *7* *18*	75 *48* *8* *20*
Berlin									
11. Berliner-Elektronenspeicher ring- Gesellschaft für Synchrotronstrahlung mbH (BESSY II) [1]	BMBF chapter 30 02 (50:50)	- - -	- - -	- - -	60.0 *23.0* *15.0*	- - - -	- - - -	- - - -	183 *157* *7* *19*
12. Deutsches Bibliotheksinstitut (DBI) [2]	BMBF chapter 30 02 (30:70)	16.7 *3.9* *0.0*	16.1 *3.9* *0.0*	15.3 *3.9* *0.0*	- - -	120 *112* *0* *7*	116 *111* *0* *5*	106 *101* *0* *5*	- - - -
13. Deutsches Institut für Wirtschaftsforschung (DIW)	BMF chapter 08 02 (50:50)	29.7 *7.4* *14.1*	31.7 *7.5* *16.0*	31.9 *7.8* *15.7*	31.4 *7.8* *15.3*	186 *105* *12* 70	180 *102* *11* 68	189 *101* *18* 70	198 *110* *18* 70
14. Fachinformationszentrum Chemie GmbH (FIZ CHEMIE BERLIN)	BMBF chapter 30 02 (50:50)	19.4 *3.2* *2.0*	19.8 *3.2* *1.3*	20.0 *2.9* *0.7*	20.0 *2.7* *0.9*	80 *51* *16* *3*	76 *50* *16* *11*	71 *49* *16* *6*	70 *47* *16* *8*
15. Ferdinand-Braun-Institut für Höchstfrequenztechnik (FBH) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	19.7 *7.7* *4.3*	17.6 *6.6* *3.7*	*19.9* 7.3 *4.7*	19.5 *10.6* *2.8*	121 *87* *11* *23*	123 *86* *10* *28*	125 *85* *9* *32*	125 *85* *9* *31*
16. Forschungsinstitut für Mole-kulare Pharmakologie (FMP) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	17.3 *7.5* *2.2*	21.3 *9.1* *3.0*	36.3 *16.0* *4.2*	35.4 *16.3* *2.8*	119 *96* *11* *12*	127 *96* *15* *17*	133 *95* *15* *23*	138 *100* *15* *23*
17. Heinrich-Hertz-Institut für Nachrichtentechnik Berlin GmbH (HHI)	BMBF chapter 30 02 (50:50)	*46.6* *15.0* *17.5*	*47.5* *13.9* *20.4*	*51.4* *14.8* *22.9*	*39.7* *13.8* *12.5*	*302* *161* *7* 134	*292* *156* *7* 129	*289* *150* *16* 123	*304* *167* *17* 120

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	1998	1999	2000	1997	1998	1999	2000
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
18. Institut für Gewässerökologie und Binnenfischerei (IGB) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	16.4 *6.9* *2.6*	17.9 *7.6* *2.8*	27.7 *12.2* *3.3*	22.0 *9.5* *3.0*	148 *108* *13* *28*	152 *108* *15* *29*	145 *104* *12* *29*	145 *104* *12* *29*
19. Institut für Kristallzüchtung (IKZ) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	23.3 *9.7* *3.6*	19.1 *7.2* *4.4*	16.4 *5.1* *5.2*	12.7 *5.2* *1.6*	80 *50* *6* *25*	87 *50* *8* *29*	84 *50* *8* *26*	83 *50* *7* *26*
20. Institut für Zoo- und Wildtierforschung (IZW) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	9.3 *4.1* *1.0*	8.2 *3.7* *0.8*	8.2 *3.7* *0.9*	8.4 *4.1* *0.2*	69 *52* *8* *9*	71 *53* *10* *9*	69 *51* *10* *8*	70 *58* *10* *2*
21. Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (MBI) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	34.0 *15.3* *3.3*	30.9 *13.5* *3.7*	27.4 *11.5* *4.4*	23.6 *10.1* *3.4*	157 *119* *15* *23*	155 *116* *16* *23*	154 *115* *15* *25*	159 *120* *15* *24*
22. Paul-Drude-Institut für Festkörperelektronik (PDI) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	11.7 *5.3* *1.0*	11.9 *5.2* *1.3*	12.0 *5.3* *1.3*	11.7 *5.4* *0.8*	76 *63* *9* *4*	81 *63* *12* *6*	80 *61* *12* *7*	77 *61* *9* *7*
23. Weierstraß-Institut für Angewandte Analyse und Stochastik (WIAS) im Forschungsverbund Berlin e.V.	BMBF chapter 30 02 (50:50)	11.1 *5.0* *1.0*	11.9 *5.1* *1.5*	12.4 *5.6* *1.0*	11.8 *5.4* *0.8*	90 *78* *6* *6*	99 *77* *5* *17*	97 *74* *6* *17*	92 *80* *4* *8*
24. Wissenschaftszentrum Berlin für Sozialforschung gGmbH (WZB)	BMBF chapter 30 02 (75:25)	26.1 *17.4* *2.7*	25.7 *16.6* *3.3*	25.4 *17.6* *1.8*	26.2 *17.9* *2.2*	203 *151* *22* *31*	201 *148* *22* *32*	200 *145* *22* *33*	197 *142* *22* *33*
Brandenburg									
25. Astrophysikalisches Institut Potsdam (AIP)	BMBF chapter 30 02 (50:50)	16.5 *6.2* *4.2*	19.9 *8.0* *3.9*	23.0 *9.4* *4.1*	20.6 *9.3* *4.1*	124 *75* *15* *35*	122 *74* *12* *36*	121 *73* *13* *36*	122 *75* *11* *36*
26. Deutsches Institut für Ernährungsforschung Potsdam-Rehbrücke (DIfE)	BMBF chapter 30 02 (50:50)	24.8 *11.1* *2.7*	25.7 *10.9* *2.3*	34.5 *13.5* *2.8*	43.2 *15.2* *1.6*	165 *117* *19* *29*	164 *115* *18* *31*	169 *116* *27* *26*	190 *131* *31* *28*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds* **1997** Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff* **1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
27. Institut für Agrartechnik Bornim e.V. (ATB)	BML chapter 10 02 (50:50)	17.6 *6.7* *1.2*	14.0 *6.4* *1.2*	13.2 *6.0* *1.2*	14.3 *6.4* *1.5*	145 *132* *4* *9*	147 *130* *4* *13*	148 *130* *4* *14*	141 *125* - *16*
28. Institut für Gemüse- und Zierpflanzenbau Großbeeren/Erfurt e.V. (IGZ)	BML chapter 10 02 (50:50)	13.7 *6.6* *0.5*	13.7 *6.1* *1.5*	17.9 *5.4* *7.0*	13.1 *4.9* *0.7*	106 *98* *4* *4*	109 *98* *6* *5*	100 *98* *1* *2*	100 *97* *0* *3*
29. Institut für Innovative Mikroelektronik GmbH (IHP) *GmbH*	BMBF chapter 30 02 (50:50)	39.3 *18.8* *1.9*	44.8 *21.3* *4.9*	49.4 *22.8* *3.8*	54.5 *24.6* *5.0*	166 *145* *4* *17*	168 *135* *6* *27*	172 *141* *4* *28*	181 *147* *7* *28*
30. Institut für Regionalentwicklung und Strukturplanung e.V. (IRS)	BMVBW chapter 12 25 (50:50)	5.4 *2.2* *0.8*	5.4 *2.3* *0.9*	5.5 *2.3* *0.8*	5.7 *2.4* *0.8*	56 *48* *2* *6*	57 *46* *3* *8*	54 *46* *4* *4*	54 *48* *2* *5*
31. Potsdam-Institut für Klimafolgenforschung e.V. (PIK)	BMBF chapter 30 02 (50:50)	12.2 *3.9* *4.4*	13.5 *4.5* *4.4*	17.7 *6.5* *4.6*	19.9 *7.3* *5.2*	73 *36* *8* *29*	86 *39* *16* *31*	100 *41* *21* *38*	111 *42* *31* *38*
32. Zentrum für Agrarlandschafts- und Landnutzungsforschung e.V. (ZALF)	BML chapter 10 02 (50:50)	26.3 *13.1* *4.4*	25.8 *12.4* *4.8*	31.1 *12.5* *7.1*	29.5 *13.4* *6.7*	290 *247* *0* *43*	290 *245* *0* *45*	279 *241* *5* *33*	282 *239* *3* *40*
Bremen									
33. Deutsches Schiffahrtsmuseum (DSM)	BKM chapter 04 05 (50:50)	18.3 *4.8* *0.1*	16.4 *3.5* *0.1*	13.7 *4.1* *0.1*	11.0 *3.3* *0.0*	54 *49* *4* *1*	53 *49* *3* *1*	52 *48* *3* *1*	51 *48* *2* *0*
Hamburg									
34. Bernhard-Nocht-Institut für Tropenmedizin (BNI)[3]	BMG chapter 15 02 (50:50)	38.2 *12.2* *4.3*	29.0 *9.1* *4.4*	28.3 *9.8* *4.2*	27.5 *9.9* *4.0*	298 *224* *24* *50*	214 *159* *18* *38*	212 *155* *21* *37*	225 *160* *25* *40*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which: – Basic funding from the Federal Government (including HSP) – External funds*				Total staff (full-time equivalent) *of which: – Established) Posts – Additional staff – Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
35. Deutsches Übersee-Institut (DÜI)	AA	13.2	12.8	13.8	13.0	108	116	122	112
	chapter 05 02	*5.2*	*5.3*	*5.4*	*5.5*	*81*	*80*	*79*	*77*
	(50:50)	*1.4*	*1.2*	*2.0*	*0.8*	*11*	*12*	*27*	*12*
						16	*10*	*16*	*11*
36. Heinrich-Pette-Institut für Experimentelle Virologie und Immunologie (HPI) an der Universiät Hamburg	BMG	22.0	23.0	21.0	23.0	121	131	124	130
	chapter 15 02	*6.0*	*7.0*	*8.0*	*7.0*	*75*	*74*	*75*	*76*
	(50:50)	*7.0*	*7.0*	*7.0*	*8.0*	*3*	*3*	*3*	*4*
						43	*54*	*46*	*50*
37. Hamburgisches Welt-Wirtschafts-Archiv (HWWA)[4]	BMF	24.0	23.7	20.6	20.3	215	223	181	182
	chapter 08 02	*9.7*	*9.9*	*8.0*	*8.0*	*174*	*188*	*137*	*137*
	(50:50)	*2.2*	*1.9*	*1.8*	*1.8*	*35*	*30*	*39*	*39*
						6	*5*	*5*	*6*
Hessen/Hesse									
38. Deutsches Institut für Erwachsenenbildung e.V. (DIE)	BMBF	8.5	6.3	7.8	9.4	65	51	47	46
	chapter 30 02	*2.6*	*2.7*	*2.6*	*2.6*	*34*	*33*	*32*	*32*
	(50:50)	*2.6*	*0.7*	*2.4*	*2.8*	*2*	*2*	*1*	*0*
						29	*16*	*14*	*14*
39. Deutsches Institut für Internationale Pädagogische Forschung (DIPF)	BMBF	17.7	17.3	17.8	15.9	121	120	120	121
	chapter 30 02	*8.2*	*8.2*	*8.2*	*7.5*	*117*	*116*	*109*	*82*
	(50:50)	*1.5*	*1.3*	*1.5*	*1.7*	*2*	*2*	*3*	*27*
						2	*2*	*8*	*12*
40. Forschungsinstitut und Naturmuseum Senckenberg (FIS)	BMBF	*22.6*	*26.5*	*23.8*	*33.0*	*176*	*170*	*173*	*206*
	chapter 30 02	*9.3*	*10.2*	*10.5*	*14.7*	*122*	*119*	*115*	*152*
	(50:50)	*4.1*	*7.0*	*3.5*	*3.5*	*15*	*14*	*12*	*12*
						39	38	46	42
41. Herder-Institut e.V. (HI)	BMI	6.9	6.8	6.9	7.0	52	49	47	47
	chapter 06 40	*3.0*	*3.0*	*3.0*	*3.0*	*47*	*45*	*41*	*42*
	(50:50)	*0.5*	*0.6*	*0.7*	*0.8*	*2*	*3*	*5*	*3*
						3	*1*	*2*	*3*
Mecklenburg-Vorpommern/ Mecklenburg-Western Pomerania									
42. Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere, Dummerstorf (FBN)	BML	29.8	28.0	29.8	29.9	244	241	236	241
	chapter 10 02	*14.5*	*13.6*	*14.5*	*14.5*	*229*	*224*	*217*	*223*
	(50:50)	*0.8*	*0.8*	*0.8*	*0.9*	*8*	*11*	*13*	*12*
						7	*6*	*7*	*7*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds* 1997 Actual	1998 Actual	1999 Budget / Estimate	2000 Budget / Estimate	Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff* 1997 Actual as of June 30	1998 Actual as of June 30	1999 Actual as of June 30	2000 Budget / Estimate
43. Institut für Niedertemperatur-Plasmaphysik e.V. an der Ernst-Moritz-Arndt-Universität Greifswald (INP)	BMBF chapter 30 02 (50:50)	27.2 *12.5* *2.2*	25.9 *12.1* *1.8*	19.6 *8.3* *3.0*	13.8 *5.4* *3.0*	85 *50* *7* *28*	78 *50* *5* *23*	76 *50* *5* *21*	90 *50* *7* *33*
44. Institut für Ostseeforschung Warnemünde an der Universität Rostock (IOW)[5]	BMBF chapter 30 02 (50:50)	23.2 *12.7* *3.0*	24.2 *13.2* *3.2*	26.7 *14.2* *4.0*	22.5 *13.5* *3.5*	142 *115* *5* *22*	150 *117* *12* *21*	156 *115* *11* *30*	158 *117* *11* *30*
45. Leibniz-Institut für Atmosphärenphysik e.V. an der Universität Rostock (IAP)	BMBF chapter 30 02 (50:50)	8.0 *3.4* *1.2*	8.2 *3.5* *1.2*	9.0 *3.6* *1.8*	9.0 *3.9* *1.2*	50 *32* *6* *12*	49 *32* *5* *12*	46 *32* *6* *8*	47 *32* *5* *10*
Niedersachsen/Lower Saxony									
46. Akademie für Raumforschung und Landesplanung (ARL)	BMVBW chapter 12 25 (30:70)	*3.7* *1.1* *0.0*	*3.7* *1.1* *0.0*	*3.9* *1.1* *0.0*	*3.9* *1.1* *0.1*	*25* *24* *1* 0	*25* *24* *1* 0	*25* *24* *1* 0	*25* *24* *1* 0
47. Deutsches Primatenzentrum GmbH (DPZ)	BMBF chapter 30 02 (50:50)	16.6 *6.3* *4.0*	18.0 *6.2* *5.7*	18.1 *6.9* *4.3*	22.3 *9.0* *4.3*	162 *85* *33* *44*	161 *85* *26* *50*	171 *85* *31* *54*	167 *87* *30* *50*
48. DSMZ – Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH	BMBF chapter 30 02 (50:50)	8.7 *3.1* *0.2*	8.9 *2.9* *0.2*	9.0 *3.4* *0.0*	9.4 *3.5* *0.0*	67 *61* *4* *2*	69 *62* *3* *4*	69 *62* *3* *4*	68 *61* *8* *0*
49. Institut für den Wissenschaftlichen Film gGmbH (IWF)	BMF chapter 30 02 (50:50)	13.0 *6.3* *0.4*	14.5 *6.0* *0.9*	12.9 *5.4* *1.6*	10.2 *3.7* *2.2*	103 *100* *2* *1*	112 *108* *0* *4*	80 *54* *18* *8*	69 *56* *5* *8*
50. Institut für Erdöl- und Erdgasforschung (IfE)	BMWi chapter 09 02 (50:50)	7.0 *2.5* *1.7*	6.0 *2.2* *1.4*	4.8 *1.9* *0.7*	4.8 *1.6* *1.2*	69 *45* *5* *19*	59 *43* *0* *16*	44 *34* *0* *10*	37 *34* *0* *4*
51. Niedersächsisches Landesamt für Bodenforschung – Geowissenschaftliche Gemeinschaftsaufgaben (GGA)	BMWi chapter 09 02 (50:50)	14.5 *5.8* *3.3*	11.8 *5.3* *1.9*	11.4 *5.0* *1.0*	10.4 *4.6* *1.0*	112 *91* *1* *20*	83 *71* *1* *11*	78 *65* *2* *11*	73 *60* *2* *11*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
52. Technische Informationsbibliothek Hannover (TIB)	BMBF chapter 30 02 (30:70)	22.9 *5.8* *0.2*	23.8 *6.0* *0.7*	26.3 *6.6* *4.2*	28.5 *7.2* *4.2*	165 *141* *12* *12*	164 *139* *12* *13*	164 *140* *15* *9*	164 *140* *15* *9*
Nordrhein-Westfalen/North Rhine-Westphalia									
53. Deutsches Bergbau-Museum Bochum (DBM)	BMI chapter 04 05 (50:50)	12.5 *2.4* *1.0*	13.4 *2.6* *1.3*	13.7 *2.2* *1.1*	13.7 *2.3* *0.9*	97 *74* *13* *10*	104 *75* *16* *13*	105 *76* *14* *15*	110 *76* *14* *20*
54. Deutsche Zentralbibliothek für Landbauwissenschaften (ZBL)	BML chapter 10 02 (30:70)	4.3 *1.2* *0.0*	4.4 *1.3* *0.0*	4.6 *1.4* *0.0*	4.6 *1.4* *0.0*	34 *32* *2* *0*	33 *31* *2* *0*	32 *30* *2* *0*	32 *30* *2* *0*
55. Deutsche Zentralbibliothek für Medizin (ZBM)	BMG chapter 15 02 (30:70)	22.2 *5.5* *0.1*	18.5 *4.3* *0.3*	12.9 *2.7* *0.5*	13.3 *2.8* *0.5*	72 *65* *6* *1*	72 *65* *5* *2*	80 *64* *15* *2*	81 *65* *13* *4*
56. Diabetes-Forschungsinstitut an der Heinrich-Heine-Universität Düsseldorf (DFI)	BMG chapter 15 02 (50:50)	27.9 *8.2* *3.2*	29.6 *8.5* *4.6*	29.7 *8.3* *5.9*	29.9 *8.6* *5.9*	228 *185* *12* *31*	232 *183* *5* *44*	230 *182* *10* *38*	234 *186* *8* *40*
57. Forschungsinstitut für Kinderernährung (FKE)	BMG chapter 15 02 (50:50)	5.0 *2.2* *0.5*	4.6 *2.1* *0.4*	3.8 *1.8* *0.2*	3.0 *1.5* *0.1*	50 *41* *5* *4*	49 *40* *5* *4*	34 *28* *3* *3*	33 *28* *3* *2*
58. Institut für Arbeitsphysiologie an der Universität Dortmund (IFA)	BMA chapter 11 02 (50:50)	17.8 *7.2* *3.0*	17.2 *7.0* *2.8*	17.6 *7.1* *3.0*	18.0 *7.3* *3.0*	177 *115* *26* *36*	173 *114* *37* *22*	170 *112* *33* *25*	165 *112* *30* *23*
59. Institut für Spektrochemie und angewandte Spektroskopie (ISAS)	BMBF chapter 30 02 (50:50)	17.2 *7.6* *1.9*	18.3 *7.5* *3.3*	19.0 *7.7* *3.5*	19.9 *7.9* *4.0*	147 *111* *10* *26*	139 *107* *7* *25*	140 *108* *4* *28*	142 *108* *6* *28*
60. Medizinisches Institut für Umwelthygiene (MIU) an der Heinrich-Heine-Universität Düsseldorf	BMU chapter 16 02 (50:50)	23.2 *10.5* *2.1*	22.2 *10.4* *1.3*	19.8 *9.6* *1.8*	18.0 *9.0* *1.8*	245 *193* *30* *22*	216 *179* *25* *12*	136 *116* *9* *11*	150 *130* *10* *10*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which: – Basic funding from the Federal Government (including HSP) – External funds*				Total staff (full-time equivalent) *of which: – Established) Posts – Additional staff – Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
61. Rheinisch-Westfälisches Institut für Wirtschaftsforschung (RWI)	BMF chapter 08 02 (50:50)	11.3 *3.2* *4.3*	9.9 *3.5* *2.5*	9.7 *3.3* *2.7*	10.0 *3.5* *2.6*	71 *51* *0* *20*	71 *50* *0* *21*	70 *49* *0* *21*	83 *53* *0* *24*
62. Zoologisches Forschungsinstitut und Museum Alexander-Koenig (ZFMK)	BMI chapter 04 05 (50:50)	6.2 *1.6* *0.3*	7.1 *1.9* *0.4*	11.1 *2.7* *0.3*	11.4 *2.8* *0.3*	59 *50* *5* *4*	59 *50* *7* *2*	59 *49* *5* *5*	63 *50* *7* *6*
Rheinland-Pfalz/ Rhineland-Palatine									
63. Forschungsinstitut für öffentliche Verwaltung (FÖV) bei der Deutschen Hochschule für Verwaltungswissenschaften Speyer	BMI chapter 06 02 (50:50)	4.4 *1.7* *1.1*	4.2 *1.7* *0.7*	4.2 *1.9* *0.4*	4.6 *2.0* *0.5*	24 *18* *3* *3*	25 *19* *3* *3*	28 *19* *4* *5*	29 *22* *2* *5*
64. Römisch-Germanisches Zentralmuseum (RGZM) – Forschungsinstitut für Vor- und Frühgeschichte	BMI chapter 04 05 (50:50)	9.0 *2.9* *4.8*	9.3 *2.9* *3.7*	9.4 *3.1* *3.7*	9.6 *3.2* *3.7*	118 *78* *6* *34*	119 *77* *7* *35*	117 *75* *6* *36*	117 *75* *6* *36*
65. Zentralstelle für Psychologische Information und Dokumentation (ZPID) an der Universität Trier	BMG chapter 15 02 (50:50)	2.9 *1.3* *0.1*	2.9 *1.3* *0.1*	3.0 *1.4* *0.0*	3.1 *1.5* *0.0*	21 *20* *1* *0*	22 *20* *1* *1*	21 *20* *1* *0*	21 *20* *1* *0*
Saarland									
66. Institut für Neue Materialien (INM) [6]	BMBF chapter 30 02 (50:50)	30.6 - *12.6*	31.8 - *13.4*	32.4 *9.0* *13.4*	35.0 *9.8* *14.7*	195 *115* *9* *15*	194 *115* *6* *14*	186 *115* *6* *14*	193 *115* *6* *15*
Sachsen/Saxony									
67. Forschungszentrum Rossendorf e.V. (FZR)	BMBF chapter 30 02 (50:50)	97.1 *41.9* *10.6*	102.2 *42.8* *11.4*	103.6 *43.4* *12.2*	96.1 *44.1* *6.9*	567 *436* *45* *87*	557 *425* *45* *87*	569 *420* *47* *103*	571 *420* *48* *103*
68. Institut für Festkörper- und Werkstoffforschung Dresden e.V. (IFW)	BMBF chapter 30 02 (50:50)	53.0 *20.9* *11.2*	53.5 *21.5* *12.5*	65.1 *23.5* *18.2*	55.5 *21.3* *13.0*	341 *236* *17* *89*	324 *230* *15* *80*	319 *230* *14* *76*	322 *230* *23* *70*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
69. Institut für Länderkunde e.V. Leipzig (IfL)	BMVBW chapter 12 25 (50:50)	4.6 *2.2* *0.1*	4.9 *2.3* *0.2*	6.1 *2.5* *1.1*	6.1 *2.5* *1.0*	40 *35* *2* *3*	39 *35* *2* *3*	44 *35* *1* *8*	44 *35* *1* *8*
70. Institut für Oberflächenmodifizierung e.V. (IOM)	BMBF chapter 30 02 (50:50)	14.2 *4.5* *5.2*	14.0 *4.5* *4.8*	13.4 *4.5* *4.4*	16.0 *5.4* *5.0*	87 *47* *3* *36*	91 *48* *3* *40*	85 *48* *3* *34*	90 *48* *3* *39*
71. Institut für ökologische Raumentwicklung e.V. Dresden (IÖR)	BMVBW chapter 12 25 (50:50)	7.2 *3.5* *0.2*	8.0 *3.5* *0.9*	8.8 *3.7* *1.4*	9.5 *4.0* *1.5*	82 *76* *0* *6*	88 *76* *0* *11*	89 *77* *0* *12*	90 *77* *0* *13*
72. Institut für Polymerforschung Dresden e.V. (IPF)	BMBF chapter 30 02 (50:50)	29.7 *12.3* *5.1*	30.2 *12.4* *5.4*	35.4 *13.0* *9.4*	37.0 *15.1* *6.8*	230 *164* *17* *49*	217 *164* *16* *37*	234 *161* *17* *57*	228 *161* *17* *60*
73. Institut für Troposphärenforschung e.V. (IfT)	BMBF chapter 30 02 (50:50)	12.9 *5.6* *1.4*	12.8 *5.4* *1.9*	13.9 *5.7* *1.9*	12.8 *6.0* *0.9*	73 *56* *8* *9*	83 *57* *9* *17*	82 *56* *5* *21*	82 *57* *7* *18*
Sachsen-Anhalt/ Saxony-Anhalt									
74. Institut für Agrarentwicklung in Mittel- und Osteuropa (IAMO)	BML chapter 10 02 (50:50)	4.3 *2.0* *0.2*	6.7 *3.2* *0.2*	8.5 *4.1* *0.2*	5.8 *2.6* *0.5*	50 *38* *12* *1*	52 *35* *16* *1*	51 *36* *15* *0*	57 *39* *15* *3*
75. Institut für Pflanzenbiochemie (IPB)	BMBF chapter 30 02 (50:50)	17.2 *7.2* *2.9*	19.3 *8.4* *2.6*	22.5 *9.5* *3.5*	27.4 *11.7* *4.0*	133 *88* *15* *31*	124 *83* *16* *26*	123 *83* *15* *26*	134 *89* *15* *30*
76. Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK)	BMBF chapter 30 02 (50:50)	43.7 *18.1* *7.6*	49.7 *21.0* *7.7*	58.8 *25.0* *8.8*	47.0 *23.5* *9.5*	372 *242* *48* *82*	362 *240* *43* *79*	379 *236* *68* *75*	355 *240* *40* *75*
77. Institut für Wirtschaftsforschung Halle (IWH)	BMF chapter 08 02 (50:50)	7.9 *3.4* *1.0*	8.3 *3.8* *1.2*	8.4 *3.8* *0.8*	9.0 *3.9* *1.2*	68 *59* *2* *7*	72 *61.5* *2* *8.5*	72 *61* *3* *8*	73.5 *61.5* *3* *8*

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
78. Leibniz-Institut für Neurobiologie Magdeburg (IfN)	BMBF chapter 30 02 (50:50)	15.1 *6.0* *3.2*	18.6 *6.3* *6.0*	19.2 *6.5* *6.3*	17.1 *6.5* *4.0*	117 *75* *9* *32*	122 *72* *15* *34*	113 *75* *11* *27*	116 *75* *9* *32*
Schleswig-Holstein									
79. Deutsche Zentralbibliothek für Wirtschaftswissenschaften (ZBW). Kiel	BMF chapter 08 02 (50:50)	17.4 *8.1* *1.4*	23.3 *10.7* *1.3*	24.9 *13.0* *1.3*	31.7 *13.0* *1.3*	142 *115* *3* *24*	120 *108* *1* *11*	119 *107* *1* *11*	134 *110* *0* *24*
80. Forschungszentrum Borstel (FZB) Zentrum für Medizin und Biowissenschaften	BMG chapter 15 02 (50:50)	28.5 *13.0* *4.0*	26.9 *12.7* *4.7*	27.3 *13.3* *4.9*	28.9 *14.0* *5.1*	244 *182* *18* *44*	237 *176* *18* *43*	244 *175* *23* *46*	245 *176* *23* *46*
81. Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel (IPN)	BMBF chapter 30 02 (50:50)	12.2 *4.7* *2.7*	12.7 *4.6* *3.5*	11.3 *5.1* *3.1*	12.0 *5.3* *3.4*	139 *71* *40* *28*	142 *71* *41* *30*	143 *71* *41* *31*	143 *69* *42* *32*
82. Institut für Meereskunde an der Universität Kiel (IfM)	BMBF chapter 30 02 (50:50)	44.3 *13.8* *12.8*	42.2 *14.2* *9.2*	50.4 *14.8* *16.8*	51.8 *15.5* *16.8*	241 *127* *32* *82*	235 *123* *32* *80*	264 *123* *32* *109*	262 *121* *32* *109*
83. Institut für Weltwirtschaft an der Universität Kiel (IFW)	BMWi chapter 08 02 (50:50)	16.8 *5.4* *2.8*	16.8 *5.6* *2.9*	16.8 *5.6* *2.9*	18.7 *6.0* *3.3*	168 *102* *11* *55*	133 *104* *4* *25*	136 *105* *4* *27*	156 *100* *0* *56*
Thüringen/Thuringia									
84. Institut für Molekulare Biotechnologie e.V. Jena (IMB)	BMBF chapter 30 02 (50:50)	31.1 *10.5* *11.7*	35.4 *12.8* *14.5*	34.4 *11.3* *11.8*	33.0 *10.5* *12.0*	220 *114* *14* *92*	235 *106* *8* *121*	218 *101* *11* *107*	246 *116* *20* *110*

1 The Berliner-Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung mbH (BESSY II) was added to the Blue List on January 1, 2000.
2 The Deutsches Bibliotheksinstitut (DBI) was dissolved on January 1, 2000.
3 The Clinical Department of the Bernhard-Nocht-Institut für Tropenmedizin (BNI) has been estimated separately since 1998.
4 Since January 1, 1999 the HWWA-Institut für Wirtschaftsforschung has been supported as service institution with scientific competence. On July 1, 2000 the HWWA was re-established as a public law foundation and renamed "Hamburgisches Welt-Wirtschafts-Archiv".
5 Basic funding from the Federal Government includes funds of the BMBauV for the implementation of the administrative agreement BSH-IOW (1997: DM5.4 million, 2000: DM5.8 million).
6 The Institut für Neue Materialien (INM) was added to the Blue List on January 1, 1999.

Source: Federal budgets and individual institutionsg

Rounding error

6. Federal institutions performing R&D

Federal institutions performing R&D play a particular role in the German research environment. These statutory bodies without legal capacity fulfil their R&D tasks in connection with their tasks under public law. The entire range of tasks is related to the responsibilities of the Federal Ministry under whose jurisdiction they come.

Their research is therefore mainly aimed at generating scientific knowledge for the implementation of departmental tasks (departmental research); however, they also contribute to the generation of knowledge in general. The institutions differ greatly in the proportion of resources they allocate for R&D – from some estimated 10 percent to 100 percent. As a rule, the federal institutions performing R&D are exclusively financed by the Federal Government, mainly via provision of basic funding; only in exceptional cases are external funds raised for well-defined research projects.

R&D expenditure by these institutions has hardly changed over the past years; since 1995 it has been approximately DM1.3 billion or some 43 percent of their overall expenditure (cf. table VII/21a). As a proportion of the entire sector of non-university institutions, R&D expenditure by federal institutions is slightly above 10 percent.

The modernisation processes started in recent years with regard to the structure and tasks of these institutions, for example in the context of the "lean government" initiative, will be continued to make research meet current needs.

Institution	Main tasks
1. Federal Chancellery (BK)	
1.1. Stiftung Wissenschaft und Politik (SWP) *Stiftung des bürgerlichen Rechts* Zellerweg 27, 82067 Ebenhausen Tel.: 0 81 78-7 00; Fax: 0 81 78-7 03 12 E-Mail: swp@swp.extern.lrz-muenchen.de Branch: Berlin	• Integration and international relations of Europe • European and Atlantic security and defence policy • Strategic developments, arms control and technological trends • Atlantic and Pacific relations • Conflicts and structural developments in non-European regions • Non-military risks, international regimes and economic relations
2. Federal Foreign Office (AA)	
2.1. Deutsches Archäologisches Institut (DAI) Podbielskiallee 69-71, 14195 Berlin Tel.: 01888-77 11-0; Fax: 01888-77 11-168 E-Mail: verwaltung@dainst.de Internet: http://www.dainst.de Branches: Baghdad, Damascus, Sanaa, Teheran, Frankfurt/M., München, Bonn, Rome, Athens, Cairo, Istanbul, Madrid	• Classical advanced civilisations of the Old World (Mediterranean countries) • Celtic, Roman, Germanic and Slavic cultures in Central Europe • Oriental advanced civilisations • General and comparative archaeology of world cultures • Eurasian archaeology
3. Federal Ministry of the Interior (BMI)	
3.1. Bundesinstitut für ostwissenschaftliche und internationale Studien (BIOst) Lindenbornstraße 22, 50823 Köln Tel.: 02 21-5 74 70; Fax: 02 21-5 74 71 10 E-Mail: administration@biost.de Internet: http://www.biost.de	• Ice masses analysis in Antarctic regions Research on political, social and economic developments in • Russia and the successor states of the Soviet Union, • the states in Central and Eastern Europe and in South-eastern Europe • the non-European successor states of the Soviet Union • Communist third-world countries and effects of these developments on international relations

Institution	Main tasks
3.2 Bundesinstitut für Bevölkerungsforschung (BIB) Friedrich-Ebert-Allee 4, 65185 Wiesbaden Tel.: 06 11-75-22 35; Fax: 06 11-75-39 60 E-Mail: bib@statistik-bund.de Internet: http://www.bib-demographie.de	• Regular observation and analysis of demographic trends • Provision of advice to the Federal Government and representation in international organisations • Lifestyles and their influence on health and life expectancy • Family and fertility • Determinants and indicators regarding the integration of the second-generation foreigners
3.3. Bundesinstitut für Sportwissenschaft (BISp) Carl-Diem-Weg 4, 50933 Köln Tel.: 02 21-49 79-0; Fax: 02 21-49 51 64 E-Mail: info@bisp.de Internet: http://www.bisp.de	• Awarding of public research funds to sports-related science • Administration of the SPOLIT and SPOFOR databases • Implementation of research findings by means of transfer activities • Sports counselling and safeguarding of public interests in the planning of sports infrastructure and standardisation for efficient and safe facilities • International co-operation between comparable public institutions
4. Federal Ministry of Economics and Technology (BMWi)	
4.1. Physikalisch-Technische Bundesanstalt (PTB) Bundesallee 100, 38116 Braunschweig Tel.: 05 31-5 92-0; Fax: 05 31-5 92-92 92 E-Mail: presse@ptb.de Internet: http://www.ptb.de Branch: Berlin	• Research and development in all areas of physical and technical metrology and safety technology (explosion prevention) • Realisation and dissemination of SI-units using quantum effects and traceability to fundamental constants • Precision measurement of physical constants • R&D on the dissemination of units in industrial (also Deutscher Kalibrierdienst) and legal metrology (also environmental and consumer protection)
4.2. Bundesanstalt für Materialforschung und -prüfung (BAM) Unter den Eichen 87, 12205 Berlin Tel.: 0 30-81 04-0; Fax: 0 30-8 11 20 29 E-Mail: info@bam.de Internet: http://www.bam.de Branches: Berlin-Adlershof, open air testing site, Horstwalde	• Analytical chemistry • Public technical safety • Environmental compatibility • Materials technology • Technical and scientific service functions
4.3. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) Stilleweg 2, 30655 Hannover Tel.: 05 11-6 43-0; Fax: 05 11-6 43-23 04 E-Mail: public.relations.bgr-nlfb@bgr.de Internet: http://www..bgr.de Branch: Berlin	• Mineral resources and energy-producing raw materials • Geo-environmental research • Geo-risk research • Scientific and technological co-operation with developing countries

Institution	Main tasks
5. Federal Ministry of Food, Agriculture and Forestry (BML)	
5.1. Bundesforschungsanstalt für Landwirtschaft (FAL) Bundesallee 50, 38116 Braunschweig Tel.: 05 31-59 61; Fax: 05 31-59 68 14 E-Mail: christopher.otto@fal.de Internet: http://www.fal.de Branches: Mariensee near Neustadt am Rübenberge with Mecklenhorst and Trenthorst/Wulmenau; Celle with Höfer and Merbitz; Müncheberg	• Conservation and maintenance of natural resources in agricultural ecosystems, of phytogenetical and animal genetic resources • Further development of vegetable and animal food and raw material production and of product quality • Socio-economic research on action by target groups of agricultural policy • Analysis, impact assessment and evaluation of future developments in agriculture and in rural areas
5.2. Biologische Bundesanstalt für Land- und Forstwirtschaft Berlin/Braunschweig (BBA) Messeweg 11/12, 38104 Braunschweig Tel.: 05 31-29 95; Fax: 05 31-2 99 30 01 E-Mail: pressestelle@bba.de Internet: http://www.bba.de Branches: Berlin, Darmstadt, Dossenheim, Bernkastel-Kues, Kleinmachnow, Münster	• Phytopathology • Integrated plant protection • Genetic engineering • Ecosystem • Consumer protection
5.3. Bundesanstalt für Milchforschung (BAfM) Hermann-Weigmann-Straße 1, 24103 Kiel Tel.: 04 31-60 91; Fax: 04 31-60 92 22 2 E-Mail: bafm@bafm.de Internet: http://www.bafm.de	• Chemistry and technology • Microbiology • Hygiene • Physiology and biochemistry of nutrition • Food economy
5.4. Bundesforschungsanstalt für Fischerei (BFAFi) Palmaille 9, 22767 Hamburg Tel.: 0 40-38 90 50; Fax: 0 40-38 90 52 00 E-Mail: 100565.1223@compuserve.com Internet: http://www.dainet.de/bfafi Branches: Rostock, Ahrensburg, Cuxhaven	• Biological monitoring of fish stocks (sea) • Effects of environmental changes on fishery • Fishery ecology / ecosystem (sea) • Fishery technology • Fish and fishery products (food law)
5.5. Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH) Leuschnerstraße 91, 21031 Hamburg Tel.: 0 40-73 96 20; Fax: 0 40-73 96 24 80 E-Mail: bfafh@aixh0001.holz.uni-hamburg.de Internet: http://www.dainet.de/bfh Branches: Großhansdorf, Eberswalde, Waldsieversdorf	• World forestry including tropical forest research, survey of forest damage • Forest ecology, forest genetics and forest plant breeding • Forest economy, life cycle analysis • Market situation for wood, wood products and paper • Wood biology and wood protection • Wood physics and wood technology • Wood chemistry and wood pulping methods
5.6. Bundesanstalt für Getreide-, Kartoffel- und Fettforschung (BAGKF) Schützenberg 12, 32756 Detmold Tel.: 0 52 31-74 10; Fax: 0 52 31-74 11 00 E-Mail: post.bagkf@t-online.de Internet: http://www.dainet.de/bagkf Branch: Münster	• Cereal research • Potato and starch research • Fats and oils • Renewable resources • Food analytics

Institution	Main tasks
5.7. Bundesforschungsanstalt für Viruskrankheiten der Tiere (BFAV) Boddenblick 5a, 17498 Insel Riems Tel.: 0 38 351-70; Fax: 0 38 351-71 51 E-Mail: bfav@rie.bfav.de Internet: http://www.dainet.de/bfav Branches: Tübingen, Wusterhausen	• Virology • Bacteriology • Parasitology • Immunology • Epidemiology
5.8. Bundesanstalt für Fleischforschung (BAFF) E. C.-Baumannstraße 20, 95326 Kulmbach Tel.: 0 92 21-80 31; Fax: 0 92 21-80 32 44 E-Mail: baff@compuserve.com Internet: http://www.dainet.de/baff	• Product quality • Product safety • Animal protection • Registration of slaughter value • Quality management
5.9. Bundesforschungsanstalt für Ernährung (BFE) Haid-und-Neu-Straße 9, 76131 Karlsruhe Tel.: 07 21-6 62 50; Fax: 07 21-6 62 51 11 E-Mail: al.bfe@bfe.uni-karlsruhe.de Internet: http://www.dainet.de/bfe	• Nutritional science • Food processing • Food microbiology • Food quality • Nutritional behaviour
5.10. Bundesanstalt für Züchtungsforschung an Kulturpflanzen (BAZ) Neuer Weg 22/23, 06484 Quedlinburg Tel.: 0 39 46-47 0; Fax: 0 39 46-47 255 E-Mail: bafz-al@bafz.de Internet: http://www.bafz.de Branches: Aschersleben, Dresden, Groß Lüsewitz, Siebeldingen, Ahrensburg, Braunschweig	• Cultivation research for the production of healthy basic material • Cultivation research for the provision of basic material of improved quality for use as food and industrial plant • Cultivation methods for improvement of selection • Cultivation methods for use and development of genetic variability
5.11. Zentralstelle für Agrardokumentation und -information (ZADI) Am Michaelishof 4b, 53177 Bonn Tel.: 02 28-93 45 20; Fax: 02 28-3 68 05 19 E-Mail: zadi@zadi.de Internet: http://www.zadi.de	• Tapping of genetic resources • Information management, services and co-ordination in the area of food, agriculture and forestry (FIS-ELF specialised food, agriculture and foresty information system) • Operation of the German Agroinformation Network (DAINet) • Operation of the Information System for Genetic Resources (GENRES) • Systems analysis and information technology methods and techniques in information management
6. Federal Ministry of Labour and Social Affairs (BMA)	
6.1. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA) Friedrich-Henkel-Weg 1–25, 44149 Dortmund Tel.: 02 31-90 71-0; Fax: 02 31-90 71-4 54 E-Mail: grundsatz@baua.de Internet: http://www.baua.de Locations: Berlin, Dresden, Chemnitz, Bremen	• Analysis, evaluation and minimisation of hazards • Information about and control of work-related diseases • Design of work systems in accordance with human needs • Quality and efficiency in occupational safety and health

Institution	Main tasks
6.2. Institut für Arbeitsmarkt- und Berufsforschung der Bundesanstalt für Arbeit (IAB) *Selbstverwaltungskörperschaft mit staatlicher Rechtsaufsicht* Regensburger Straße 104, 90478 Nürnberg Tel.: 09 11-1 79-0; Fax: 09 11-1 79-32 58 E-Mail: iab.ba@t-online.de Internet: http://www.iab.de	• Fulfilment of tasks pursuant to the Social Code III • Short- and medium-term labour market projections • Research on changes in the labour force • Research on employment opportunities and labour market risks of groups of persons • IAB-Establishment Panel (companies and jobs) • Research on the effects of labour market policy
7. Federal Ministry of Defence (BMVg)	
7.1. Forschungsgesellschaft für Angewandte Naturwissenschaften e.V. (FGAN) Neuenahrer Straße 20 53343 Wachtberg-Werthhoven Tel.: 02 28-94 35-0 Fax: 02 28-34 35-617 E-Mail: dornhaus@fgan.de Internet: http://www.fgan.de	• Radar technology • Optronics • Information processing and communication • Image processing and pattern recognition • Ergonomics
7.2. Forschungsanstalt der Bundeswehr für Wasserschall- u. Geophysik (FWG) Klausdorfer Weg 2–24, 24148 Kiel Tel.: 04 31-6 07-0; Fax: 04 31-6 07-41 50 E-Mail: fwg@fwg-kiel.de	• Underwater sound: environment-related conditions of sound propagation in the sea • Geophysics: characteristics of sea surface, layers and the sea bed • Defence research vessel PLANET • SONAR processes
7.3. Wehrwissenschaftliches Institut für Schutz-technologien – ABC-Schutz (WIS) Humboldtstraße, 29633 Munster Tel.: 0 51 92-1 36-0; Fax: 0 51 92-1 36-3 55 E-Mail: wis@bwb.org	• Protection from ABC weapon effects • Fire protection equipment for the German Federal Armed Forces • New and improved processes for purification of drinking water • Reclamation of contaminated areas with conventional and biological methods • Verification methods for the Agreement on Chemical Weapons
7.4. Wehrwissenschaftliches Institut für Werk-, Explosiv- und Betriebsstoffe (WIWEB) [1] Landshuter Straße 70, 85435 Erding Tel.: 0 81 22-57-1; Fax: 0 81 22-57-3 12 E-Mail: wiweb@bwb.org Branches: Kiel, Wilhelmshaven, Swisttal	• Testing techniques and methods for materials, explosives and petroleum, oils and lubricants • Lightweight materials (Al-foam, MMC, CFC), properties and damage tolerance • High-temperature materials for high-velocity missiles • Explosives, qualification and determination of safety requirements • Lubricants, application-oriented further development

Institution	Main tasks
8. Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ)	
8.1. Deutsches Jugendinstitut e.V. (DJI) Nockherstraße 2, 81541 München Tel.: 0 89-6 23 06-0; Fax: 0 89-6 23 06-1 62 E-Mail: dji@dji.de Internet: http://www.dji.de Außenstellen: Leipzig	• Continuous observation of situations in life in the areas of family, youth, children, women • Continuous observation of state and intermediary forms of aid in the above-mentioned areas • Research on particular problems and topical social issues • Implementation of practice assistance and evaluation projects under the Child and Youth Services Act (KJHG) • Practice counselling and networking, documentation and dissemination of information and materials from the working areas
9. Federal Ministry for Health (BMG)	
9.1. Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (BgVV) Thielallee 88–92, 14195 Berlin Tel.: 0 30-84 12-0; Fax: 0 30-84 12-47 41 E-Mail: pressestelle@bgvv.de Internet: http://www.bgvv.de Außenstellen: Dessau, Jena	• Securing of health protection • Registration and evaluation of hygienic and micro-biological risks in the food industry • Healthy nutrition • Licensing and registration of veterinary drugs • Registration and evaluation of methods replacing and supplementing animal experiments
9.2. Robert Koch-Institut (RKI) Bundesinstitut für Infektionskrankheiten und nicht übertragbare Krankheiten Nordufer 20, 13353 Berlin Tel.: 0 30-45 47-4; Fax: 0 30-45 47-23 28 E-Mail: forschung@rki.de Internet: http://www.rki.de Außenstelle: Wernigerode	• Epidemiology, clinical treatment and pathogenesis of selected viral, bacterial parasitogenic infectious diseases • Epidemiology and surveillance of infectious diseases and non-transmissable diseases and their risks • Mechanisms of immune response and secondary effects of infections • Risk and safety assessment for genetically modified organisms and genetic methods
9.3. Bundesinstitut für Arzneimittel und Medizinprodukte (BfArM) Friedrich-Ebert-Allee 38, 53113 Bonn Tel.: 0228-207-30; Fax: 0228-207-5207 E-Mail: poststelle@bfarm.de Internet: htpp://www.bfarm.de Außenstelle: Berlin	• Licensing of ready-to-use drugs; risk identification and assessment for drugs and implementation of adequate measures according to a phased plan • Registration of homeopathic drugs • Surveillance of narcotics trafficking • Monitoring of basic substances • Medical products (central risk registration and coord.) • Scientific research
9.4. Paul-Ehrlich-Institut – Bundesamt für Sera und Impfstoffe – (PEI) Paul-Ehrlich-Straße 51–59, 63225 Langen/Hessen Tel.: 0 61 03-77-0; Fax: 0 61 03-77-12 34 E-Mail: s.stoecker@em.uni-frankfurt.de Internet: pei@pei.de	• Immunopathogenesis of HIV/SIV infection • Molecular analysis and biological significance of human endogenous retroviruses • Molecular and cellular regulation of immune response • Virus safety of blood products • Molecular characterisation of allergens • Retroviral vectors for gene therapy

Institution	Main tasks
9.5. Deutsches Institut für medizinische Dokumentation und Information (DIMDI) Weißhausstraße 27, 50939 Köln Tel.: 02 21-47 24-1; Fax: 02 21-41 14 29 E-Mail: ky@dimdi.de Internet: http://www.dimdi.de	Research support by provision of related specialised information databases for the areas of • Medicine, healthcare • Biosciences • Social sciences • Drugs, medical products • Classification systems
10. Federal Ministry of Transport, Building and Housing (BMVBW)	
10.1. Bundesanstalt für Straßenwesen (BASt) Brüderstraße 53, 51427 Bergisch Gladbach Tel.: 0 22 04-43-0; Fax: 0 22 04-43-6 73 E-Mail: info@bast.de Internet: http://www.bast.de	• Low-cost and functional road construction and maintenance • Efficient road use • Analysis of accidents and their causes • Traffic safety • Environmental protection in road construction and operation
10.2. Bundesanstalt für Gewässerkunde (BfG) Kaiserin-Augusta-Anlagen 15–17 56068 Koblenz Tel.: 02 61-13 06-0; Fax: 02 61-13 06-53 02 E-Mail: posteingang@bafg.de Internet: http://www.bafg.de Branch: Berlin	• Recording and evaluation of quantitative and qualitative hydrologic conditions along Federal waterways • Recording and evaluation of ecological conditions along Federal waterways • Measuring programme for monitoring water quality in cross-border waters • Basis for future-oriented, ecological management in the Elbe catchment area
10.3. Bundesanstalt für Wasserbau (BAW) Kußmaulstraße 17, 76187 Karlsruhe Tel.: 07 21-97 26-0; Fax: 07 21-97 26-4 54 E-Mail: info@karlsruhe.baw.de Internet: http://www.karlsruhe.baw.de Branches: Berlin, Hamburg	• Special scientific services for the Federal Waterways and Shipping Administration (WSV) • Norms and technical standards • Applied research • Testing agency in the following areas: building materials, geotextiles, frost-resistance corrosion protection • Development of basis for IT use at WSV, IT process development, IT services
10.4. Deutscher Wetterdienst (DWD) Frankfurter Straße 135, 63067 Offenbach/M. Tel.: 0 69-80 62-0; Fax: 0 69-80 62-44 84 E-Mail: info@dwd.de Internet: http://www.dwd.de Branches: Hohenpeißenberg, Lindenberg, Potsdam, Braunschweig, Berlin	• Numerical weather analysis and forecasting / spreading of air pollution • Monitoring of the atmosphere: physical structure, chemical composition • Climate diagnosis • Applied meteorology: synoptics, general climatology, agro- and hydrometeorology, medical meteorology
10.5. Bundesamt für Seeschiffahrt und Hydrographie (BSH) Bernhard-Nocht-Straße 78, 20359 Hamburg Tel.: 0 40-31 90-0; Fax: 0 40-31 90-50 00 E-Mail: posteingang-hh@bsh.d400.de Internet: http://www.bsh.de Branch: Rostock	• Marine environmental protection • Marine research • Testing and certification of nautical instruments and equipment • Nautical and hydrographic services • Nautical engineering research

Institution	Main tasks
10.6. Institut für Erhaltung und Modernisierung von Bauwerken e.V. (IEMB) Salzufer 14, 10587 Berlin Tel.: 0 30-39 92 16; Fax: 0 30-3 99 21-8 50-8 50 E-Mail: zentrale@iemb.de Internet: http://www.iemb.de	• Preservation and modernisation of buildings, in particular of panel buildings • Further development of panel building estates • Energy-related modernisation of buildings • Environmentally friendly building and modernisation • Cost-efficient building and modernisation
10.7. Bundesamt für Bauwesen und Raumordnung (BBR) [2] Deichmanns Aue 31-37, 53179 Bonn Tel.: 01 88-84 01-0; Fax: 01 88-84 01-1270 E-Mail: florian.mausbach@bbr.bund.de Internet: http://www.bbr.bund.de Branch: Berlin	• Sustainable regional and settlement development • Sustainable urban development • Housing provision • Regional development in Europe • Regional information system • Transfer tasks
11. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	
11.1. Umweltbundesamt (UBA) Bismarckplatz 1, 14193 Berlin Tel.: 0 30-89 03-0; Fax: 0 30-89 03-22 85 E-Mail: nicole.kobosil@uba.de Internet: http://www.umweltbundesamt.de Branch: Berlin-Spandau	• Generic issues of environmental protection • Climate protection, air pollution control and noise protection • Waste and water management • Soil protection, reclamation of contaminated soils • Environmental and health research, safe chemicals
11.2. Bundesamt für Naturschutz (BfN) Konstantinstraße 110, 53179 Bonn Tel.: 02 28-84 91-0; Fax: 02 28-84 91-2 00 E-Mail: pbox-bfn@bfn.de Internet: http://www.bfn.de Branches: Insel Vilm, Leipzig	• Analysis of hazards and protection of animals, plants and biotopes • Environment observation oriented to nature conservation and information on nature conservation • Models for landscapes and biotope networks • Environmentally sound development of the Federal Transport Infrastructure Plan and post-mining landscapes • Landscape planning, regulation of interference and area protection • Nature conservation support projects by the Federal Government
11.3. Bundesamt für Strahlenschutz (BfS) Willy-Brandt-Straße 5, 38226 Salzgitter Tel.: 0 53 41-8 85-0; Fax: 0 53 41-8 85-8 85 E-Mail: lebermann@bfs.de Internet: http://www.bfs.de Branches: Neuherberg/München, Freiburg, Berlin, Braunschweig, Bonn, Hanau	• Radiation protection • Nuclear safety • Disposal of radioactive waste • Emergency provision • Research on radiation effects and hygiene
12. Federal Ministry of Education and Research (BMBF)	
12.1. Kunsthistorisches Institut Florenz (KHI) Via G. Giusti 44, I-50121 Firenze Tel.: 00 39 55-2 49 11-1; Fax: 00 39 55-24 43 94 E-Mail: verwaltung@khi.fi.it Internet: http://www.khi.fi.it	• Interdisciplinary research on Renaissance art (together with Romance scholars, historians and philosophers) • Art topography in Tuscany, in particular in Siena and Lucca • New technologies in the humanities • Individual research on Italian art from the Middle Ages to present times • Florentine Renaissance villas

Institution	Main tasks
12.2. Deutsches Historisches Institut in Paris (DHI Paris) 8, rue du Parc-Royal, F-75003 Paris Tel: 00 33-142 71 56 16; Fax: 00 33-142 71 56 43 E-Mail: direktor@dhi-paris.fr E-Mail: bibliothek@dhi-paris.fr E-Mail: verwaltung@dhi-paris.fr Internet: http://www.dhi-paris.fr	• Social history of late Antiquity and the early Middle Ages in Gaul • Papal documents in France • France in Europe between humanism and absolutism • German occupation of France 1940-1944 • Franco-German trade relations in the 20th century
12.3. Deutsches Historisches Institut in Rom (DHI Rom) Via Aurelia Antica, 391, I-00165 Roma Tel.: 0 03 96-06 66 04 921; Fax: 0 03 96-06 66 23 838 E-Mail: postmaster@dhi-roma.it Internet: www.dhi-roma.it	• Research on Italo-German relations in the Middle Ages and in the modern age • Edition of nuncio reports, Repertorium Germanicum (German persons and places in papal registries), Italia Pontificia (papal documents)
12.4. Deutsches Historisches Institut in London (DHI London) *Stiftung des bürgerlichen Rechts* 17 Bloomsbury Square, GB-London WC 1A2 LP Tel.: 0 044-20 74 04 5486 Fax: 0 044-20 74 04 5573 E-Mail: ghil@ghil.co.uk Internet: http://www.ghil.co.uk	• British-German relations, in particular: English legation reports (1815 – 1871) and British occupation policy after 1945 • Empire and Commonwealth • English social history
12.5. Deutsches Historisches Institut in Washington D.C. (DHI Washington) *Stiftung des bürgerlichen Rechts* 1607 New Hampshire Avenue, N.W., Washington D.C. 20009/USA Tel.: 00 12 02-3 87 33 55; Fax: 00 12 02-4 83 34 30 E-Mail: dhiusa@idt.net	• Comparative research on political, social cultural and intellectual developments in Germany and the US • Germany and the United States during the Cold War • German-American relations in an international context • Individual studies on social history and political history of the US and Germany
12.6. Deutsches Historisches Institut in Warschau (DHI Warschau) *Stiftung des bürgerlichen Rechts* Palac Kultury i Nauki, Plac Defilad 1, skr. 33 PL-00-901 Warszawa, Tel.: 00 48-22 65 67 183; Fax: 00 48-22 69 37 006 E-Mail: ziemer@dhi.waw.pl Internet: http://www.dhi.waw.pl	• Research on German-Polish relations, issues of comparative history of Germany and Poland and historiography • Publication of research results and sources concerning German-Polish relations • Establishing of scientific contacts between Poland and Germany and with scientific institutions of other states
12.7. Deutsches Institut für Japanstudien in Tokyo (DIJ Tokyo) *Stiftung des bürgerlichen Rechts* Nissei Kojimachi Bldg. F 2 Kudan-Minami 3-3-6, Chiyoda-ku, 102-0074 Tokyo/Japan Tel.: 0 08 13-32 22 50 77 Fax: 0 08 13-32 22 54 20 E-Mail: dijtokyo@dijtokyo.org Internet: http://www.dijtokyo.org	• Research on modern Japan and German-Japanese relations in the humanities, social sciences and in economics • Transfer of Japanese research results to Germany • Support of young scientists • Awarding of fellowships • Organisation of conferences and meetings • Counselling, information and establishing of scientific contacts

Institution	Main tasks
12.8. Orient-Institut Beirut der Deutschen Morgenländischen Gesellschaft e.V. (OI Beirut) Rue Hussein Beyhum, P.O.B. 2988, Beirut/Libanon Tel.: 00 96 11 37 29 40; Fax: 00 96 11 37 65 99 E-Mail: oib@netgate.com.lb Branch: Istanbul	• Ethnogenesis in the Middle East and in the Turk-speaking area in Central Asia • Urbanisation processes in the Middle East • Literature sociology and history of the literatures of the Middle East • Standardisation and change of standards a) in the media b) in education
12.9. Stiftung Deutsch-Amerikanisches Akademisches Konzil (DAAK) *Stiftung des bürgerlichen Rechts* Jean-Paul-Straße 9, 53173 Bonn Tel.: 02 28-9 56 77-0; Fax: 02 28-9 56 77-19 E-Mail: kontakt@gaac.org Internet: http://www.gaac.org Branch: Washington D.C. (USA)	• Political counselling studies on social political, technological issues of modern industrialised societies • Programmes for the promotion of networks between young German and American scientists • Public symposiums on priority issues of the Council
12.10. Bundesinstitut für Berufsbildung (BIBB) *Bundesunmittelbare Körperschaft des öffentlichen Rechts* Hermann-Ehlers-Straße 10, 53043 Bonn Tel.: 0228-107-0; Fax: 0228-107-2977 E-Mail: zentrale@bibb.de Internet: http://www.bibb.de	• Mobility and professional career paths for professionally qualified people • New occupations • New fields for employment • Individualisation and differentiation of vocational training by curricular, organisational and didactic measures
13. Federal Ministry of Economic Cooperation and Development (BMZ)	
13.1. Deutsches Institut für Entwicklungspolitik gGmbH (DIE) Tulpenfeld 4, 53113 Bonn Tel.: 0228-94927-0; Fax: 0228-94927-23 E-Mail: die-berlin@die-gdi.de Internet: http://www.die-gdi.de	• Concepts and instruments of bilateral and multilateral development co-operation • Political and social framework conditions, protection of human rights, democratisation • Improving the economic performance of developing countries • Crisis and conflict prevention, refugee and migration issues • Environmental policy and sustainable use of resources • Increased participation and self-help in connection with structural adaptation measures • Training of university graduates for professional practice in development policy

* Basic funding from the Federal Government (including Special Funding Programme for Higher Education and Research).

** After the re-design of tasks, this institution does no longer do research.

1 Since January 1, 1997, the former Bundesinstitut für chemisch-technische Untersuchungen at the Bundesamt für Wehrtechnik und Beschaffung (BICT) has been part of the Wehrwissenschaftliches Institut für Werk-, Explosiv- und Betriebsstoffe (WIWEB). Staff data for 1995 and 1996 estimated.

2 On January 1, 1998, the Bundesamt für Bauwesen und Raumordnung (BBR) was established by merging the BBD and BfLR on the basis of the law of December 15, 1997 (BGBl. I, page 2902). The BBR continues the tasks of BBD and BfLR with a new focus.

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
1. Federal Chancellery (BK)									
1.1. Stiftung Wissenschaft und Politik (SWP)	BK chapter 04 02	17.0 *14.6 ** *2.4*	17.9 *14.4 ** *3.5*	. *15.3 ** .	. *15.5 ** .	118 *111* *5* *2*	115 *108* *5* *2*	. *107* *5* .	. *107* *5* .
2. Federal Foreign Office (AA)									
2.1. Deutsches Archäologisches Institut (DAI)	AA chapter 05 11	44.2 *42.5* *1.7*	45.0 *42.6* *2.4*	46.5 *43.7* 2.8	46.5 *43.7* 2.8	339 *253* *64* *22*	329 *250* *53* *26*	338 *251* *60* 27	338 *256* *60* 27
3. Federal Ministry of the Interior (BMI)									
3.1. Bundesinstitut für ostwissenschaftliche und internationale Studien (BIOst)	BMI chapter 06 34	8.1 *8.0* *0.1*	7.9 *7.7* *0.2*	. *8.4* .	. *9.3* .	78 *74* *1* *3*	73 *69* *1* *3*	. *64* *1* .	. *67* *0* .
3.2 Bundesinstitut für Bevölkerungsforschung (BIB)	BMI chapter 06 17	2.4 *2.3* *0.1*	2.3 *2.3* *0.0*	. *2.6* .	. *2.7* .	20 *19* *0* *1*	18 *18* *0* *0*	. *18* *0* .	. *19* *0* .
3.3. Bundesinstitut für Sportwissenschaft (BISp)	BMI chapter 06 18	11.7 *11.7* *0.0*	12.6 *12.6* *0.0*	. *13.0* .	. *12.2* .	54 *53* *1* *0*	61 *60* *1* *0*	. *60* *2* .	. *68* *1* .
4. Federal Ministry of Economics and Technology (BMWi)									
4.1. Physikalisch-Technische Bundesanstalt (PTB)	BMWi chapter 09 03	252.7 *234.8* *17.9*	240.3 *225.5* *14.8*	241.6 *249.1* 13.1	243.1 *242.6* 13.0	1715 *1568* *56* *91*	1625 *1510* *33* *82*	1661 *1508* *43* 110	1633 *1493* *40* 100
4.2. Bundesanstalt für Materialforschung und -prüfung (BAM)	BMWi chapter 09 07	200.3 *185.7* *14.6*	191.2 *177.2* *14.0*	193.4 *180.4* 13.0	200.2 *186.2* 14.0	1566 *1337* *91* *138*	1572 *1299* *103* *170*	1515 *1291* *116* 108	1482 *1249* *125* 108

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds* 1997 Actual	1998 Actual	1999 Budget / Estimate	2000 Budget / Estimate	Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff* 1997 Actual as of June 30	1998 Actual as of June 30	1999 Actual as of June 30	2000 Budget / Estimate
4.3. Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)	BMWi chapter 09 09	125.6 *98.2* *27.4*	120.7 *96.4* *24.3*	122.6 *102.5* 20.4	119.3 *99.8* 20.0	748 *659* *33* *57*	715 *645* *13* *57*	693 *645* *8* 40	702 *674* *16* 41
5. Federal Ministry of Food, Agriculture and Forestry (BML)									
5.1. Bundesforschungsanstalt für Landwirtschaft Braunschweig-Völkenrode (FAL)	BML chapter 10 10	94.7 *90.8* *3.9*	85.6 *82.2* *3.4*	84.7 *81.8* 2.9	. *74.3* .	1136 *814* *200* *122*	1090 *770* *200* *120*	952 *683* *149* 120	880 *661* *100* 119
5.2. Biologische Bundesanstalt für *Land*- und Forstwirtschaft Berlin/Braunschweig (BBA)	BML chapter 10 10	78.7 *74.2* *4.5*	74.8 *70.5* *4.3*	75.2 *70.0* 5.2	. *61.7* .	728 *647* *38* *43*	700 *633* *31* *35*	665 *600* *30* 35	657 *595* *27* 35
5.3. Bundesanstalt für Milchforschung (BAfM)	BML chapter 10 10	27.7 *26.1* *1.6*	26.3 *24.4* *1.9*	24.1 *21.9* 2.2	. *19.1* .	221 *203* *2* *17*	199 *182* *1* *16*	194 *177* *2* 15	186 *169* *2* 15
5.4. Bundesforschungsanstalt für Fischerei (BFAFi)	BML chapter 10 10	21.4 *19.9* *1.5*	21.6 *20.2* *1.5*	21.5 *19.7* 1.8	. 16.8 .	248 *206* *22* *20*	246 *205* *20* *22*	235 *192* *20* 23	235 *189* *25* 21
5.5. Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH)	BML chapter 10 10	27.0 *21.9* *5.1*	25.8 *20.9* *4.9*	27.1 *21.6* 5.5	. *19.7* .	275 *212* *5* *58*	269 *203* *6* *60*	270 *203* *6* 61	270 *200* *8* 62
5.6. Bundesanstalt für Getreide-. Kartoffel- und Fettforschung (BAGKF)	BML chapter 10 10	17.1 *16.5* *0.6*	16.4 *15.6* *0.8*	16.7 *15.8* 0.9	. 13.2 .	182 *165* *4* *13*	176 *155* *5* *17*	169 *149* *2* 18	165 *146* *2* 17
5.7. Bundesforschungsanstalt für Viruskrankheiten der Tiere (BFAV)	BML chapter 10 10	37.2 *34.7* *2.5*	41.1 *37.7* *3.7*	35.2 *30.8* 4.4	. 29.9 .	404 *347* *15* *42*	377 *328* *13* *36*	374 *324* *11* 39	366 *317* *8* 41
5.8. Bundesanstalt für Fleischforschung (BAFF)	BML chapter 10 10	15.9 *13.5* *2.4*	17.5 *15.7* *1.8*	17.3 *15.3* 2.0	. 9.9 .	129 *103* *0* *27*	121 *97* *0* *25*	117 *91* *0* 26	117 *92* *0* 25

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds* **1997** Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff* **1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
5.9. Bundesforschungsanstalt für Ernährung (BFE)	BML chapter 10 10	48.0 *47.0* *1.0*	43.6 *42.6* *1.0*	35.3 *34.2* 1.1	. 13.6 .	176 *168* *0* *8*	165 *159* *0* *6*	160 *153* *0* 7	165 *156* *0* 9
5.10. Bundesanstalt für Züchtungsforschung an Kulturpflanzen (BAZ)	BML chapter 10 10	49.1 *46.6* *2.5*	49.0 *46.0* *3.0*	44.4 *42.1* 2.3	. 35.5 .	513 *456* *29* *28*	499 *430* *22* *47*	495 *418* *28* 49	478 *405* *25* 48
5.11. Zentralstelle für Agrardokumentation und -information (ZADI)	BML chapter 10 10	5.0 *4.8* *0.2*	5.8 *5.0* *0.8*	7.2 *5.6* 1.6	. 4.7 .	48 *42* *2* *4*	49 *44* *2* *3*	51 *45* *3* 3	50 *44* *3* 3
6. Federal Ministry of Labour and Social Affairs (BMA)									
6.1. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)	BMA chapter 11 04	89.4 *88.2* *1.2*	94.6 *93.9* *0.7*	. *95.6* .	. *90.9* .	538 *535* *22* *4*	564 *542* *18* *4*	. *543* *20* .	. *558* *20* .
6.2. Institut für Arbeitsmarkt- und Berufsforschung der Bundesanstalt für Arbeit (IAB)	BMA	. . .	. . .	. . .	. . .	118 *108* *0* *10*	121 *111* *0* *11*	. *111* *0* .	. *110* *0* .
7. Federal Ministry of Defence (BMVg)									
7.1. Forschungsgesellschaft für Angewandte Naturwissenschaften e.V. (FGAN)	BMVg chapter 14 20	70.1 *46.2 ** *24.2*	71.1 *46.5 ** *24.8*	. *47.9 ** .	. *48.3 ** .	432 *316* *0* *116*	426 *311* *0* *115*	. *309* .	. *309* .
7.2. Forschungsanstalt der Bundeswehr für Wasserschall- u. Geophysik (FWG)	BMVg chapter 14 21	20.1 *20.1* *0.0*	20.1 *20.1* *0.0*	. *20.2* .	. *20.2* .	143 *143* *0* *0*	143 *143* *0* *0*	. *143* *0* .	. *143* *0* .
7.3. Wehrwissenschaftliches Institut für Schutztechnologien – ABC-Schutz (WIS)	BMVg chapter 14 21	56.4 *56.4* *0.0*	49.1 *49.1* *0.0*	. *51.1* .	. *52.0* .	342 *342* *0* *0*	292 *292* *0* *0*	. *284* *0* .	. *284* *0* .

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds* 1997	1998	1999	2000	Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff* 1997	1998	1999	2000
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
7.4. Wehrwissenschaftliches Institut für Werk-. Explosiv- und Betriebsstoffe (WIWEB) [1]	BMVg chapter 14 21	29.6 *29.6* *0.0*	28.8 *28.8* *0.0*	. *31.7* .	. *32.0* .	345 *345* *0* *0*	326 *326* *0* *0*	. *326* *0* .	. *326* *0* .
8. Federal Ministry for Family Affairs, Senior Citizens, Women and Youth (BMFSFJ)									
8.1. Deutsches Jugendinstitut e.V. (DJI)	BMFSFJ chapter 17 02	21.7 *14.6 ** *7.1*	23.5 *14.9 ** *8.6*	25.2 *15.3 ** 9.9	. *15.8 ** .	153 *106* *6* *42*	163 *105* *8* *50*	179 *104* *11* 64	. *105* *14* .
9. Federal Ministry for Health (BMG)									
9.1. Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (BgVV)	BMG chapter 15 12	117.1 *113.4* *3.7*	120.1 *115.8* *4.3*	. *116.5* .	. *118.5* .	756 *737* *8* *11*	762 *737* *10* *15*	. *717* *12* .	. *739* *10* .
9.2. Robert Koch-Institut (RKI)	BMG chapter 15 11	77.0 *75.3* *1.7*	83.3 *81.4* *1.9*	. *78.0* .	. *80.4* .	613 *491* *6* *5*	610 *482* *6* *7*	. *486* *8* .	. *493* *6* .
9.3. Bundesinstitut für Arzneimittel und Medizinprodukte (BfArM)	BMG chapter 15 10	85.5 *85.1* *0.4*	89.2 *88.8* *0.4*	115.0 *114.7* 0.3	. *194.0* .	766 *759* *3* *4*	769 *760* *4* *5*	. *748* *4* .	. *786* *4* .
9.4. Paul-Ehrlich-Institut – Bundesamt für Sera und Impfstoffe – (PEI)	BMG chapter 15 06	74.0 *71.3* *2.7*	78.3 *75.2* *3.1*	104.2 *100.8* 3.4	85.9 *82.3* 3.6	465 *405* *34* *26*	488 *413* *37* *38*	495 *418* *37* 40	514 *435* *37* 42
9.5. Deutsches Institut für medizinische Dokumentation und Information (DIMDI)	BMG chapter 15 05	30.2 *30.2* *0.0*	24.3 *24.3* *0.0*	. *24.8* .	. *25.3* .	90 *88* *0* *2*	90 *88* *0* *2*	. *88* *0* .	. *92* *0* .
10. Federal Ministry of Transport, Building and Housing (BMVBW)									
10.1. Bundesanstalt für Straßenwesen (BASt)	BMVBW chapter 12 11	59.2 *55.1* *4.1*	58.8 *54.0* *4.8*	. *63.5* .	. *57.4* .	375 *353* *13* *9*	361 *345* *7* *9*	. *339* *0* .	. *362* *0* .

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997 Actual	**1998** Actual	**1999** Budget / Estimate	**2000** Budget / Estimate	**1997** Actual as of June 30	**1998** Actual as of June 30	**1999** Actual as of June 30	**2000** Budget / Estimate
10.2. Bundesanstalt für Gewässerkunde (BfG)	BMVBW chapter 12 03	50.7 *43.9* *6.8*	53.4 *45.1* *8.3*	. *53.2* .	. *60.0* .	420 *358* *16* *46*	402 *339* *13* *50*	. *328* *10* .	. *314* *11* .
10.3. Bundesanstalt für Wasserbau (BAW)	BMVBW chapter 12 03	73.3 *71.7* *1.6*	77.0 *75.1* *1.9*	. *75.1* .	. *75.1* .	450 *439* *4* *7*	440 *440* *3* *7*	. *440* *3* .	. *440* *3* .
10.4. Deutscher Wetterdienst (DWD)	BMVBW chapter 12 14	460.7 *457.4* *3.3*	562.6 *559.7* *2.9*	. *638.9* .	. *582.2* .	3174 *3148* *8* *18*	3037 *3015* *8* *12*	. *3015* *10* .	. *3257* *10* .
10.5. Bundesamt für Seeschiffahrt und Hydrographie (BSH)	BMVBW chapter 12 08	137.0 *133.5* *3.5*	143.2 *140.2* *3.0*	. *125.8* . *17*	. *119.7* . *12*	950 *887* *3* .	911 *857* *3* .	. *860* *3*	. *907* *3*
10.6. Institut für Erhaltung und Modernisierung von Bauwerken e.V. (IEMB)	BMVBW chapter 12 25	8.2 *6.4* *1.8*	7.8 *6.4* *1.4*	. *6.5* .	. *6.5* .	62 *58* *4* *0*	59 *56* *2* *0*	. *54* *0* .	. *54* *0* .
10.7. Bundesamt für Bauwesen und Raumordnung (BBR) [2]	BMVBW chapter 12 27	129.4 *129.4* *0.0*	115.5 *115.5* *0.0*	. *139.2* .	. *151.3* .	668 *663* *5* *0*	650 *645* *5* *0*	. *633* *5* .	. *674* *5* .
11. Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)									
11.1. Umweltbundesamt (UBA)	BMU chapter 16 05	141.9 *135.4* *6.5*	144.0 *138.0* *6.0*	. *148.6* .	. *169.9* .	1031 *975* *30* *26*	1120 *1063* *32* *25*	. *1050* *29* .	. *1059* *40* .
11.2. Bundesamt für Naturschutz (BfN)	BMU chapter 16 06	21.9 *21.5* *0.4*	24.5 *24.1* *0.4*	. *26.8* .	. *27.1* .	207 *194* *10* *3*	207 *195* *8* *4*	. *201* *11* .	. *203* *6* .

Part VI

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which:* *– Basic funding from the Federal Government (including HSP)* *– External funds*				Total staff (full-time equivalent) *of which:* *– Established) Posts* *– Additional staff* *– Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
11.3. Bundesamt für Strahlenschutz (BfS)	BMU chapter 16 07	401.0 *398.1* *2.9*	414.7 *411.1* *3.6*	. *392.6* .	. *417.1* .	577 *531* *23* *23*	638 *590* *24* *24*	. *571* *24* .	. *604* *24* .
12. Federal Ministry of Education and Research (BMBF)									
12.1. Kunsthistorisches Institut Florenz (KHI)	BMBF chapter 30 13	6.4 *6.1* *0.4*	6.9 *6.5* *0.4*	. *6.0* .	. *7.0* .	50 *36* *12* *3*	53 *37* *14* *3*	. 37 15 .	. 36 *14* .
12.2. Deutsches Historisches Institut in Paris (DHI Paris)	BMBF chapter 30 12	5.2 *5.0* *0.2*	5.4 *5.0* *0.4*	. *4.8* .	. *5.2* .	28 *25* *1* *2*	30 *25* *1* *4*	. *25* *1* .	. *25* *1* .
12.3. Deutsches Historisches Institut in Rom (DHI Rom)	BMBF chapter 30 11	6.0 *5.9* *0.1*	6.1 *6.0* *0.1*	. *6.7* .	. *7.6* .	34 *30* *4* *0*	34 *30* *4* *0*	. *30* *5* .	. *31* *5* .
12.4. Deutsches Historisches Institut in London (DHI London)	BMBF chapter 30 02	4.6 *4.6 ** *0.0*	4.6 *4.6 ** *0.0*	. *4.8 ** .	. *4.9 ** .	19 *16* *3* *0*	18 *15* *3* *0*	. *15* *3* .	. *15* *3* .
12.5. Deutsches Historisches Institut in Washington D.C. (DHI Washington)	BMBF chapter 30 02	5.6 *5.4 ** *0.2*	5.4 *5.2 ** *0.2*	. *5.5 ** .	. *5.8 ** .	24 *19* *3* *2*	24 *19* *3* *2*	. *18* *3* .	. *18* *3* .
12.6. Deutsches Historisches Institut in Warschau (DHI Warschau)	BMBF chapter 30 02	3.4 *3.4 ** *0.0*	3.7 *3.7 ** *0.0*	. *3.7 ** .	. *3.9 ** .	18 *18* *0* *0*	18 *18* *0* *0*	. *17* *0* .	. *17* *0* .
12.7. Deutsches Institut für Japanstudien in Tokyo (DIJ Tokyo)	BMBF chapter 30 02	7.7 *7.6 ** *0.1*	7.5 *7.4 ** *0.1*	. *8.6 ** .	. *8.5 ** .	23 21 *2* *0*	23 21 *2* *0*	. 20 *2* .	. 20 *2* .
12.8. Orient-Institut Beirut der Deutschen Morgenländischen Gesellschaft e.V. (OI Beirut)	BMBF chapter 30 02	2.5 *2.5 ** *0.0*	2.6 *2.6 ** *0.0*	. *2.6 ** .	. *2.7 ** .	19 *15* *3* *1*	18 *14* *3* *1*	. *14* *3* .	. *14* *3* .

Institution	Responsible Federal Government department; chapter of the federal budget; financing ratio (Federal Government : *Land*)	Total expenditure (DM million) *of which: – Basic funding from the Federal Government (including HSP) – External funds*				Total staff (full-time equivalent) *of which: – Established) Posts – Additional staff – Externally funded staff*			
		1997	**1998**	**1999**	**2000**	**1997**	**1998**	**1999**	**2000**
		Actual		Budget / Estimate		Actual as of June 30			Budget / Estimate
12.9. Stiftung Deutsch-Amerikanisches Akademisches Konzil (DAAK)	BMBF chapter 30 02	5.8 *4.8 ** *1.0*	6.0 *4.9 ** *1.1*	. *5.1 ** .	. *4.8 ** .	11 *9* *2* *1*	12 *9* *2* *1*	. *10* *1* .	. *10* *1* .
12.10. Bundesinstitut für Berufsbildung (BIBB)	BMBF chapter 30 03	*49.8* *46.6 ** *3.1*	*52.1* *46.9 ** *5.0*	. *52.7 ** .	. *65.7 ** .	391 *371* *5* *15*	375 *357* *5* *13*	. *357* *5* .	. *350* *5* .
13. Federal Ministry for Economic Co-operation and Development (BMZ)									
13.1. Deutsches Institut für Entwicklungspolitik gGmbH (DIE)	BMZ chapter 23 02	7.4 *5.3 ** *0.0*	7.4 *5.5 ** *0.0*	8.2 *6.1 ** .	10.5 *8.4 ** .	47 *43* *4* *0*	47 *43* *4* *0*	. *43* *0* .	. *43* *0* .

* Basic funding from the Federal Government (including Special Funding Programme for Higher Education and Research).

** After the re-design of tasks, this institution does no longer do research.

1 Since January 1, 1997, the former Bundesinstitut für chemisch-technische Untersuchungen at the Bundesamt für Wehrtechnik und Beschaffung (BICT) has been part of the Wehrwissenschaftliches Institut für Werk-, Explosiv- und Betriebsstoffe (WIWEB). Staff data for 1995 and 1996 estimated.

2 On January 1, 1998, the Bundesamt für Bauwesen und Raumordnung (BBR) was established by merging the BBD and BfLR on the basis of the law of December 15, 1997 (BGBI. I, page 2902). The BBR continues the tasks of BBD and BfLR with a new focus.

Source: Federal budgets and individual institutions

7. CAESAR Foundation (Centre of Advanced European Studies and Research)

Friedensplatz 16, 53111 Bonn
Tel.: 02 28/96 56-100; Fax: 02 28/96 56-111
E-mail: office@caesar.de; Internet: http://www.caesar.de

Founded:
On July 11, 1995 as foundation under private law having legal capacity.

Financing:
Foundation capital gains totalling DM750 million (Federal Government: DM685 million), including DM190 million for building and investment measures; payments are made between 1995 and 2004. The foundation is not a recipient of grants, but mainly raises its own funds.

Structure:
The supervisory body of the foundation is the *foundation council*. It consists of three members of the Federal Government, three members of the German Bundestag appointed by the Federal Government, two members of *Land* North Rhine-Westphalia, two members of the North Rhine-Westphalian parliament appointed by the *Land*, one member of the Federal City of Bonn and four co-opted members of science and industry.

The foundation is managed jointly by a scientific and an administrative director.

The foundation council and the directors are advised by a scientific advisory board, which consists of nine representatives of science and industry.

Tasks:
Under the terms of the statutes the foundation is to promote science and research. This is mainly done by establishing and operating in Bonn a natural science- and engineering-oriented research centre.

CAESAR is a new type of private foundation with a capital endowment of its own, major organisational freedom and no fixed institutional structures. The research centre will do transdisciplinary basic and application-oriented research. Already in the project definition phase, needs and market-orientation as well as opportunities for technology-oriented spin-offs will be taken into consideration.

IN 1999, CAESAR started scientific work and at the same time started to plan the construction of the research centre. According to the recommendations of the founding committee and the Science Council, CAESAR will start working in the fields of nanotechnology, coupling of biological and electronic systems and ergonomics in communications, but will also flexibly respond to current research trends. Co-operation between theoretical research, experimental testing and industrial application will be achieved by having each project addressed by three teams (research in triplets). Project teams will consist of foundation staff with fixed-term contracts, researchers from universities, research institutions and industry as well as visiting scientists. CAESAR aims to co-operate closely with science and industry in the region and beyond.

8. Central specialised information institutions and central specialised libraries

Several federal government departments run specialised information institutions and central specialised libraries, which provide the services necessary for fulfilling departmental tasks.

Most of the supraregional specialised information institutions and the central specialised libraries are Blue List institutions or Federal institutions performing R&D. They have the following tasks:

– Development of literature and factual databases,
– Provision and sales of information services,
– Provision of information databases for online use via specialised information computing centres,
– Collection and provision of literature.

These institutions are partly open to the public.

Institution	Specialised information offered
Fachinformationsverb und Internationale Beziehungen und Länderkunde c/o Stiftung Wissenschaft und Politik (SWP) 82067 Ebenhausen Tel.: 0 81 78-70-274; Fax: 0 81 78-70-3 32 E-Mail: fiv@swp.extern.lrz-muenchen.de Internet: http://www.fiv-iblk.de	• Social science literature • Factual information • International relations • Area studies
juris GmbH – Juristisches Informationssystem für die Bundesrepublik Deutschland Gutenbergstraße 23, 66117 Saarbrücken Tel.: 06 81-58 66-0; Fax: 06 81-58 66-2 39 E-Mail: juris@juris.de Internet: http://www.juris.de	• Federal law • Administrative regulations • Court rulings • Legal literature
Informationszentrum im HWWA-Institut für Wirtschaftsforschung Neuer Jungfernstieg 21, 20354 Hamburg Tel.: 0 40-35 62-0; Fax: 0 40-35 19 00 E-Mail: hwwa@hwwa.uni-hamburg.de Internet: http://www.hwwa.uni-hamburg.de	• Economics • Economic practice • Social policy • Market, industry and product information • Information on companies and persons
Deutsche Zentralbibliothek für Wirtschaftswissenschaften und Wirtschaftsarchiv (ZBW) Düsternbrooker Weg 120, 24105 Kiel Tel.: 04 31-88 14-1; Fax: 04 31-88 14-5 20 E-Mail: zbw@zbw.ifw-kiel.de Internet: http://www.uni-kiel.de/ifw.zbw/econis.htm	• Economics
Fachinformationszentrum Technik e.V. Ostbahnhofstraße 13, 60314 Frankfurt/M. Tel.: 0 69-4 30 82 12; Fax: 0 69-4 30 82 25 E-Mail: kundenberatung@fiz.technik.de Internet: http://www.fiz-technik.de	• Electrical engineering and electronics • Mechanical and plant engineering • Materials • Textiles • Information technology
Deutsches Informationszentrum für Technische Regeln (DITR) im DIN Burggrafenstraße 6, 10787 Berlin Tel.: 0 30-26 01-2610; Fax: 0 30-26 28-1 25 E-Mail: marschall@ditr.din.de Internet: http://www.din.de	• Standards, worldwide (electronic and printed information) • Technical law in Germany and the European Union • Full text databases
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) Stilleweg 2, 30655 Hannover Tel.: 05 11-6 43-0; Fax: 05 11-6 43-23 04 E-Mail: bibl.info@bgr.de Internet: http://www.bgr.de	• Mineral resources and energy-producing raw materials • Geo-environmental research • Geo-risk research • Regional geology
Bundesstelle für Außenhandelsinformation (BfAI) Agrippastraße 87–93, 50676 Köln Tel.: 02 21-2 05 70; Fax: 02 21-2 05 72 12 E-Mail: bfai@geod.geonet.de Internet: http://www.bfai.com	• Foreign trade information

Institution	Specialised information offered
Zentralstelle für Agrardokumentation und -information (ZADI) Villichgasse 17, 53177 Bonn Tel.: 02 28-95 48-0; Fax: 02 28-95 48-111 E-Mail: zadi@zadi.de Internet: http://www.zadi.de	• Nutrition • Agriculture • Forestry • Horticulture • Fishery • Genetic resources
Deutsche Zentralbibliothek für Landbau-wissenschaften (ZBL) Nußallee 15a, 53115 Bonn Tel.: 02 28-73-34 02; Fax: 02 28-73-32 81 E-Mail: zbl@ulb.uni-bonn.de Internet: http://www.dainet.de/zbl/zbl.htm	• Agricultural science • Nutritional science • Nature conservation • Domestic science and home economics • Horticulture • Environmental sciences
Bundesanstalt für Straßenwesen (BASt) Brüderstraße 53, 51427 Bergisch Gladbach Tel.: 0 22 04-43-0; Fax: 0 22 04-43-673 E-Mail: info@bast.de E-Mail: irtad@bast.de Internet: http://www.bast.de	Traffic databases: • IRRD (International Road Research Documentation) • IRTAD (International Road Traffic and Accident Database)
Deutscher Wetterdienst (DWD) Frankfurter Straße 135, 63067 Offenbach Tel.: 0 69-80 62-0; Fax: 0 69-80 62-24 88 E-Mail: udo.gaertner@dwd.de Internet: http://www.dwd.de	• Weather and climate • Atmosphere (physics and chemistry) • Interaction between meteorological, economic and social processes, environment • Observation networks
Bundesanstalt für Gewässerkunde (BfG) Kaiserin-Augusta-Anlagen 15-17, 56068 Koblenz Tel.: 02 61-13 06-0; Fax: 02 61-13 06-53 02 E-Mail: posteingang@bafg.de Internet: http://www.bafg.de	• Recording and evaluation of quantitative and qualitative hydrologic conditions and of ecological conditions along Federal waterways • Measuring programme for monitoring water quality in cross-border waters • Co-ordination of basic knowledge for future-oriented, ecological management in the Elbe catchment area
Bundesanstalt für Wasserbau (BAW) Kußmaulstraße 17, 76187 Karlsruhe Tel.: 07 21-97 26-0; Fax: 0 7121-97 26-454 E-Mail: info@karlsruhe.baw.de Internet: http://www.baw.de	• Special scientific services for the Federal Waterways and Shipping Administration (WSV) • Norms and technical standards • Applied research • Testing agency in the following areas: building materials, geotextiles, frost resistance, corrosion protection • Development of basis for IT use at WSV, IT process development, IT services
Bundesamt für Seeschiffahrt und Hydrographie (BSH) Bernhard-Nocht-Straße 78, 20359 Hamburg Tel.: 0 40-31 90-0; Fax: 0 40-31 90-50 00 E-Mail: webmaster@bsh.d400.de Internet: http://www.bsh.de Dierkower Damm 45, 18146 Rostock Tel.: 0381-45 63-5; Fax: 0381-45 63-9 48	• Oceanographic services • Monitoring of changes in the marine environment including co-ordination, collection of data at the Deutsches Ozeanographisches Datenzentrum and in the marine environment database • Nautical information service • Bathymetric data centre • Ship safety • Nautical engineering research • Certification and operation of nautical systems • Central maritime specialised library

Institution	Specialised information offered
Zentrale Informationsstelle für Verkehr (ZIV) Brüderstraße 53, 51427 Bergisch Gladbach Tel.: 0 22 04-6 00 29; Fax: 0 22 04-6 77 43 E-Mail: dvwgziv@t-online.de Internet: http://www.dvwg.de	• Transport and traffic in general • Transport policy • Transport economy
Deutsches Institut für medizinische Dokumentation und Information (DIMDI) Weißhausstraße 27, 50939 Köln Tel.: 02 21-47 24-1; Fax: 02 21-41 14 29 E-Mail: ky@dimdi.de Internet: http://www.dimdi.de	• Medicine, healthcare • Biosciences • Social sciences • Drugs, medical products • Classification systems
Deutsche Zentralbibliothek für Medizin (ZBM) Joseph-Stelzmann-Straße 9, 50931 Köln Tel.: 02 21-4 78 56 00; Fax: 02 21-4 78 56 97 E-Mail: zbmed.zbmed@uni-koeln.de Internet: http://www.zbmed.de	Services for research in the following areas: • Healthcare • Medicine • Pharmaceuticals • Molecular biology • Cell biology
Zentralstelle für Psychologische Information und Dokumentation an der Universität Trier (ZPID) Universitätsring 15, 54296 Trier Tel.; 06 51-2 01-28 77; Fax: 06 51-2 01-20 71 E-Mail: zpid@zpid.uni-trier.de Internet: http://www.zpid-psychologie.de	• Psychology • Bibliometry • Literature documentation • Testing methods documentation • Psychology on the Internet • Scientometry
Umweltbundesamt Bismarckplatz 1, 14193 Berlin Tel.: 0 30-89 03-0; Fax: 0 30-89 03-22 85 E-Mail: nicole.kobosil@uba.de Internet: http://www.umweltbundesamt.de	• Generic issues of environmental protection • Climate protection, air pollution control and noise protection • Waste and water management • Soil protection, reclamation of contaminated soils • Environmental and health research, safe chemicals • UMPLIS Group (environmental information and documentation) • Library
Fachinformationszentrum Chemie GmbH Franklinstraße 11, 10587 Berlin Tel.: 0 30-3 99 77-0; Fax: 0 30-3 99 77-1 33 E-Mail: info@fiz-chemie.de Internet: http://www.fiz-chemie.de	• Chemical information systems, electronic and printed information • Chemical information on the Internet
Fachinformationszentrum Karlsruhe, Gesellschaft für wissenschaftlich-technische Information mbH (FIZ-Ka) 76344 Eggenstein-Leopoldshafen Tel.: 0 72 47-8 08-0; Fax: 0 72 47-8 08-1 14 E-Mail: fizka@fiz-karlsruhe.de Internet: http://www.fiz-karlsruhe.de	• Online services (STN International – topical science and technology data) • Provision of literature • Internet sites and electronic publishing • Database production, printed and electronic products, editorial services • Computer centre services
Fraunhofer Informationszentrum Raum und Bau Nobelstraße 12, 70569 Stuttgart Tel.: 07 11-9 70-25 00; Fax: 07 11-9 70-25 08 E-Mail: irb@irb.fhg.de Internet: http://www.irb.fhg.de	• Civil engineering, architecture • Construction planning, building industry • Urban planning, housing • Regional planning, preservation of historic monuments • Construction damage

Institution	Specialised information offered
Technische Informationsbibliothek Hannover (TIB) Welfengarten 1B, 30167 Hannover Tel.: 05 11-7 62-22 68; Fax: 05 11-7 71 59 36 E-Mail: ubtib@tib.uni-hannover.de Internet: http://www.tib.uni-hannover.de	• Technology / Engineering and its basic sciences (mainly chemistry, computer science, mathematics and physics)
Gesellschaft Sozialwissenschaftlicher Infrastruktur-einrichtungen e.V. (GESIS)	
– Informationszentrum Sozialwissenschaften (IZ) der Arbeitsgemeinschaft sozialwissenschaftlicher Institute e.V. Lennéstraße 30, 53113 Bonn Tel.: 02 28-22 81-0; Fax: 02 28-2 28 11 20 E-Mail: iz@bonn.iz-soz.de Internet: http://www.bonn.iz-soz.de/index.htm	• Information and advisory function for social sciences • Provision and acquisition of social scientific data and continuous data preparation • Development and provision of factual and bibliographical databases
– Zentralarchiv für empirische Sozialwissenschaften der Universität Köln (ZA) Bachemer Straße 40, 50931 Köln Tel.: 02 21-4 76 94-0; Fax: 02 21-4 76 94-44 E-Mail: za@za.uni-koeln.de Internet: http://www.za.uni-koeln.de/index.htm	• Methods development and advice
– Zentrum für Umfragen, Methoden und Analysen (ZUMA) e.V. B 2, 1, 68159 Mannheim Tel.: 06 21-12 46-0; Fax: 06 21-12 46-100 E-Mail: zuma@zuma-mannheim.de Internet: http://www.zuma-mannheim.de/index.htm	
– GESIS-Außenstelle Schiffbauerdamm 19, 10117 Berlin Tel.: 0 30-30 87 40; Fax: 0 30-282 36 92 E-Mail: post@berlin.iz-soz.de Internet: http://www.berlin.iz-soz.de/index.htm	

9. Union der deutschen Akademien der Wissenschaften (Union)

Geschwister-Scholl-Straße 2, 55131 Mainz
Tel.: 06131-218528-10
Fax: 06131-218528-11
E-Mail: uaw@mail.uni-mainz.de
Internet: http://www.akademienunion.de

President: Prof. Dr. Clemens Zintzen

The Union der deutschen Akademien is an association of the seven German academies of science. The Union co-ordinates the scientific projects of its member academies and is responsible for information and PR. It communicates with science institutions in Germany and abroad and sends delegates to national and international science organisations. The academies receive basic funding from their respective host *Land*.

Academies Programme

The Academies Programme supports long-term basic research projects of supraregional significance and national science policy interest carried out by the Academies of Sciences. The funds of DM75 million (2000) are provided in equal shares by the Federal Government (BMBF) and the *Land* hosting the research unit concerned. The Union der deutschen Akademien der Wissenschaften co-ordinates the Academies Programme. The focus of the programme is on specialised and foreign-language dictionaries, editions in theology, philosophy, language and literature, history, archaeology, history of art and music as well as scientific long-term studies.

Addresses

Berlin-Brandenburgische Akademie der Wissenschaften
Jägerstraße 22/23, 10117 Berlin
Tel.: 030-20370-0
Fax: 030-20370-500
E-Mail: info@bbaw.de
Internet: http://www.bbaw.de

President: Prof. Dr. Dieter Simon

Akademie der Wissenschaften zu Göttingen
Theaterstraße 7, 37073 Göttingen
Tel.: 0551-39-5362
Fax: 0551-39-5365
E-Mail: udeppe@gwdg.de
Internet: http://www.ADW-Goettingen.gwdg.de

President: Prof. Dr. Rudolf Smend

Bayerische Akademie der Wissenschaften
Marstallplatz 8, 80539 München
Tel.: 089-23031-0
Fax: 089-23031-100
E-Mail: webmaster@badw.de
Internet: http://www.badw.de

President: Prof. Dr. Heinrich Nöth

Sächsische Akademie der Wissenschaften zu Leipzig
Karl-Tauchnitz-Straße 1, 04107 Leipzig
Tel.: 0341-7115-30
Fax: 0341-7115-344
E-Mail: saw@saw-leipzig.de
Internet: http://www.saw-leipzig.de

President: Prof. Dr. Gotthard Lerchner

Heidelberger Akademie der Wissenschaften
Karlstraße 4, 69117 Heidelberg
Tel.: 06221-543265-68
Fax: 06221-543355
E-Mail: haw@baden-wuerttemberg.de
Internet: http://www.haw.baden-wuerttemberg.de

President: Prof. Dr. Gottfried Seebass
Ab 01.10. 2000: Prof. Dr. Gisbert Frhr. zu Putlitz

Akademie der Wissenschaften und der Literatur, Mainz
Geschwister-Scholl-Straße 2, 55131 Mainz
Tel.: 06131-577-0
Fax: 06131-577-206
E-Mail: juliane.klein@mail.uni-mainz.de
Internet: http://www.adwmainz.de

President: Prof. Dr. Clemens Zintzen

Nordrhein-Westfälische Akademie der Wissenschaften
Karl-Arnold-Haus, Haus der Wissenschaften
Palmenstraße 16, 40217 Düsseldorf
Tel.: 0211-342051
Fax: 0211-341475
E-Mail: akdw@mail.akdw.nrw.de
Internet: http://www.akdw.nrw.de

President: Prof. Dr. Paul Mikat

10. DLR space activities management and project management agencies of the Federal Ministry of Education and Research (BMBF)

10.1 DLR space activities management

In the area of space activities management, the DLR fulfils its tasks on its own responsibility under contracts concluded with the BMBF and other Federal Ministries dealing with space activities. These tasks include

– drawing up the German space plan to be adopted by the Federal Government,
– implementing the German space programmes and activities; awarding contracts and grants within the framework of the space budget and
– representing German space interests in the international community, in particular vis-a-vis ESA, within the framework of decisions taken by the Federal Government.

Details concerning the scope and implementation of the tasks are specified in special implementation agreements concluded between the DLR and the commissioning Federal Ministries.

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)
Königswinterer Straße 522-524, 53227 Bonn
Tel.: 02 28-4 47-4 43 Fax: 02 28-4 47-7 04
E-Mail: achim.bachem@dlr.de
Internet: http://www.dlr.de

10.2 Project management agencies of the Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Economics and Technology (BMWi)

The project management agencies are organisational units established at the Helmholtz Centres or other qualified institutions; they fulfil scientific, technical and administrative management tasks in various fields on behalf of the BMBF and the BMWi.

Within the framework of direct project support, the main tasks of the project management agencies include in particular provision of technical and administrative advice to applicants, preparation of funding decisions and monitoring of projects and success.

Furthermore, the project management agencies fulfil a number of additional tasks, such as the support in planning, analysis and evaluation of programmes, organisation of special meetings and workshops, activities in international cooperation and advice for applicants on special EU programmes.

Since 1995, the BMBF has entrusted several project management agencies not only with preparing funding decisions of the BMBF, but also with taking their own decisions within the framework of relevant research goals.

Project management agencies of the Federal Ministry of Education and Research (BMBF)	Tasks
1. Arbeitsgemeinschaft Industrieller Forschungsvereinigungen „Otto von Guericke“ e.V. (AiF) Bayenthalgürtel 23, 50968 Köln Tel.: 02 21-3 76 80-28 Fax: 02 21-3 76 80-27 E-Mail: afue@aif.de Internet: http://www.aif.de	• Application-oriented research and development at universities of applied sciences
2. Bundesinstitut für Berufsbildung (BIBB) Hermann-Ehlers-Straße 10 53113 Bonn Tel.: 0228-10710-14 Fax: 0228-1072954 E-Mail: stuebig@bibb.de Internet: http://www.bibb.de	• Innovation in vocational training and continuing education
3. Deutsches Elektronen-Synchrotron (DESY) Notkestraße 85, 22607 Hamburg Tel.:0 40-89 98-0 Fax: 0 40-89 94-37 02 E-Mail: postmaster@desy-hs.desy.de Internet: http://www.desy.de	• High-energy physics, astrophysics and research with synchrotron radiation

Project management agencies of the Federal Ministry of Education and Research (BMBF)	Tasks
4a. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Linder Höhe, 51147 Köln Tel.: 0 22 03-6 01-36 10 Fax: 0 22 03-6 01-46 43 E-Mail: wolfgang.klimek@dlr.de Internet: http://www.dlr.de/IT	• Information technology
Außenstelle: Rutherfordstraße 2, 12489 Berlin Tel.:0 30-6 70 55-7 20 Fax: 0 30-6 70 55-7 22 E-mail: hans-joerg.werrmann@dlr.de Internet: http://www.dlr.de/IT	• Information technology
4b. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Südstraße 125, 53175 Bonn Tel.:02 28-38 21-0 Fax: 02 28-38 21-2 29 E-Mail: helmut.klein@dlr.de Internet: http://www.dlr.de/PT Godesberger Allee 117, 53175 Bonn Tel.: 02 28-8 19 96-11 Fax: 02 28-8 19 96-40 E-Mail: umweltsystemforschung@dlr.de Internet: http://www.dlr.de/PT/uf/uf_home.htm	AUG (Work, Environment and Health): • Health research • Research on the preservation of the cultural heritage • Humanities • Innovative work organisation • Innovative services • Environmental research and technology
5. Forschungszentrum Jülich GmbH (FZJ) Leo-Brandt-Straße, 52428 Jülich Tel.: 0 24 61-61-0 Fax: 0 24 61-61-58 37 E-Mail: beo01.beo@fz-juelich.de Internet: http://www.kfa-juelich.de/beo/beo.htm Tel.: 0 24 61-61-24 57 Fax: 0 24 61-61-24 59 E-Mail: pfr@fz-juelich.de Internet: http://www.kfa-juelich.de/beo/org4.htm Tel.: 0 24 61-61-48 65 Fax: 0 24 61-61-23 98 E-Mail: nmt@fz-juelich.de Internet: http://www.kfa-juelich.de/nmt	BEO (Biology, Energy, Environment): • Biotechnology • Ecology, environmental technology • Inno Regio • EXIST • Condensed matter research, new technologies in the humanities, selected areas of mathematics NMT: New Materials and Chemical Technologies
Branches BEO: Wallstraße 17–22, 10179 Berlin Tel.: 0 30-2 01 99- Fax: 0 30-2 01 99-4 70 E-Mail: beo11.beo@fz-juelich.de Internet: http://www.kfa-juelich.de	BEO: (Biology, Energy, Environment): • Biotechnology • Ecology, environmental technology • Inno Regio
Seestraße 15, 18119 Rostock-Warnemünde Tel.: 03 81-51 97-2 80 Fax: 03 81-5 15 09 E-Mail: beo71.beo@fz-juelich.de Internet: http://www.fz-juelich.de/beo/fmeeresp.htm	• Marine and polar research

Project management agencies of the Federal Ministry of Education and Research (BMBF)	Tasks
6. Forschungszentrum Karlsruhe GmbH (FZK) Technik und Umwelt Postfach 3640, 76021 Karlsruhe – Projektbereich Wassertechnologie Tel.: 07247-82-4851 Fax: 07247-82-2377 E-Mail: mail-ptwt@ptwt.fzk.de Internet: www.fzk.de/ptwt – Projektbereich Entsorgung	• Water technology and waste disposal
Tel.: 07247-82-5790 Fax: 04247-82-5796 Email: klaus.detlef.clon@ptl.fzk.de Internet: www.fzk.de/pte	• Production and manufacturing technologies
Tel.:0 72 47-82-52 80 Fax: 0 72 47-82-54 56-28 91 E-Mail: bey@pft.fzk.de Internet: http://www.iai.fzk.de/pft/pftd1.htm Tel.:0 72 47-82-57 90 Fax: 0 72 47-82-57 96 E-Mail: klaus-detlef.closs@pte.fzk.de Internet: http://hbksun17.fzk.de:8080/PTE/welcome.html *Branch:*	• Waste Disposal
a) PTWT + E Hallwachsstraße 3, 01069 Dresden Tel.: 03 51-4 63-14 33 Fax: 03 51-4 63-14 42 E-Mail: elvitte.foerster@ptwt.fzk.de b) PTFT Hallwachsstraße 3, 01069 Dresden Tel.: 03 51-463-1430 Fax: 03 51-4 63-14 44 Internet: http://www.fzk.de	• Water technology and waste disposal • Production and manufacturing technologies
7. Germanischer Lloyd Vorsetzen 32, 20459 Hamburg Tel.: 0 40-3 61 49-0 Fax: 0 40-3 61 49-48 32 E-Mail: but@hamburg.germanlloyd.de Internet: http://www.germanlloyd.de *Branch:*	• Nautical engineering
Doberaner Straße 44-47, 18057 Rostock Tel.: 03 81-4 92 88-31 Fax: 03 81-4 92 88-30 E-Mail: voe@hamburg.germanlloyd.de Internet:http://www.germanlloyd.de	• Nautical engineering
8. GMD-Forschungszentrum Informationstechnik GmbH Dolivostraße 15, 64293 Darmstadt Tel.: 0 61 51-8 69-7 26 Fax: 0 61 51-8 69-7 40 E-Mail: klaus@darmstadt.gmd.de Internet: http://www.darmstadt.gmd.de/PTF/ptfd.html	• Specialised information

Project management agencies of the Federal Ministry of Education and Research (BMBF)	Tasks
9. Gesellschaft für Schwerionenforschung mbH (GSI) Planckstraße 1, 64291 Darmstadt Tel.: 0 61 59-71-28 48 Fax: 0 61 59-71-29 83 E-Mail: dmueller@-gsi.de Internet: http://www.gsi.de/gsi-pt	• Hadron and nuclear physics (KKS)
10. GSF-Forschungszentrum für Umwelt und Gesundheit GmbH Kühbachstraße 11, 81543 München Tel.: 0 89-65 10 88-51 Fax: 0 89-65 10 88-54 E-Mail: pt-ukf@gsf.de Internet: http://www.gsf.de/ptukf.html	• Environmental and climate research
11. TÜV Rheinland Sicherheit und Umweltschutz GmbH Am Grauen Stein, 51105 Köln Tel.: 02 21-8 06-24 90 Fax: 02 21-8 06-27 12 E-Mail: pt-bvt@tuev-rheinland.de Internet: http://www.tuev-rheinland.de/tsu/bvt/home.htm	• Mobility and transport • Building and housing
12. Umweltbundesamt Seecktstraße 8-10, 13581 Berlin Tel.: 0 30-89 03-37 52 Fax: 0 30-89 03-38 33 E-Mail: jutta.penning@uba.de Internet: http://www.umweltbundesamt.de	• Waste management and reclamation of contaminated areas
13. VDI-Technologiezentrum Graf-Recke-Straße 84, 40239 Düsseldorf Tel.: 02 11-62 14-4 01 Fax: 02 11-62 14-4 84 E-Mail: vditz@vdi.de Internet: http://www.vdi.de	• Physical technologies, laser research and laser technology
14. VDI-VDE Technologiezentrum Informationstechnik GmbH Rheinstraße 10 B, 14513 Teltow Tel.: 0 33 28-4 35-1 32 Fax: 0 33 28-4 35-1 41 E-Mail: sturm@vdivde-it.de Internet: http://www.vdivde-it.de/it/fpmst	• Microsystems technology

Auskunftsstelle BMBF-Förderung:
Projektträger BEO
Wallstraße 17–22, 10179 Berlin
Tel.: 0 30-2 01 99-4 19, -4 17
Fax: 0 30-2 01 99-4 70
E-Mail: beo1101.beo@fz-juelich.de
Internet: http://www.kfa-juelich.de/beo/auskunft.htm

Project management agencies of the Federal Ministry of Economics and Technology (BMWi)	Tasks
1.a. Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke" e.V. (AiF) Bayenthalgürtel 23, 50968 Köln Tel.: 02 21-3 76 80-0 Fax: 02 21-3 76 80-27 Internet: http://www.aif.de	• Support of co-operative industrial research under the programme on future technologies for small and medium-sized enterprises
1.b. Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke" e.V. (AiF) – Geschäftsstelle Berlin – Abteilung BMWi-Programme Tschaikowskistraße 49, 13156 Berlin Tel.: 030-481 63-4 51 Fax: 030-4 81 63- 4 02 E-Mail: aif@forschungskoop.de Internet: http://www.forschungskoop.de	• PROgramme INNOvation skills of small and medium-sized enterprises (PRO INNO)
1.c. Arbeitsgemeinschaft industrieller Forschungsvereinigungen „Otto von Guericke" e.V. (AiF) – Geschäftsstelle Berlin – Abteilung BMWi-Programme Tschaikowskistraße 49, 13156 Berlin Tel.: 030-481 63-4 18 Fax: 030-4 81 63- 4 01 E-Mail: wi@aif.de Internet: http://www.aif.de Internet: http://www.aif-pfo.de	• Funding research, development and innovation in SMEs and extramural industrial research institutions in the new *Länder* • R&D personnel funding programme line
2.a. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Projektträger Luftfahrtforschung und -technologie Königswinterer Straße 522–524, 532227 Bonn Tel.: 0 228-44 76 62 Fax: 0 228-44 77 10 E-Mail: Dagmar.Wollsiefen@dlr.de Internet: http://www.dlr.de/pt-lf	• Aeronautical research and technology
2.b. Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) Projektträger Multimedia des BMWi Linder Höhe, 51170 Köln Tel.: 0 22 03-601-36 72 Fax: 0 22 03-601-3017 E-Mail: Sigrid.Hogrefe@dlr.de Internet: http://www.dlr.de/it/mm	• Multimedia innovation programme
3.a. Forschungszentrum Jülich GmbH Projektträger Biologie, Energie, Ökologie (BEO) Postfach1913 52425 Jülich Tel.: 0 24 61-61-0, -46 22 Fax: 0 24 61-61-69 99 E-Mail: beo01.beo@fz-juelich.de Internet: http://www.fz-juelich.de/beo/beo.htm	• Energy research and technology

Project management agencies of the Federal Ministry of Economics and Technology (BMWi)	Tasks
3.b. Forschungszentrum Jülich GmbH Projektträger Biologie, Energie, Ökologie (BEO) – Branch Berlin – Wallstraße 17–22 10179 Berlin Tel.: 030-201 99-3 Fax: 030-201 99-470 E-Mail: beo11.beo@fz-juelich.de Internet: http://www.fz-juelich.de	• FUTOUR 2000 – Funding and support for new technology-based companies in the new *Länder* and East Berlin
4. Forschungszentrum Karlsruhe GmbH Projektträgerschaft Wassertechnologie und Entsorgung (PTWT+E) Postfach 3640, 76021 Karlsruhe Tel.: 07 247-820 Fax: 07 247-82 23 77 E-Mail: klaus-detlef.closs@pte.fzk.de	• Final storage of radioactive substances
5. Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH Projektträger Reaktorsicherheit Schwertnergasse 1, 50667 Köln Tel.: 0221-26 80 Fax: 0221-268-888 E-Mail: erl@grs.de	• Reactor safety
6. GEWIPLAN Projektmanagement GmbH Torstraße 35, 10119 Berlin Tel.: 030-44 02 10-15 Fax: 030-44 02 10-05 E-Mail: info@gewiplan.de Internet: http://www.gewiplan.de	• Funding research, development and innovation in SMEs and extramural industrial research institutions in the new *Länder* • R&D project funding programme line
7.a. VDI-VDE Technologiezentrum Informationstechnik GmbH PT-Gruppe InnoNet Rheinstraße 10 B, 14513 Teltow Tel.: 0 33 28-4 35-0 Fax: 0 33 28-4 35-104 E-Mail: InnoNet@vdivde-it.de Internet: http://www.vdivde-it.de/innonet	• Support of innovative networks (InnoNet)
7.b. VDI-VDE Technologiezentrum Informationstechnik GmbH PT-Gruppe FUTOUR Rheinstraße 10 B, 14513 Teltow Tel.: 0 33 28-4 35-280 Fax: 0 33 28-4 35-126 E-Mail: baier@vdivde-it.de Internet: http://www.vdivde-it.de/futour	• FUTOUR 2000 – Funding and support for new technology-based companies in the new *Länder* and East Berlin and Berlin (East)

Project management agencies of the Federal Ministry of Economics and Technology (BMWi)	Tasks
Information Bureau for BMWi Programmes: **Bundesministerium für Wirtschaft und Technologie (BMWi)** **Förderberatung** **Scharnhorststraße 34 – 37** **10115 Berlin** **Tel.: 030-2014-76 48, -76 49** **Fax: 030-2014-70 33**	

Part VII

Statistics

1. Introduction

Quantitative indicators have proved to be a useful instrument for research policy decisions and the evaluation of the scientific and technical performance of countries and regions: science and technology indicators are becoming increasingly important in view of the much debated development towards a science- and technology-based society and economy. The requirements which therefore have to be met by indicators and statistics include first and foremost reliability and meaningfulness as well as quick availability, topicality and acceptability.

Both nationally and internationally – for example within the framework of the OECD and the EU – methodological work aims to meet these requirements to the greatest possible extent – despite scarce resources.

In Germany, research statistics has developed continuously since the mid 1960s – in parallel with relevant work by the OECD. As Germany has no research statistics law providing for a uniform survey procedure in all sectors of the economy, different sources are used for obtaining the statistical material concerning research activities in the individual sectors.

Co-ordination between the organisations responsible for the individual sectors (for example, Stifterverband Wissenschaftsstatistik, Federal Statistical Office and Federal Ministry of Education and Research (BMBF)) is ensured by the BMBF.[1]

Current research surveys are based on the methodological work which was initiated mainly by the OECD and carried out over many years. In 1963, the first official version of the "Proposed Standard Practice for Surveys of Research and Experimental Development"[2] was presented, which had been prepared in co-operation between researchers, experts of the OECD member states and the OECD Secretariat. The 5th edition of the manual is now available.[3] It contains basic definitions and conventions, classifications and methods for measuring research and development activities in all science areas. Its annexes provide additional information on specific topics, for example specific features of the higher education sector, software issues, R&D in the social sciences and humanities, R&D deflators and other science and technology indicators.

UNESCO, too, conducts regular surveys of R&D resources in its member states. The methodological and theoretical basis was developed further together with national experts of different continents. The aim is to collect data on scientific and technological activities in a form which facilitates international comparison on the broadest possible scale. The Recommendation Concerning the International Standardisation of Statistics on Science and Technology was adopted by the General Assembly of UNESCO in 1978. Most of the definitions of the Frascati Manual for the R&D area were included.

For the purposes of co-ordinating research policies in the member countries of the European Union, a special statistical instrument was created which initially covered only research funding by central governments. Based on the methods outlined in the Frascati Manual, the "Nomenclature for the analysis and comparison of science programmes and budgets" (NABS)[4] was developed; it makes possible functional classification by socio-economic research goals. The nomenclature, which was developed in 1966, has been revised repeatedly with the aim of adapting it to more recent orientations of research activities. On the basis of this nomenclature, the Statistical Office of the European Community (EUROSTAT) conducts annual surveys of government expenditure on research and development as indicated in the budgets or draft budgets of EU member states.

Other EUROSTAT activities on science and technology indicators conducted together with the OECD and other international organisations cover the areas of innovation surveys and human resources in science and technology (HRST). Furthermore, methodological work for regional statistics is one of the priorities of EUROSTAT's work.[5]

In addition to the above-mentioned Frascati Manual, the OECD published a number of other manuals dealing with methodological and statistical issues concerning science and technology indicators and offering hints and assistance for surveys and the use of indicators. Major examples include the TBP Manual on technology balance of payments data (Paris 1990), the Oslo Manual on innovation data (Paris 1997) and the Canberra Manual on the measurement of human resources devoted to S&T (Paris 1995). Further manuals are being prepared (cf. Frascati Manual 1993, annex 2).

[1] A general survey of statistic related to science – including recommendation for further reading – can be found in Pia Brugger, Heinz-Werner Hetmeier, "Wissenschafts- und Technologiestatistiken in Deutschland" in Wirtschaft und Statistik, 3/1999.

[2] The measurement of Scientific and Technical Activities – Proposed Standard Practice for Surveys of Research and Experimental Development – "Frascati Manual" 1980, Hrg. OECD, Paris 1981 (Diese Fassung ("Frascati-Handbuch 1980") liegt auch in der deutschen Übersetzung vor).

[3] Frascati Manual 1993, Paris (OECD), 1994.

[4] Nomenclature pour l'Analyse et la Comparaison des Budgets et Programmes Scientifiques, Hrg. EUROSTAT, Luxemburg 1986. 1993 erschien die NABS in der revidierten Fassung NABS 1992.

[5] Vgl. EUROSTAT, Die Regionale Dimension der FuE und Innovationsstatistik. Regionales Handbuch. Luxemburg, 1996.

2. Definitions

Science expenditure
Science expenditure covers expenditure on research and development (R&D) as well as expenditure on academic teaching and education and other related scientific and technological activities. The latter include, for example, scientific and technical information services, data collections for general purposes, studies on the feasibility of technical projects (feasibility studies for research projects, however, form part of R&D), and development of a basis for decision-making in politics and industry.

R&D expenditure
Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (cf. Frascati Manual 1993, para. 57). Expenditure incurred in the context of this work is expenditure on research and development.

Basic research
Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view (cf. Frascati Manual 1993, para. 224).

Net expenditure
Expenditure adjusted for payments made at the same level of the public sector minus payments made by other public institutions. It reflects the expenditure to be financed from the institution's or group's of institutions own sources of funds (burden principle).

Direct expenditure
Labour costs, current operating expenditure, expenditure on fixed assets as well as regular and capital-forming payments to other sectors, excluding payments to the government sector.
Deviations from net expenditure basically correspond to the balance of payment transactions within the government sector.

Basic funds
Net expenditure minus direct revenues, i.e. revenues generated in the functional area concerned. It indicates the level of funds from the general budget provided by a body for this area.

Gross domestic expenditure on research and development
Total intramural expenditure on R&D performed on the national territory, whatever the source of finance; this also includes R&D performed within the country and funded from abroad and by international organisations. However, it does not cover the expenditure on R&D performed by international organisations on the national territory as well as payment made for R&D performed abroad (cf. Frascati Manual 1993, para. 385).

Intramural R&D expenditure
All expenditure on R&D performed within a country or within a certain sector of the economy or another reporting unit, whatever the source of funds. This does not include funds for R&D performed abroad or by international organisations (cf. Frascati Manual 1993, para. 335).

Extramural R&D expenditure
Expenditure on research and development performed abroad, within international organisations or outside a certain sector or other unit (reporting unit) of the economy (cf. Frascati Manual 1993, para. 333).

Total R&D expenditure
Total expenditure comprises the intramural and extramural R&D expenditure of a country, a sector or other unit (reporting unit) of the economy.

Government expenditure on R&D
All resources allocated to R&D by Federal and Länder (state) governments, regardless of the sector in which R&D is performed.

R&D expenditure by the business enterprise sector
Expenditure by business enterprises and institutions for co-operative industrial research and experimental development

Self-financed expenditure by the business enterprise sector
Intramural R&D expenditure financed from the business enterprise sector's own resources.

Sectoring
– Business enterprise sector: private and public enterprises, institutions for co-operative industrial research and experimental development, and private non-profit institutions mainly financed by, or serving, business enterprises (cf. Frascati Manual 1993, paras. 145–167).
– Higher education sector: all universities, colleges of technology, Fachhochschulen (Universities of Applied Sciences) and other institutions of post-secondary education, whatever their source of finance or legal status, including their research institutes, experimental stations and clinics (cf. Frascati Manual 1993, paras. 190–214).
– Government sector (without higher education): National reporting is based on a narrow definition of the government sector, i.e. on the financing side only the budget resources of Federal, Länder and local governments are covered, and on the performing side it is also only the institutions of the Federal, Länder and local governments that are covered.
  For purposes of international reporting, the government sector also comprises private non-profit organisations mainly financed by government (e.g. Helmholtz Centres, Max Planck Society and Fraunhofer Society). On the financing side revenues by these organisations are also included (cf. Frascati Manual 1993, paras. 168–177).

– Private non-profit institutions (PNP sector): In national reports, coverage of this sector includes non-profit organisations mainly financed by government (e.g. Helmholtz Centres, Max Planck Society and Fraunhofer Society) and private non-profit organisations financed neither mainly by government nor mainly by the business enterprise sector and not primarily serving business enterprises.
  For international reporting, however, this sector includes only private non-profit organisations financed neither mainly by government nor mainly by the business enterprise sector (cf. Frascati Manual 1993, paras. 178–189).
– Abroad: On the financing side, this sector includes funds from abroad, the European Union and international organisations earmarked for research and development performed within the frontiers of the Federal Republic of Germany, while the performing side includes flows of R&D funds to other countries, to the EU and international organisations, even if the latter are based in Germany (cf. Frascati Manual 1993, paras. 215–219).

Personnel devoted to research and development (R&D personnel)
All persons employed directly on R&D, regardless of the level at which they are employed, including researchers, technicians and equivalent staff and other supporting staff (cf. Frascati Manual 1993, paras. 279 ff).

Researchers
Scientists or engineers engaged in the conception or creation of new knowledge, products, processes, methods and systems – as a rule, holders of university level degrees (cf. Frascati Manual 1993, para. 311).

Technicians and equivalent staff
Persons with technical training or equivalent non-technical training employed directly on R&D, usually under the supervision of researchers – generally persons who have completed trade or technical school (Fachschule) (cf. Frascati Manual 1993, para. 316).

Other supporting staff
Persons directly associated with R&D activities, i.e. secretarial, clerical and administrative staff, skilled craftsmen, unskilled and semi-skilled auxiliary staff (cf. Frascati Manual 1993, para. 319).

Full-time equivalent (FTE)
Unit to measure the full-time activity of a person over a certain period. This unit serves to express the working time of a person doing part-time R&D work (including part-time workers) as the working time of a full-time R&D worker (cf. Frascati Manual 1993, paras. 295 ff).

Territory

1. Results for Germany as a whole:
– Results for the Federal Republic of Germany covering the territory after 3 October 1990: ***"Germany"***

2. Results for parts of Germany:
– Results for the Federal Republic of Germany including West Berlin covering the territory up to 3 October 1990: ***"Former West Germany"***
– Results for the new German Länder and East Berlin as from 3 October 1990: ***"New Länder and East Berlin"***
  (The new Länder are Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia).

Legend

0 = less than half of one in the last decimal place, but more than nothing
\- = not available
. = survey not yet completed or no longer possible
X = not shown for reasons of confidentiality, but included in total

3. Tables

Footnotes and sources at the end of the table

3.1 Financial data

3.1.1 Federal Republic of Germany

Table 1

Science expenditure of the Federal Republic of Germany[1]

– DM million –

Funding sources	1989	1991	1993	1995	1996	1997	1998	1999
1. Government								
1.1 Territorial authorities[2]								
a) Federal Government including ERP[3]	16 423	20 096	20 520	20 290	20 481	19 796	19 913	20 789
b) Länder[4]	19 749	26 539	30 351	32 609	33 702	33 357	33 570	34 862
of which new Länder (without East Berlin)	.	3320	4425	5452	5920	5828	5863	5997
c) Local authorities	268	323	308	310	312	318	300	304
Total 1.1	**36 440**	**46 958**	**51 179**	**53 209**	**54 496**	**53 471**	**53 782**	**55 955**
1.2 Non-profit science organisations[5]	1555	1679	1643	1969	2033	2404	2404	2404
Total 1	**37 995**	**48 637**	**52 822**	**55 178**	**56 529**	**55 875**	**56 186**	**58 359**
in % of overall government budget[6]	*5.4*	*5,2*	*4,7*	*4,6*	*4,7*	*4,7*	*5,0*	*4,9*
2. Business enterprise sector[7]								
2.1 Business enterprises[8]	41 197	46 949	48 323	49 542	50 166	53 108	56 401	60 706
2.2 Foundations and donations[9]	620	620	620	620	620	600	600	600
Total 2	**41 817**	**47 569**	**48 943**	**50 162**	**50 786**	**53 708**	**57 001**	**61 306**
3. Government and business enterprise sector								
Total 1+2	**79 812**	**96 206**	**101 765**	**105 340**	**107 315**	**109 583**	**113 187**	**119 665**
in % of gross national income[10]	*3.2*	*3,3*	*3,1*	*3,0*	*3,0*	*3,0*	*3,0*	*3,1*

1 1989 former West Germany. Expenditure on research, development, academic teaching and other R&D-related activities.
2 Federal Government: actual figures up to and including 1998, 1999 budgeted figures; Länder: actual figures up to and including 1997, 1998 preliminary actual figures, 1999 budgeted figures; local government: actual figures up to and including 1997; estimates from 1998 onwards.
3 Deviations from publications of the Federal Statistical Office resulting from BMBF's own surveys.
4 Science expenditure by the Länder is based on "basic funds" resulting from deduction of direct receipts (especially Länder revenues from patient care in university hospitals) from net expenditure.
5 Expenditure from own revenue of the mainly government-funded institutes; actual figures up to and including 1997; 1998 and 1999 estimates.
6 Without social insurance.
7 Estimates for even years and 1999.
8 Data from surveys conducted by the Stifterverband Wissenschaftsstatistik, 1981 figures including data of the R&D payroll cost grants programme (German Federation of Industrial Co-operative Research Associations AiF), adjusted for double counting. Expenditure by the business enterprise (BE) sector covers intramural R&D expenditure and BE funds going to other sectors (e.g. higher education, entities abroad).
9 Including Volkswagen Foundation, estimates from 1991 onwards. Data from 1997 onwards not comparable with previous years.
10 Since 1991 in accordance with the European System of Accounts (ESA) 1995; 1989 gross national product.

Source: Federal Ministry of Education and Research (BMBF), Federal Statistical Office, Stifterverband Wissenschaftsstatistik — Rounding error

Tabelle 2

German R&D expenditure and financing sectors *

– DM million –

Year[1]	Territorial authorities[2] DM million	Territorial authorities[2] % of overall government budget	Business enterprise sector[3] DM million (finanziert durch)	Private non-profit sector[4] DM million (finanziert durch)	Total R&D expenditure DM million	Total R&D expenditure % of gross national income[5]
1962	2278	*2.1*	2150	62	**4490**	*1.3*
1963	2627	*2.2*	2670	83	**5380**	*1.4*
1964	3192	*2.5*	3279	89	**6560**	*1.6*
1965	3746	*2.7*	4060	94	**7900**	*1.7*
1966	4220	*2.9*	4500	100	**8820**	*1.8*
1967	4796	*3.1*	4807	107	**9710**	*2.0*
1968	4960	*3.1*	5454	106	**10 520**	*2.0*
1969	5674	*3.3*	6399	147	**12 220**	*2.0*
1970	6900	*3.5*	7610	190	**14 700**	*2.2*
1971	8700	*3.9*	8735	315	**17 750**	*2.4*
1972	9600	*3.8*	9180	270	**19 050**	*2.3*
1973	10 350	*3.7*	9624	266	**20 240**	*2.2*
1974	11 350	*3.6*	10 340	280	**21 970**	*2.2*
1975	12 035	*3.4*	11 792	310	**24 137**	*2.3*
1976	12 300	*3.3*	12 600	320	**25 220**	*2.2*
1977	12 600	*3.2*	14 109	320	**27 029**	*2.3*
1978	13 770	*3.2*	16 870	330	**30 970**	*2.4*
1979	15 109	*3.2*	18 663	92	**33 864**	*2.4*
1980	16 026	*3.1*	19 895	120	**36 041**	*2.4*
1981[6]	17 566	*3.2*	21 816	153	**39 535**	*2.6*
1982	18 734	*3.3*	23 415	163	**42 312**	*2.7*
1983	18 531	*3.2*	25 447	168	**44 146**	*2.6*
1984	19 260	*3.3*	27 040	153	**46 453**	*2.6*
1985	20 707	*3.4*	31 089	133	**51 929**	*2.8*
1986	21 103	*3.4*	33 613	193	**54 909**	*2.8*
1987	21 737	*3.3*	36 831	238	**58 806**	*2.9*
1988	22 054	*3.3*	38 740	282	**61 076**	*2.9*
1989	23 205	*3.3*	41 197	325	**64 727**	*2.9*
1990	24 897	*3.2*	43 187	355	**68 439**	*2.8*
1991	29 192	*3.2*	46 949	382	**76 523**	*2.59*
1992	30 019	*2.8*	48 049	283	**78 351**	*2.47*
1993	30 011	*2.7*	48 323	239	**78 573**	*2.42*
1994	30 070	*2.6*	48 130	254	**78 454**	*2.32*
1995	30 928	*2.6*	49 542	203	**80 673**	*2.30*
1996	31 509	*2.6*	50 166	246	**81 921**	*2.29*
1997	30 680	*2.6*	53 108	276	**84 064**	*2.30*
1998	30 955	*2.6*	56 401	280	**87 636**	*2.33*
1999	31 630	.	60 706	298	**92 634**	*2.41*

* Data from surveys conducted in domestic financing sectors. Up to and including 1990 former West Germany, from 1991 onwards Germany.

1 Estimated in some cases, actual figures for Federal Government up to and including 1998, for other sectors up to and including 1997 (territorial authorities revised from 1981 onwards).

2 Federal Government and Länder. Amounts given for federal research institutes from 1979 onwards and for Länder research institutes from 1983 onwards included only with their R&D shares.

3 Data from surveys conducted by the Stifterverband Wissenschaftsstatistik, from 1978 to 1989 figures including data of the R&D payroll cost grants programme (German Federation of Industrial Co-operative Research Associations AiF) - estimate for 1989 - adjusted for double counting. Expenditure by the business enterprise (BE) sector covers intramural R&D expenditure and BE funds received by other sectors (e.g. higher education, entities abroad).

4 Financed from own funds. Some data estimated.

5 Since 1991 gross national income as defined by the European System of Accounts (ESA) 1995; up to and including 1990 gross national product.

6 Due to revision, reduced comparability with earlier years of data for "Total R&D expenditure" and "Territorial authorities" as, in 1995, a new computing procedure for R&D in the higher education sector was introduced (affecting data for R&D expenditure by the Länder). Data for 1981 to 1994 were revised to facilitate comparison.

Source: Federal Ministry of Education and Research

Rounding error

Table 3

Gross domestic expenditure on R&D (GERD)

– DM million –

Performing sectors[1]	1981	1982	1983	1984	1985	1986	1987	1988	1989
Business enterprise sector[2]									
financed by									
Business enterprise sector	21 407	22 845	24 702	26 185	30 108	32 580	35 739	37 460	39 653
Government sector	4421	5340	4853	4930	5545	5260	4899	4950	5073
Private non-profit sector	58	70	81	65	55	60	62	90	124
Abroad	311	365	424	465	504	550	629	900	1236
Total	26 196	28 620	30 060	31 645	36 212	38 450	41 329	43 400	46 086
Government and private non-profit sector[3]									
financed by									
Business enterprise sector	69	75	78	100	122	133	140	140	141
Government sector	5088	5279	5642	5847	6332	6746	7148	7492	8097
Private non-profit sector	95	93	87	88	78	133	176	192	201
Abroad	52	52	56	62	80	98	109	113	120
Total	5304	5499	5864	6097	6612	7110	7573	7937	8559
Higher education sector[4]									
financed by									
Business enterprise sector	115	230	349	370	394	450	525	590	646
Government sector	6365	6370	6383	6630	6909	7350	7707	8038	8426
Private non-profit sector	.	.	.	.	.	.	.	.	.
Abroad	.	.	.	.	.	.	.	.	.
Total	6480	6600	6732	7000	7303	7800	8232	8628	9072
Gross domestic expenditure on R&D									
financed by									
Business enterprise sector	21 591	23 150	25 129	26 655	30 624	33 163	36 404	38 190	40 440
Government sector	15 874	16 989	16 878	17 407	18 786	19 356	19 754	20 480	21 596
Private non-profit sector	153	163	168	153	133	193	238	282	325
Abroad	363	417	480	527	584	648	738	1013	1356
Total	37 981	40 719	42 655	44 742	50 127	53 360	57 134	59 965	63 717
GERD in % of GDP[5]	*2.47*	*2.56*	*2.56*	*2.56*	*2.75*	*2.77*	*2.87*	*2.86*	*2.86*

* Data from surveys conducted in performing sectors. Up to and including 1990 former West Germany, from 1991 onwards Germany.

1 Estimated in some cases, actual figures up to and including 1997.

2 Intramural business enterprise expenditure on R&D including government funds that cannot be broken down, but excluding government funds not accounted for (OECD concept), hence deviations from financing sector data for government funds.

3 Non-university institutions. Government: (Research) institutions owned by Federal, *Länder* and local governments, federal institutions from 1981 onwards, *Länder* institutions included only with their R&D shares from 1985 onwards. From 1992 onwards modified surveying concept, 1995 extension of coverage.

4 Revised up to and including 1995.

5 From 1991 onwards calculation of GDP in accordance with ESA (European System of Accounts) 1995 (break in series)

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office and calculations by BMBF

Regional data: tables 14; 39 to 48; 51b
International data: tables 25 to 28; 49

in Germany* by performing sector

– DM million –

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
41 410	45 023	45 695	45 578	45 490	47 005	47 560	49 734	52 569	56 640
5150	5164	5150	4594	4600	4647	4800	5196	5100	5000
140	148	140	86	100	40	40	56	60	60
1300	1340	1300	978	1000	1143	1200	1556	1600	1600
48 000	51 675	52 285	51 236	51 190	52 835	53 600	56 543	59 329	63 300
140	138	367	392	396	418	227	242	242	261
8410	10 198	10 111	10 800	10 907	11 520	11 697	11 599	12 099	12 533
215	235	143	153	154	163	206	220	220	238
110	103	136	145	146	154	202	206	210	223
8875	10 673	10 757	11 490	11 603	12 255	12 332	12 268	12 771	13 255
767	846	987	1121	1144	1184	1380	1462	1490	1505
8955	11 173	11 850	12 081	12 489	13 093	13 368	13 297	13 560	13 691
.	.	.	.	.	.	.	.	.	.
.	.	90	130	174	153	219	256	260	264
9722	12 019	12 927	13 332	13 807	14 430	14 967	15 014	15 310	15 460
42 317	46 007	47 049	47 091	47 030	48 607	49 166	51 438	54 301	58 406
22 515	26 535	27 111	27 475	27 996	29 260	29 865	30 092	30 759	31 224
355	383	283	239	254	203	246	276	280	298
1410	1443	1526	1253	1320	1450	1621	2018	2070	2087
66 597	74 368	75 969	76 058	76 600	79 520	80 898	83 825	87 410	92 015
2.75	*2.53*	*2.41*	*2.35*	*2.26*	*2.26*	*2.26*	*2.29*	*2.31*	*2.37*

3.1.2 Government sector

Table 4

Science expenditure* of the government by area and source of funding

– DM million –

Area	Year[1]	Total science expenditure	financed by: Federal Government[2] (including ERP)	Länder[*3]	Local government[*3]	Non-profit science organisations[4]
Institutions of higher education including university hospitals[5]	1981	**14 978.9**	1601.1	13 377.8	-	.
	1989	**19 643.8**	2218.0	17 425.8	-	.
	1990	**21 023.7**	2385.1	18 638.6	-	.
	1991	**26 103.8**	3313.1	22 790.7	-	.
	1992	**28 392.5**	3618.1	24 774.4	-	.
	1993	**30 101.1**	3845.6	26 255.5	-	.
	1994	**30 710.2**	3734.5	26 975.7	-	.
	1995	**32 098.8**	3909.3	28 189.5	-	.
	1996	**32 938.6**	3816.7	29 121.9	-	.
	1997	**32 807.8**	3842.8	28 965.0	-	.
	1998	**32 786.2**	3911.2	28 875.0		
	1999	**34 140.3**	4372.6	29 767.7		
Science and research outside higher education institutions[6]	1981	**12 405.5**	10 321.8	1444.0	198.0	441.7
	1989	**18 350.7**	14 204.9	2323.0	267.8	1555.0
	1990	**19 785.9**	15 253.3	2452.7	270.9	1809.0
	1991	**22 532.3**	16 782.4	3747.8	323.1	1679.0
	1992	**23 082.8**	17 247.8	3769.9	345.9	1719.2
	1993	**22 721.3**	16 674.7	4095.2	308.1	1643.3
	1994	**22 524.0**	16 325.1	4134.3	295.9	1768.7
	1995	**23 079.0**	16 380.9	4419.1	310.3	1968.7
	1996	**23 589.9**	16 664.7	4580.1	312.1	2033.0
	1997	**23 067.3**	15 953.3	4392.0	318.0	2404.0
	1998	**23 400.2**	16 001.5	4694.8	299.9	2404.0
	1999	**24 218.5**	16 416.8	5094.1	303.6	2404.0
Total government science expenditure	1981	**27 384.3**	11 922.8	14 821.8	198.0	441.7
	1989	**37 994.5**	16 422.9	19 748.8	267.8	1555.0
	1990	**40 809.6**	17 638.4	21 091.3	270.9	1809.0
	1991	**48 636.1**	20 095.5	26 538.5	323.1	1679.0
	1992	**51 475.3**	20 865.9	28 544.3	345.9	1719.2
	1993	**52 822.4**	20 520.4	30 350.7	308.1	1643.2
	1994	**53 234.1**	20 059.6	31 109.9	295.9	1768.7
	1995	**55 177.7**	20 290.1	32 608.6	310.3	1968.7
	1996	**56 528.5**	20 481.4	33 702.0	312.1	2033.0
	1997	**55 875.1**	19 796.1	33 357.0	318.0	2404.0
	1998	**56 186.4**	19 912.7	33 569.8	299.9	2404.0
	1999	**58 358.8**	20 789.4	34 861.8	303.6	2404.0

cont. Table 4

Science expenditure* of the government by area and source of funding

– DM million –

Area	Year[1]	Total science expenditure	financed by: Federal Government[2] (including ERP)	Länder*[3]	Local government *[3]	Non-profit science organi-sations[4]
of which New *Länder* (excluding East Berlin)	1991	.	.	3320.0	.	.
	1992	.	.	3555.4	24.5	*80.8*
	1993	.	.	4425.2	22.7	*132.0*
	1994	.	.	4981.5	22.2	*102.3*
	1995	.	.	5452.3	21.2	*140.6*
	1996	.	.	5919.8	22.2	*326.5*
	1997	.	.	5828.0	21.0	*219.8*
	1998	.	.	5863.0	20.5	*219.8*
	1999	.	.	5997.4	19.7	*219.8*

* Science expenditure by the *Länder* is based on "basic funds" resulting from deduction of direct receipts (especially *Länder* revenues from patient care in university hospitals) from net expenditure.

1 Up to and including 1990, data refer to former West Germany, from 1991 onwards to Germany. Federal Government: actual figures up to and including 1998, 1999 budgeted figures; *Länder*: actual figures up to and including 1997, 1998 preliminary actual figures, 1999 budgeted figures; local government: actual figures up to and including 1997, estimates from 1998 onwards; science organisations: actual figures up to and including 1997, estimates from 1998 onwards.

2 Deviations from publications of the Federal Statistical Office resulting from BMBF's own surveys.

3 For breakdown by *Länder* see table 14.

4 Financed from own revenue of the mainly government-funded institutions.

5 Institutions of higher education including Bundeswehr universities, payments to the DFG (with collaborative research centres SFB) and additional funds of hospitals keeping commercial accounts; from 1989 onwards including special funding programmes for higher education and research and financial assistance to structurally weak *Länder* – if earmarked for higher education purposes -, from 1991 onwards including the Programme for the Renewal of Higher Education and Research in the New *Länder* and East Berlin.

6 Including relevant expenditure from the defence budget and financial assistance to structurally weak *Länder* - if earmarked for science and research.

Source: Federal Statistical Office, Federal Ministry of Education and Research — Rounding error

Table 5

Science expenditure of the government by area and type of expenditure (direct expenditure)*

– DM million –

Area	Year[1]	Total direct expenditure	of which: Staff expenditure	Other current expenditure	Construction work	Other investments
Institutions of higher education including university hospitals2)	1981	**19 594.5**	12 295.5	4595.0	1670.3	1033.7
	1989	**29 461.5**	17 428.7	8238.9	1781.5	2012.4
	1990	**31 619.6**	18 845.1	8750.8	1871.0	2152.7
	1991	**34 985.6**	20 937.5	9964.2	1999.0	2084.9
	1992	**43 577.4**	25 957.3	12 431.4	2464.4	2724.3
	1993	**46 393.5**	27 517.2	13 574.6	2596.0	2705.7
	1994	**47 828.8**	28 182.8	14 093.6	2773.1	2779.3
	1995	**50 266.3**	29 323.2	15 259.5	2818.0	2865.6
	1996	**52 320.6**	29 650.5	16 529.4	3297.2	2843.5
	1997	**53 289.7**	30 153.7	17 086.4	3487.0	2562.6
	1998	**54 280.7**	.	.	.	.
	1999	**54 611.3**	.	.	.	.
Science and research outside higher education institutions3)	1981	**12 961.6**	3139.4	6759.6	508.2	2554.4
	1989	**18 634.8**	4675.2	10 075.1	890.1	2994.4
	1990	**20 139.3**	5026.2	10 127.3	921.5	4064.3
	1991	**21 992.6**	5751.7	12 868.8	815.6	2556.5
	1992	**21 480.1**	7106.7	11 778.3	867.3	1727.8
	1993	**21 846.7**	7778.1	11 335.2	1058.1	1675.3
	1994	**23 500.3**	8045.2	12 083.6	1132.8	2238.7
	1995	**23 994.4**	8419.2	12 328.3	1073.1	2173.8
	1996	**24 757.1**	8650.7	12 621.4	1427.1	2057.9
	1997	**23 661.9**	8598.7	12 309.2	1211.8	1542.1
	1998	**23 914.0**	.	.	.	.
	1999	**24 375.5**	.	.	.	.
Total government science expenditure	1981	**32 556.2**	15 434.9	11 354.7	2178.5	3588.1
	1989	**48 096.1**	22 103.9	18 313.9	2671.5	5006.8
	1990	**51 759.0**	23 871.3	18 878.2	2792.5	6217.0
	1991	**56 978.2**	26 689.2	22 833.0	2814.6	4641.4
	1992	**65 057.5**	33 064.0	24 209.7	3331.7	4452.1
	1993	**68 240.2**	35 295.3	24 909.8	3654.1	4381.0
	1994	**71 329.1**	36 228.0	26 177.2	3905.9	5018.0
	1995	**74 260.7**	37 742.4	27 587.8	3891.1	5039.4
	1996	**77 077.6**	38 301.2	29 150.7	4724.3	4901.4
	1997	**76 951.6**	38 752.4	29 395.6	4698.8	4104.7
	1998	**78 194.7**	.	.	.	.
	1999	**78 986.8**	.	.	.	.

cont. Table 5

Science expenditure of the government by area and type of expenditure (direct expenditure)*

– DM million –

Area	Year[1]	Total direct expenditure	of which: Staff expenditure	Other current expenditure	Construction work	Other investments
of which:	1991	**.**	.	.	.	–
New *Länder*	1992	**6253.2**	4061.4	1052.4	307.1	832.3
(excluding East Berlin)	1993	**7525.6**	4696.4	1292.6	584.6	952.0
	1994	**8123.3**	4607.9	1725.4	802.7	987.2
	1995	**8970.7**	5046.4	1904.2	950.5	1069.6
	1996	**9396.0**	5294.8	2014.8	1108.4	978.0
	1997	**9526.9**	5477.4	2021.2	1200.8	827.6
	1998	**9955.7**	.	.	.	.
	1999	**9927.4**	.	.	.	.

* Breakdown of science expenditure by type of expenditure is possible for direct expenditure only. Comparison with table 4 is possible only to a limited extent as table 4 is based on net expenditure – adjusted for direct receipts of the *Länder*.

1 Up to and including 1990 former West Germany
1991: Federal Government (including ERP): Germany; *Länder* and non-profit science organisations: former West Germany; Berlin: East and West Berlin; from 1992 onwards: Germany. Basic data: actual figures up to and including 1997, estimates from 1998 onwards.

2 Institutions of higher education including Bundeswehr universities, payments to the DFG (with collaborative research centres SFB) and additional funds of hospitals keeping commercial accounts; from 1989 onwards including special funding programmes for higher education and research and financial assistance to structurally weak *Länder* – if earmarked for higher education purposes –, from 1991 onwards including the Programme for the Renewal of Higher Education and Research in the New *Länder* and East Berlin. Payments to hospitals keeping commercial accounts were to some extent included in payments to other areas in the 1996 and 1997 budgeted expenditure, which therefore show major increases.

3 Including relevant expenditure from the defence budget and financial assistance to structurally weak *Länder* – if earmarked for science and research.

Source: Federal Statistical Office, Federal Ministry of Education and Research

Rounding error

Table 6: not included*

Table 7

Federal expenditure on science, research and

– DM million –

Government department	1989 actual		1991 actual		1993 actual		1995 actual	
	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
Federal Chancellor and Federal Chancellery[1]	211.6	100.1	347.8	156.1	456.6	133.3	452.1	128.3
Federal Foreign Office	251.9	169.5	345.2	240.6	347.5	236.8	354.7	240.4
Federal Ministry of the Interior[2]	87.6	58.8	181.1	105.9	235.3	109.2	164.0	97.3
Federal Ministry of Justice	3.0	3.0	2.7	2.7	2.8	2.8	2.5	2.5
Federal Ministry of Finance[3]	32.2	32.2	39.2	39.2	41.2	41.2	43.7	43.7
Federal Ministry of Economics and Technology[4]	2232.1	1871.8	2413.7	2093.9	2270.0	1921.5	2052.3	1732.0
Federal Ministry of Food, Agriculture and Forestry	314.9	269.8	323.7	276.9	533.3	438.9	499.2	404.3
Federal Ministry of Labour and Social Affairs	51.0	20.7	94.0	34.4	98.6	39.9	97.6	41.3
Federal Ministry of Transport, Building and Housing[5]	283.7	191.9	351.7	243.7	417.0	267.9	396.5	208.9
Federal Ministry of Defence	3295.6	3155.5	3353.7	3192.7	2829.3	2662.0	3043.3	2874.1
Federal Ministry for Health	443.8	254.6	515.8	305.3	534.7	304.9	434.2	235.7
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety	214.3	150.3	353.4	196.8	391.2	194.8	455.7	213.6
Federal Ministry for Family Affairs, Senior Citizens, Women and Youth	25.4	25.4	32.0	32.0	37.3	37.3	38.9	38.9
Federal Ministry for Economic Co-operation and Development	47.2	44.7	66.7	63.7	59.8	56.0	53.6	49.7
Federal Ministry of Education and Research[6/7]	639.6	7550.9	10 485.7	8908.4	11 998.6	10 184.7	12 046.6	10 080.8
General Fiscal Administration[8]	286.1	286.1	1186.5	1109.5	266.1	266.1	155.5	155.5
Total expenditure	**16 420.1**	**14 185.2**	**20 092.7**	**17 001.9**	**20 519.5**	**16 897.1**	**20 290.1**	**16 547.2**

* In order to ensure comparability of the Report of the Federal Government on Research 2000 with earlier research reports, the consecutive numbering of the tables was retained although some tables have not been included in the present report.

** Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between federal government departments.

1 Including expenditure by the Federal Government Commissioner for Cultural Affairs and the Media. For comparison, relevant cultural expenditure by the Federal Ministry of the Interior (BMI) was added retrospectively for the years up to and including 1998.

2 For comparison, relevant cultural expenditure up to and including 1998 was retrospectively shifted to the Federal Government Commissioner for Cultural Affairs and the Media.

3 For comparison, relevant expenditure on economic research institutes and on economic research of the Federal Ministry of Economics and Technology (BMWi) was added retrospectively for the years up to and including 1998.

4 For comparison, relevant expenditure on economic research institutes and on economic research up to and including 1998 was retrospectively shifted to the Federal

development by government department**

– DM million –

actual						budgeted			
1996		1997		1998		1999		2000	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
483.6	132.9	431.3	124.9	420.5	130.0	433.9	130.6	461.6	138.1
347.8	238.7	343.8	234.3	355.2	240.8	360.7	243.4	352.5	239.8
173.3	98.5	158.6	95.7	120.1	71.3	128.9	75.3	139.6	80.9
2.9	2.9	2.8	2.8	2.8	2.8	2.8	2.8	3.1	3.1
43.9	43.9	44.5	44.5	48.2	48.2	52.2	52.2	64.5	64.5
2011.0	1691.2	1766.0	1458.3	1846.3	1566.3	1945.8	1645.6	1838.7	1540.2
505.4	409.7	535.2	438.3	524.2	430.1	508.2	418.9	504.2	414.0
107.4	48.6	114.3	50.2	130.4	62.4	121.4	52.6	117.1	51.8
433.9	205.1	442.5	213.3	461.4	210.1	447.9	220.0	436.6	209.2
3090.8	2915.7	3014.8	2842.0	2840.3	2664.8	2893.1	2707.2	2797.7	2608.0
462.1	247.2	478.7	214.4	475.2	207.2	509.3	214.6	603.5	229.0
486.1	220.7	467.7	208.1	466.4	214.4	555.4	229.1	529.3	224.1
39.6	39.6	35.8	35.8	31.6	31.6	34.8	34.8	30.2	30.2
49.2	45.5	58.2	54.6	63.4	59.7	63.4	59.3	54.3	49.3
12 078.1	10 233.5	11 865.5	10 008.8	12 088.2	10 192.5	12 682.6	10 645.0	12 825.4	10 833.4
166.5	166.5	36.4	36.4	38.4	38.4	49.2	38.4	136.2	133.6
20 481.4	**16 740.3**	**19 796.1**	**16 062.3**	**19 912.7**	**16 170.7**	**20 789.4**	**16 769.6**	**20 894.6**	**16 849.3**

Ministry of Finance (BMF) and expenditure by the Federal Ministry of Education and Research (BMBF) in the areas of non-nuclear and nuclear energy research, aeronautical research, innovation and, to some extent, multimedia was added retrospectively for the years up to and including 1998.

5 For comparison, expenditure by the former Federal Ministry of Building and Housing (BMBau) was added retrospectively for the years up to and including 1998.

6 For comparison, relevant expenditure in the areas of non-nuclear and nuclear energy research, aeronautical research, innovation and, to some extent, multimedia up to and including 1998 was retrospectively shifted to the Federal Ministry of Economics and Technology (BMWi).

7 Total reduction of expenditure taken into account (1999: DM200 million, 2000: DM220 million).

8 Including financial assistance pursuant to para. 4 of Article 104a Basic Law to structurally weak *Länder* for investments promoting research and technology (1991 to 1993) and including funds for higher education and projects at industry-related research centres in the process of German unification (1991 to 1996). From 2000 onwards increase in payments to the Volkswagen Foundation.

Source: Federal Ministry of Education and Research

Rounding error

Table 8

Federal expenditure on science, research and

– DM million –

Funding area / Funding priority	1989 Total (actual)	1989 of which R&D (actual)	1991 Total (actual)	1991 of which R&D (actual)	1993 Total (actual)	1993 of which R&D (actual)	1995 Total (actual)	1995 of which R&D (actual)
A Research funding organisations; restructuring of research in the new *Länder*, university construction and mainly university-related special programmes	**2627.2**	**1644.0**	**4154.2**	**2553.6**	**4540.9**	**2805.7**	**4738.4**	**2952.6**
A1 Basic funding MPG	457.2	457.2	499.3	499.3	608.6	608.6	696.5	696.5
A2 Basic funding DFG	609.6	609.6	697.1	697.1	814.1	814.1	936.0	936.0
A3 Basic funding FhG	154.5	154.5	182.0	182.0	363.4	363.4	409.9	409.9
A4 Restructuring of research in the new *Länder*	0.0	0.0	450.0	450.0	0.0	0.0	0.0	0.0
A5 Expansion and construction of universities[1]	1223.3	345.0	1885.6	535.8	1967.7	545.5	2038.4	582.0
A6 Mainly university-related special programmes[2]	182.7	77.7	440.1	189.3	787.1	474.1	657.6	328.2
B Large-scale equipment for basic research	**979.1**	**979.1**	**948.7**	**948.7**	**1017.1**	**1017.1**	**1036.8**	**1036.8**
C Marine and polar research; marine technology	**240.0**	**237.8**	**246.8**	**243.9**	**278.7**	**275.2**	**307.9**	**282.6**
C1 Marine and polar research	177.9	177.9	173.1	173.1	213.6	213.6	263.9	242.7
C2 Marine technology	62.1	59.9	73.6	70.8	65.1	61.6	44.0	39.9
D Space research and space technology	**1217.0**	**1217.0**	**1540.1**	**1540.1**	**1803.5**	**1803.5**	**1582.1**	**1582.1**
D1 National funding of space research and space technology	504.1	504.1	575.8	575.8	615.1	615.1	490.5	490.5
D2 European Space Agency (ESA)	712.9	712.9	964.3	964.3	1188.4	1188.4	1091.6	1091.6
E Energy research and energy technology	**1419.1**	**1231.9**	**1439.0**	**1203.7**	**1271.1**	**1014.6**	**1190.4**	**826.4**
E1 Coal and other fossil fuels	157.2	157.2	113.1	113.1	63.2	63.2	35.5	33.2
E2 Renewable energy and energy conservation	240.9	240.9	332.5	332.5	355.6	355.6	302.4	302.4
E3 Nuclear energy research (excluding decommissioning of nuclear facilities)	667.5	641.8	591.5	482.8	443.3	341.5	408.3	270.2
E4 Decommissioning of nuclear facilities; risk sharing	164.7	3.3	204.4	77.7	191.9	37.2	238.5	15.0
E5 Nuclear fusion research	188.8	188.8	197.6	197.6	217.1	217.1	205.6	205.6
F Sustainable development	**813.4**	**667.9**	**1031.5**	**872.4**	**1252.1**	**1015.7**	**1250.5**	**984.3**
F1 Socio-ecological research; regional sustainability	371.3	307.0	465.4	381.1	557.1	428.8	520.7	403.8
F2 Sustainable production; cleaner environmental technology	369.5	288.2	406.2	331.4	460.8	352.7	486.5	338.6
F7 Global change (including peace-building research)	72.7	72.7	159.8	159.8	234.2	234.2	243.3	241.8
G Research and development in the health sector	**690.8**	**540.0**	**833.2**	**669.3**	**943.6**	**764.5**	**931.5**	**770.5**
H Research and development to improve working conditions	**138.6**	**108.3**	**185.9**	**126.3**	**160.7**	**102.0**	**152.6**	**96.3**

development by funding area and funding priority

– DM million –

actual						budgeted			
1996		1997		1998		1999[3]		2000[3]	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
4659.9	**3007.5**	**4726.9**	**3050.7**	**4834.1**	**3127.3**	**5141.5**	**3312.8**	**5133.8**	**3342.6**
711.1	711.1	747.8	747.8	785.2	785.2	830.1	830.1	855.0	855.0
982.2	982.2	1017.8	1017.8	1049.6	1049.6	1136.8	1136.8	1170.4	1170.4
413.0	413.0	429.2	429.2	446.0	446.0	468.3	468.3	482.3	482.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2044.3	583.5	2036.6	582.9	2036.6	583.5	2254.4	646.1	2259.2	647.0
509.4	317.8	495.4	273.0	516.7	263.1	452.0	231.6	366.9	187.9
1056.1	**1056.1**	**1027.3**	**1027.3**	**1036.4**	**1036.4**	**1076.8**	**1076.8**	**1099.1**	**1099.1**
311.1	282.2	299.1	271.0	306.4	273.4	316.1	282.1	309.8	276.6
266.6	241.1	259.2	234.0	263.9	239.2	269.1	242.8	262.8	237.2
44.5	41.1	39.9	37.0	42.5	34.3	46.9	39.4	47.0	39.5
1550.7	**1550.7**	**1449.1**	**1449.1**	**1429.7**	**1429.7**	**1415.7**	**1415.7**	**1426.4**	**1426.4**
516.7	516.7	450.6	450.6	462.7	462.7	445.7	445.7	446.4	446.4
1034.0	1034.0	998.5	998.5	967.0	967.0	970.0	970.0	980.0	980.0
1235.6	**834.9**	**1188.1**	**791.1**	**1219.8**	**833.7**	**1309.1**	**861.7**	**1257.4**	**834.4**
34.0	31.7	29.6	27.4	39.4	37.2	47.0	44.6	37.2	34.9
332.9	332.9	294.4	294.4	296.9	296.9	317.7	317.7	304.6	304.6
420.0	261.1	400.0	241.8	393.1	246.0	452.0	237.4	410.3	226.9
254.2	14.8	251.8	15.3	251.5	14.7	245.2	14.7	252.4	15.1
194.4	194.4	212.2	212.2	239.0	239.0	247.2	247.2	252.8	252.8
1317.5	**1044.4**	**1285.9**	**1019.0**	**1273.3**	**1014.6**	**1337.0**	**1066.6**	**1396.7**	**1108.0**
547.3	425.6	534.0	416.2	521.7	400.7	592.6	464.0	594.4	455.4
535.7	385.8	530.1	382.5	519.4	383.1	477.1	336.9	503.6	355.4
234.5	233.0	221.8	220.3	232.2	230.8	267.3	265.8	298.7	297.2
948.3	**775.1**	**1000.9**	**756.2**	**1024.7**	**775.2**	**1091.6**	**815.6**	**1195.5**	**840.9**
154.7	**96.0**	**149.2**	**85.1**	**157.2**	**89.1**	**167.2**	**98.4**	**164.9**	**99.5**

cont. Table 8

Federal expenditure on science, research and

– DM million –

Funding area / Funding priority	1989 actual Total	1989 of which R&D	1991 Total	1991 of which R&D	1993 Total	1993 of which R&D	1995 Total	1995 of which R&D
I Information technology (including multimedia and production engineering)	**732.9**	**710.9**	**919.1**	**872.0**	**1020.1**	**970.1**	**1017.6**	**966.8**
I1 Computer science	223.2	223.2	271.0	247.5	262.5	235.3	242.4	213.4
I2 Basic information technologies	328.5	328.5	368.9	368.9	434.5	434.5	436.5	436.5
I3 Application of microsystems (including application of microelectronics; microperipherals)	71.0	71.0	98.4	98.4	154.8	154.8	161.4	161.4
I4 Production engineering	70.6	70.6	127.9	127.9	121.9	121.9	100.8	100.8
I5 Multimedia	39.5	17.6	53.0	29.3	46.5	23.6	76.5	54.7
K Biotechnology	**260.8**	**260.8**	**274.5**	**274.5**	**407.6**	**388.0**	**417.6**	**397.1**
L Materials research; physical and chemical technologies	**667.3**	**538.4**	**719.4**	**609.9**	**737.9**	**614.2**	**744.6**	**662.8**
L1 Materials research; materials for emerging technologies	251.3	239.5	311.4	294.1	291.5	270.6	301.1	289.0
L2 Physical and chemical technologies	415.9	298.9	408.0	315.8	446.4	343.6	443.5	373.8
M Aeronautical research and hypersonic technology	**710.2**	**710.2**	**898.7**	**898.7**	**619.5**	**619.5**	**351.4**	**351.4**
N Research and technology for mobility and transport (including traffic safety)	**294.7**	**222.2**	**319.8**	**238.8**	**328.5**	**227.2**	**282.7**	**187.3**
O Geosciences and raw material supplies	**195.6**	**137.6**	**262.3**	**190.5**	**319.1**	**242.0**	**211.8**	**161.6**
O1 Geosciences (especially deep drillings)	144.2	106.0	204.0	155.9	258.2	207.1	207.9	159.1
O2 Raw material supplies	51.4	31.6	58.2	34.6	60.9	34.9	3.9	2.5
P Regional planning and urban development; building research	**148.5**	**137.2**	**194.4**	**179.9**	**198.5**	**180.7**	**123.8**	**123.1**
P1 Regional planning, urban development, housing	33.3	32.7	49.2	48.7	52.1	51.4	46.4	45.7
P2 Building research and technology; research and technology for preserving the architectural heritage; road building research	115.1	104.5	145.1	131.2	146.4	129.3	77.3	77.3
Q Research and development in the food sector	**98.0**	**88.8**	**105.6**	**95.9**	**121.9**	**103.3**	**130.4**	**91.4**
R Research and development in agriculture, forestry and fishery	**255.2**	**219.4**	**467.8**	**430.1**	**341.6**	**288.4**	**307.3**	**254.1**
S Educational research	**125.7**	**91.2**	**148.0**	**107.3**	**165.9**	**121.9**	**154.5**	**118.2**
S1 Vocational training research	62.4	56.6	73.6	66.9	79.7	72.6	79.0	72.3
S2 Other educational research	63.3	34.6	74.4	40.4	86.2	49.3	75.5	45.8
T Innovation and improved basic conditions	**452.2**	**352.2**	**497.9**	**426.9**	**740.7**	**664.8**	**930.7**	**860.6**
T1 Indirect funding of R&D personnel in the business enterprise sector	113.4	113.4	32.2	32.2	113.5	113.5	126.1	126.1

development by funding area and funding priority

– DM million –

actual						budgeted			
1996		1997		1998		1999[3]		2000[3]	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
1088.6	**1027.7**	**989.3**	**936.0**	**1021.9**	**961.2**	**1101.3**	**1035.8**	**1158.5**	**1096.5**
262.2	222.1	220.6	187.4	216.8	176.0	228.7	188.9	241.8	197.1
423.0	423.0	355.1	355.1	381.0	381.0	390.9	390.9	397.9	397.9
167.3	167.3	158.7	158.7	149.8	149.8	151.6	151.6	151.7	151.7
117.1	117.1	115.0	115.0	117.9	117.9	118.0	118.0	120.0	120.0
119.0	98.2	140.0	119.8	156.3	136.4	212.1	186.5	247.1	229.8
426.7	**406.3**	**440.3**	**420.0**	**480.5**	**461.1**	**499.6**	**481.3**	**523.9**	**506.2**
786.6	**708.2**	**745.2**	**668.3**	**746.1**	**701.0**	**797.8**	**747.9**	**792.2**	**744.2**
306.2	295.5	294.1	282.1	300.8	289.5	326.3	313.8	327.8	316.4
480.4	412.6	451.2	386.2	445.4	411.5	471.5	434.1	464.3	427.9
329.6	**329.6**	**296.9**	**296.9**	**282.4**	**282.4**	**271.8**	**271.8**	**234.6**	**234.6**
304.2	**182.7**	**311.8**	**188.0**	**315.2**	**183.5**	**341.6**	**226.0**	**278.6**	**168.7**
194.7	**145.4**	**152.3**	**104.0**	**106.4**	**68.7**	**106.6**	**70.5**	**115.6**	**79.8**
190.6	142.8	148.2	101.3	102.5	66.1	102.7	68.1	112.0	77.7
4.1	2.6	4.2	2.7	4.0	2.5	3.9	2.4	3.6	2.1
104.8	**103.3**	**99.4**	**97.9**	**94.3**	**92.7**	**95.9**	**94.3**	**100.8**	**99.2**
44.8	43.3	39.7	38.2	43.4	41.8	43.8	42.2	43.8	42.2
60.0	60.0	59.8	59.8	50.9	50.9	52.1	52.1	57.0	57.0
139.6	**98.6**	**105.3**	**84.3**	**100.6**	**79.6**	**96.2**	**76.3**	**90.4**	**71.1**
309.2	**256.1**	**308.9**	**255.6**	**302.0**	**250.9**	**292.3**	**243.7**	**287.3**	**237.8**
160.8	**121.3**	**142.8**	**106.7**	**160.4**	**121.3**	**208.1**	**154.4**	**201.1**	**157.0**
78.7	72.2	71.1	66.2	76.7	70.8	94.7	86.3	109.6	101.0
82.2	49.0	71.7	40.5	83.7	50.6	113.4	68.1	91.5	56.0
902.5	**834.3**	**779.5**	**717.5**	**878.4**	**799.4**	**925.7**	**841.3**	**883.1**	**800.4**
116.2	116.2	104.2	104.2	90.7	90.7	80.0	80.0	70.0	70.0

cont. Table 8

Federal expenditure on science, research and

– DM million –

Funding area Funding priority	1989 Total	1989 of which R&D	1991 Total	1991 of which R&D	1993 Total	1993 of which R&D	1995 Total	1995 of which R&D
	actual							
T2 Improving the transfer of technology and knowledge	70.5	61.3	85.4	73.9	153.1	138.6	245.0	224.1
T3 Sharing the innovation risk of technology-based firms	53.5	53.5	45.9	45.9	81.7	81.7	70.0	70.0
T4 Other indirect funding measures (excluding indirect specific measures)	106.9	106.9	199.8	199.8	169.6	169.6	169.9	169.9
T8 Rationalisation as well as scientific and technical departmental services (BMWi)	95.0	4.3	64.0	4.4	65.6	4.2	53.5	4.2
T9 Other funding measures (BMWi)	12.8	12.8	70.6	70.6	157.1	157.1	266.2	266.2
U Specialised information	**95.8**	**67.5**	**108.8**	**74.6**	**98.8**	**66.1**	**65.7**	**36.7**
V Humanities; economics and social sciences	**466.8**	**352.2**	**633.6**	**438.6**	**802.5**	**475.8**	**785.7**	**458.7**
W1/W2 Structural/innovative (generic) measures/Other generic activities	**662.8**	**543.0**	**992.5**	**836.6**	**712.8**	**501.7**	**735.0**	**506.1**
W1 Structural/innovative (generic) measures	13.6	8.8	26.6	22.1	13.5	9.0	28.0	23.7
W2 Other generic activities	649.2	534.2	966.0	814.6	699.3	492.7	707.0	482.3
W3 Total reduction of expenditure of BMBF[4]	-	-	-	-	-	-	-	-
A-W Total of civil funding areas	**13 291.7**	**11 057.7**	**16 921.7**	**13 832.1**	**17 883.2**	**14 262.1**	**17 449.1**	**13 707.3**
X Defence research and technology	**3128.4**	**3127.6**	**3171.0**	**3169.8**	**2636.3**	**2635.0**	**2841.1**	**2839.9**
Total expenditure	**16 420.1**	**14 185.2**	**20 092.7**	**17 001.9**	**20 519.5**	**16 897.1**	**20 290.1**	**16 547.2**

1 Including Bundeswehr universities and the Federal Government's college of public administration.

2 Including the programme to secure the performance and openness of higher education institutions in particularly overcrowded subjects (HSP I, 1991 to 1995), the programme for the renewal of higher education and research in the new *Länder* and East Berlin (HEP, 1991 to 1996) and the programme to secure the performance of higher education and research (HSP II/III, from 1991 onwards).

3 Estimated in some cases.

4 Breakdown of total reduction of expenditure of BMBF by funding area and funding priority is possible for actual expenditure only.

Source: Federal Ministry of Education and Research

development by funding area and funding priority

– DM million –

actual						budgeted			
1996		1997		1998		1999[3]		2000[3]	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
208.7	190.2	179.5	164.5	282.3	248.5	304.2	269.6	277.0	242.8
82.7	82.7	91.0	91.0	98.6	98.6	114.6	114.6	120.0	120.0
169.8	169.8	150.3	150.3	172.0	172.0	180.0	180.0	175.0	175.0
54.2	4.5	50.1	3.1	48.7	3.6	54.5	4.7	52.9	4.3
270.9	270.9	204.4	204.4	186.0	186.0	192.4	192.4	188.2	188.2
56.2	**24.4**	**51.6**	**22.2**	**49.6**	**18.7**	**52.1**	**19.4**	**55.7**	**20.4**
821.6	**467.5**	**772.2**	**459.5**	**768.8**	**474.8**	**783.3**	**473.7**	**825.0**	**495.4**
740.8	**508.0**	**666.8**	**450.0**	**695.4**	**468.4**	**892.4**	**635.4**	**1014.6**	**762.5**
36.9	31.9	47.5	43.4	47.2	43.0	237.5	199.8	263.5	222.7
703.9	476.1	619.4	406.6	648.2	425.4	654.9	435.6	751.1	539.8
-	-	-	-	-	-	- 200.0	-200.0	-220.0	-220.0
17 600.1	**13 860.2**	**16 988.9**	**13 256.3**	**17 283.8**	**13 543.3**	**18 119.7**	**14 101.6**	**18 324.9**	**14 281.3**
2881.4	**2880.1**	**2807.2**	**2806.0**	**2629.0**	**2627.4**	**2669.7**	**2668.1**	**2569.7**	**2568.0**
20 481.4	**16 740.3**	**19 796.1**	**16 062.3**	**19 912.7**	**16 170.7**	**20 789.4**	**16 769.6**	**20 894.6**	**16 849.3**

Rounding error

Table 9

Federal expenditure on science, research

– DM million –

Type of funding	actual 1989 Total	1989 of which R&D	1991 Total	1991 of which R&D	1993 Total	1993 of which R&D	1995 Total	1995 of which R&D
1. Project funding	**7838.5**	**7597.9**	**8914.0**	**8679.8**	**7917.0**	**7611.0**	**7740.5**	**7381.0**
1.1 Direct project funding[1]	7448.4	7207.9	8471.8	8237.6	7283.3	6977.3	7081.3	6721.8
1.2 Indirect research and innovation funding[2]	390.1	390.1	442.2	442.2	633.7	633.7	659.2	659.2
2. Basic funding of institutions	**5976.8**	**5048.6**	**7321.7**	**6169.2**	**8110.7**	**6634.1**	**8186.9**	**6696.3**
2.1 Research and science funding organisations	1310.0	1283.0	1488.0	1454.5	1897.7	1856.3	2149.0	2107.7
2.2 Hermann von Helmholtz Association of National Research Centres (HGF)	2315.2	2315.2	2405.9	2405.9	2685.3	2685.3	2544.6	2544.6
2.3 Blue List institutions[3]	241.0	215.0	271.3	243.7	565.1	536.3	609.2	581.8
2.4 Other non-profit organisations	323.4	231.9	1104.9[6]	950.6[6]	546.9	280.6	549.6	281.3
2.5 Research institutions owned by the Federal Government and other federal institutes	1787.2	1003.5	2051.5	1114.5	2415.7	1275.6	2334.5	1180.9
3. University-related funding[4]	**1373.3**	**390.0**	**2270.7**	**670.0**	**2698.1**	**962.9**	**2636.5**	**850.7**
4. International co-operation	**1231.6**	**1148.7**	**1586.3**	**1482.9**	**1793.7**	**1689.0**	**1726.3**	**1619.3**
4.1 Contributions to organisations and institutions[5]	1122.5	1095.8	1414.8	1384.0	1645.6	1613.3	1579.1	1544.4
4.2 Project funding in international co-operation	109.1	52.8	171.5	98.9	148.2	75.7	147.2	74.9
5. Total reduction of expenditure of BMBF[7]	-	-	-	-	-	-	-	-
Total expenditure	**16 420.1**	**14 185.2**	**20 092.7**	**17 001.9**	**20 519.5**	**16 897.1**	**20 290.1**	**16 547.2**
For information:								
Direct project funding[1]	*7448.4*	*7207.9*	*8471.8*	*8237.6*	*7283.3*	*6977.3*	*7081.3*	*6721.8*
of which:								
BMBF[8]	*2646.2*	*2419.3*	*3134.7*	*2924.2*	*3166.0*	*2881.4*	*3113.0*	*2774.8*
BMWi[8]	*1261.8*	*1254.0*	*1484.0*	*1470.4*	*1084.1*	*1074.3*	*838.0*	*827.5*
BMVg	*2840.9*	*2840.1*	*2843.5*	*2842.4*	*2306.8*	*2305.5*	*2533.6*	*2532.4*

1 Including expenditure on contracts in the context of departmental and defence research and development.

2 Excluding fiscal measures (bonuses, special depreciation allowances).

3 Including *Länder*-owned institutions funded jointly by the Federal Government and the *Länder*.

4 Including Bundeswehr universities and the Federal Government's college of public administration; the programme to secure the performance and openness of higher education institutions in particularly overcrowded subjects (HSP I, 1991 to 1995), the programme to secure the performance of higher education and research (HSP II/III, from 1991 onwards), and the programme for the renewal of higher education and research in the new *Länder* and East Berlin (HEP, up to and including 1996).

5 Based in Germany or abroad.

6 Including transient funding of the Academy of Agriculture, the Building Academy and the Academy of Sciences in the new *Länder*.

7 Breakdown of total reduction of expenditure of BMBF by type of funding is possible for actual expenditure only.

8 Structure in accordance with the Federal Budget Plan 2000. Deviation from earlier publications is due to the shifting of responsibilities between federal government departments.

Source: Federal Ministry of Education and Research

and development by type of funding

– DM million –

actual						budgeted			
1996		1997		1998		1999		2000	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
7881.2	**7506.9**	**7157.3**	**6802.6**	**7186.2**	**6834.1**	**7764.2**	**7364.5**	**7605.0**	**7216.5**
7262.3	6887.9	6610.0	6255.4	6534.5	6182.4	7097.6	6698.0	6983.6	6595.1
619.0	619.0	547.2	547.2	651.7	651.7	666.6	666.6	621.4	621.4
8431.9	**6821.4**	**8569.3**	**6968.0**	**8636.7**	**7069.7**	**8953.2**	**7286.4**	**9286.7**	**7546.7**
2209.4	2169.9	2297.5	2259.2	2384.4	2344.6	2538.9	2500.1	2610.9	2572.6
2549.1	2549.1	2629.0	2629.0	2652.9	2652.9	2669.0	2669.0	2708.6	2708.6
609.6	582.4	619.0	593.0	644.6	618.8	658.2	633.3	678.0	655.5
574.6	285.0	529.9	278.0	517.6	280.6	541.7	294.1	685.6	415.1
2489.1	1234.9	2493.9	1208.8	2437.2	1172.8	2545.4	1189.9	2603.6	1194.9
2495.8	**843.4**	**2479.8**	**803.6**	**2504.6**	**797.8**	**2640.4**	**811.7**	**2572.6**	**781.4**
1672.5	**1568.7**	**1589.7**	**1488.1**	**1585.3**	**1469.0**	**1631.6**	**1507.0**	**1650.3**	**1524.7**
1526.0	1491.4	1443.5	1412.7	1426.4	1396.0	1465.5	1432.0	1492.3	1455.3
146.5	77.2	146.2	75.4	159.0	73.0	166.1	75.1	158.0	69.4
-	-	-	-	-	-	**-200.0**	**-200.0**	**-220.0**	**-220.0**
20 481.4	**16 740.3**	**19 796.1**	**16 062.3**	**19 912.7**	**16 170.7**	**20 789.4**	**16 769.6**	**20 894.6**	**16 849.3**
7262.3	*6887.9*	*6610.0*	*6255.4*	*6534.5*	*6182.4*	*7097.6*	*6698.0*	*6983.6*	*6595.1*
3302.9	*2948.5*	*2939.4*	*2602.8*	*3023.8*	*2690.9*	*3474.2*	*3106.8*	*3546.5*	*3182.4*
808.9	*798.7*	*645.2*	*636.6*	*634.7*	*623.8*	*675.5*	*662.9*	*621.3*	*608.7*
2551.9	*2550.7*	*2474.0*	*2472.8*	*2306.7*	*2305.1*	*2345.0*	*2343.4*	*2242.0*	*2240.3*

Rounding error

Table 10

Federal expenditure on science, research

– DM million –

Recipient group	actual 1989 Total	1989 of which R&D	1991 Total	1991 of which R&D	1993 Total	1993 of which R&D	1995 Total	1995 of which R&D
1. Territorial authorities	**4561.1**	**2772.7**	**6140.8**	**3589.1**	**6239.4**	**3392.9**	**6087.8**	**3209.3**
1.1 Federal Government	2127.7	1188.3	2527.5	1395.3	2963.0	1567.7	2779.8	1417.2
1.1.1 Federal Government-owned research institutions	1903.1	1119.4	2181.5	1243.9	2545.0	1398.3	2445.6	1281.8
1.1.2 Other institutions of the federal administration[2]	224.6	68.9	345.9	151.4	417.9	169.3	334.2	135.4
1.2 *Länder* and local government	2433.5	1584.4	3613.3	2193.8	3276.4	1825.3	3308.1	1792.1
1.2.1 Research institutions of the *Länder*	136.7	132.0	176.4	170.8	184.6	178.2	171.1	164.3
1.2.2 Universities and university hospitals[3]	1981.1	1142.0	3014.8	1606.6	2944.8	1505.9	2991.2	1486.3
1.2.3 Other institutions of the *Länder*	277.3	273.7	385.7	381.2	101.1	96.8	115.6	112.7
1.2.4 Local government, local authority and special-purpose associations	38.3	36.6	36.4	35.1	45.9	44.3	30.1	28.8
2. Private non-profit organisations	**5304.6**	**5031.7**	**6908.5**	**6474.8**	**7582.6**	**7024.2**	**7790.5**	**7081.1**
2.1 Research funding organisations (e.g. MPG, FhG, DFG)[4]	1921.8	1815.5	2295.9	2149.6	2918.5	2721.5	3150.2	2927.6
2.2 Hermann von Helmholtz Association of National Research Centres (HGF)	2556.7	2533.1	2782.8	2709.9	3083.9	3059.4	3050.3	2896.6
2.3 Other non-profit science organisations	712.8	584.7	1659.2[5]	1468.8[5]	1404.1	1097.4	1434.0	1128.2
2.4 Other non-profit organisations	113.2	98.3	170.6	146.5	176.1	146.0	156.0	128.6
3. Business enterprise sector	**5061.5**	**4916.0**	**5206.5**	**5132.2**	**4731.4**	**4563.8**	**4655.8**	**4537.2**
3.1 Business enterprises	3926.8	3785.5	4207.2	4146.3	3570.7	3419.3	3707.4	3608.1
3.2 Services if rendered by companies and the professions	1134.7	1130.5	999.3	985.9	1160.8	1144.5	948.5	929.1
4. Abroad	**1492.9**	**1464.9**	**1836.9**	**1805.9**	**1966.1**	**1916.1**	**1755.9**	**1719.6**
4.1 Payments to business enterprises abroad	170.8	169.5	332.0	331.9	71.3	70.8	37.7	37.2
4.2 Contributions to international organisations and other payments to recipients abroad	1322.1	1295.3	1504.8	1474.0	1894.8	1845.3	1718.2	1682.5
5. Total reduction of expenditure of BMBF	-	-	-	-	-	-	-	-
Total expenditure	**16 420.1**	**14 185.2**	**20 092.7**	**17 001.9**	**20 519.6**	**16 897.1**	**20 290.2**	**16 547.2**
For information:								
Business enterprises[6]	*5061.5*	4916.0	*5206.5*	*5132.2*	*4731.4*	*4563.8*	*4655.8*	*4537.2*
receiving funds from:								
BMBF	*1139.2*	994.9	*1110.3*	*1046.2*	*1166.6*	*1007.5*	*970.7*	*861.8*
BMWi	*1350.1*	1349.1	*1539.6*	*1529.4*	*1311.8*	*1303.3*	*1221.8*	*1212.2*
BMVg	*2467.0*	2467.0	*2421.6*	*2421.6*	*2063.8*	*2063.8*	*2308.2*	*2308.2*

* 1989 former West Germany, from 1991 onwards Germany.

1 Breakdown estimated. Breakdown of total reduction of expenditure of BMBF by recipient group is possible for actual expenditure only.

2 Including Bundeswehr universities.

3 Excluding basic funding of DFG and funds for collaborative research centres.

4 Including basic funding of DFG and funds for collaborative research centres.

and development by recipient group

– DM million –

actual						budgeted			
1996		1997		1998		1999[1]		2000[1]	
Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D	Total	of which R&D
6123.4	**3260.3**	**5978.9**	**3068.8**	**5983.5**	**3061.3**	**6404.5**	**3246.9**	**6367.1**	**3181.9**
2935.0	1467.8	2875.9	1388.2	2832.4	1367.2	2973.3	1402.3	3017.0	1388.4
2593.0	1329.1	2538.3	1252.2	2482.4	1217.3	2594.7	1238.2	2645.1	1234.6
342.0	138.8	337.6	136.0	350.0	149.9	378.6	164.1	371.9	153.8
3188.4	1792.5	3103.0	1680.6	3151.1	1694.2	3431.3	1844.6	3350.1	1793.5
160.4	154.0	130.7	124.7	127.3	121.1	140.3	132.2	144.1	136.6
2869.3	1484.3	2915.3	1502.4	2968.8	1521.4	3228.4	1655.1	3152.2	1607.1
119.2	116.1	33.7	31.1	32.0	29.6	36.3	32.2	29.7	26.4
39.5	38.1	23.3	22.4	22.9	22.1	26.3	25.1	24.2	23.4
7888.3	**7155.8**	**7814.1**	**7139.9**	**7938.6**	**7267.7**	**8435.8**	**7729.0**	**8710.8**	**8013.4**
3155.0	2948.9	3153.2	2942.7	3244.6	3022.8	3445.8	3229.9	3621.2	3421.0
3101.2	2928.1	3157.1	3002.2	3172.3	3015.7	3383.5	3201.3	3423.3	3251.3
1475.3	1149.9	1359.2	1071.9	1361.4	1090.4	1430.2	1147.3	1481.8	1179.6
156.8	128.9	144.5	123.1	160.4	138.9	176.3	150.6	184.4	161.5
4806.6	**4697.4**	**4443.3**	**4329.3**	**4371.8**	**4255.9**	**4489.5**	**4371.1**	**4372.2**	**4249.0**
4027.3	3938.0	3724.9	3625.6	3576.1	3478.8	3649.9	3552.9	3508.9	3405.0
779.2	759.4	718.4	703.7	795.7	777.1	839.6	818.2	863.3	844.0
1663.2	**1626.8**	**1559.8**	**1524.4**	**1618.9**	**1585.7**	**1659.6**	**1622.6**	**1664.5**	**1625.0**
37.0	36.4	34.7	34.0	92.5	91.2	95.0	93.5	92.6	91.1
1626.2	1590.5	1525.0	1490.4	1526.4	1494.5	1564.6	1529.2	1571.9	1533.9
-	**-**	**-**	**-**	**-**	**-**	**-200.0**	**-200.0**	**-220.0**	**-220.0**
20 481.4	**16 740.3**	**19 796.1**	**16 062.3**	**19 912.8**	**16 170.7**	**20 789.4**	**16 769.6**	**20 894.6**	**16 849.3**
4806.6	*4697.4*	*4443.3*	*4329.3*	*4371.8*	*4255.9*	*4489.5*	*4371.1*	*4372.2*	*4249.0*
1044.7	*944.9*	*948.1*	*841.7*	*1076.6*	*970.8*	*1112.2*	*1007.0*	*1170.0*	*1058.7*
1155.0	*1145.8*	*956.1*	*948.5*	*1035.0*	*1025.0*	*1069.5*	*1058.0*	*994.9*	*983.3*
2456.9	*2456.9*	*2379.4*	*2379.4*	*2114.5*	*2114.5*	*2149.5*	*2149.5*	*2054.5*	*2054.5*

5 Including transient funding of the Academy of Agriculture, the Building Academy and the Academy of Sciences in the new *Länder*.
6 Including funds for contract research; classification pursuant to the Nomenclature of Economic Activities; excluding payments to business enterprises abroad (see 4.1)

Source: Federal Ministry of Education and Research

Rounding error

Table 11

Federal Government payments to business enterprises for science,

– DM million –

Economic activity	Sector 1993	actual 1993 Total	actual 1993 of which direct project funding[1]
Agriculture, hunting and forestry; fishing	**01 – 05**	**51.7**	**36.3**
Mining and quarrying (excluding electricity, gas and water supply)	**10 – 14**	**15.9**	**14.9**
Manufacturing	**15 – 37**	**3343.2**	**2906.9**
Manufacture of food products and beverages; manufacture of tobacco products	15/16	24.5	11.4
Manufacture of textiles and wearing apparel; dressing and dyeing of fur; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	17 – 19	50.3	15.2
Manufacture of wood and of products of wood and cork, except furniture; manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	20 – 22	34.5	8.5
Manufacture of coke, refined petroleum products and nuclear fuel	23	78.4	77.6
Manufacture of chemicals and chemical products	24	115.4	79.8
Manufacture of rubber and plastic products	25	21.0	9.0
Manufacture of other non-metallic mineral products	26	33.4	19.8
Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	27/28	76.4	34.8
Manufacture of machinery and equipment n.e.c.	29	413.1	280.7
Manufacture of office machinery and computers	30	154.8	145.8
Manufacture of electrical machinery and apparatus n.e.c.	31	122.5	103.3
Manufacture of radio, television and communication equipment and apparatus	32	485.2	475.6
Manufacture of medical, precision and optical instruments, watches and clocks	33	302.4	221.4
Manufacture of motor vehicles, trailers and semi-trailers	34	27.1	25.9
Building and repairing of ships and boats	35.1	51.4	49.1
Manufacture of railway and tramway locomotives and rolling stock	35.2	4.4	2.8
Manufacture of aircraft and spacecraft	35.3	1342.3	1341.9
Manufacture of motorcycles and bicycles; manufacture of other transport equipment n.e.c.	35.9	1.3	0.8

research and development by economic activity*

– DM million –

actual								
1995		1996		1997		1998		Sector 1993
Total	of which direct project funding[1]	Total	of which direct project funding[1]	Total	of which direct project funding[1]	Total	of which direct project funding[1]	
40.7	**30.1**	**.**	**27.7**	**.**	**47.9**	**.**	**10.3**	**01–05**
4.2	**2.9**	**.**	**5.7**	**.**	**7.7**	**.**	**6.0**	**10–14**
3598.2	**3134.5**	**.**	**3489.6**	**.**	**3226.8**	**.**	**3024.8**	**15–37**
23.6	6.8	.	6.2	.	5.7	.	5.7	15/16
54.2	16.8	.	11.7	.	18.4	.	19.2	17–19
40.5	15.7	.	17.3	.	13.2	.	16.3	20–22
96.2	92.7	.	93.6	.	93.9	.	94.4	23
177.5	113.4	.	114.5	.	103.6	.	123.7	24
36.7	19.8	.	14.3	.	13.7	.	15.9	25
39.8	22.9	.	24.6	.	25.1	.	24.3	26
176.1	131.9	.	125.8	.	115.5	.	142.8	27/28
419.2	335.9	.	321.0	.	282.8	.	303.1	29
171.8	158.4	.	126.0	.	125.3	.	141.7	30
115.1	104.1	.	137.7	.	111.6	.	117.2	31
493.8	485.0	.	657.8	.	648.3	.	568.0	32
523.6	433.1	.	390.5	.	311.4	.	364.9	33
25.6	19.0	.	87.8	.	116.2	.	33.8	34
57.6	53.0	.	93.4	.	90.0	.	45.3	35.1
7.8	3.9	.	6.1	.	5.2	.	6.1	35.2
1101.1	1100.9	.	1245.0	.	1132.4	.	993.2	35.3
13.4	6.4	.	2.0	.	2.5	.	1.2	35.9

noch Tabelle 11

Federal Government payments to business enterprises for science,

– DM million –

Economic activity	Sector 1993	actual 1993 Total	actual 1993 of which direct project funding[1]
Manufacture of furniture; manufacturing n.e.c.	36	4.8	3.5
Recycling	37	0.0	0.0
Electricity, gas and water supply (excluding mining)	**40/41**	**65.4**	**51.2**
Construction (including electrical installation)	**45**	**94.5**	**89.9**
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; hotels and restaurants	**50 – 55**	**34.4**	**34.1**
Transport, storage and communication	**60 – 64**	**22.9**	**22.8**
Financial intermediation	**65 – 67**	**16.6**	**0.3**
Other service activities by businesses and members of the professions[2]	**70 – 93**	**1086.9**	**1008.5**
Total expenditure		**4731.4**	**4164.8**
of which R&D		**4563.8**	**3997.3**
of which funding for co-operative research of BMWi		*169.6*	.

* Classification pursuant to Nomenclature of Economic Activities 1993; expenditure of earlier years selectively assigned and shifted to the new Nomenclature of Economic Activities.

1 Including expenditure on contracts in the context of departmental and defence research and development.

2 Including research and development conducted in facilities of business enterprises.

Source: Federal Ministry of Education and Research

research and development by economic activity*

– DM million –

1995 Total (actual)	1995 of which direct project funding[1] (actual)	1996 Total (actual)	1996 of which direct project funding[1] (actual)	1997 Total (actual)	1997 of which direct project funding[1] (actual)	1998 Total (actual)	1998 of which direct project funding[1] (actual)	Sector 1993
16.7	7.5	.	10.0	.	8.5	.	4.8	36
8.0	7.5	.	4.4	.	3.4	.	2.8	37
40.4	**14.4**	**.**	**20.8**	**.**	**22.7**	**.**	**23.1**	**40/41**
23.9	**19.5**	**.**	**9.7**	**.**	**8.8**	**.**	**9.4**	**45**
33.9	**32.5**	**.**	**29.4**	**.**	**4.0**	**.**	**4.5**	**50 – 55**
21.2	**21.1**	**.**	**10.4**	**.**	**12.3**	**.**	**16.8**	**60 – 64**
32.1	**0.3**	**.**	**0.5**	**.**	**1.6**	**.**	**0.9**	**65 – 67**
861.2	**785.8**	**.**	**637.6**	**.**	**616.0**	**.**	**669.8**	**70 – 93**
4655.8	**4040.9**	**4806.6**	**4 231.5**	**4443.3**	**3947.6**	**4371.8**	**3764.8**	
4537.2	**3922.3**	**4697.4**	**4 122.3**	**4329.3**	**3833.6**	**4255.9**	**3649.1**	
169.9	.	*169.8*	.	*150.3*	.	*172.0*	.	

Table 12

Expenditure of the Federal Government on international science organisations and intergovernmental research institutions

– DM million –

Organisation/institution	1989 (actual)	1991 (actual)	1993 (actual)	1995 (actual)	1996 (actual)	1997 (actual)	1998 (actual)	1999 (budgeted)	2000 (budgeted)
1 Organisations/institutions based abroad									
Anglo-German Foundation for the Study of Industrial Society in London	0.8	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.7
North Atlantic Treaty Organisation (NATO), contribution to the civil part of the budget	6.9	7.3	7.2	7.7	7.9	7.2	6.3	7.2	7.2
International Institute for Administrative Sciences in Brussels	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
International Council for the Exploration of the Sea (ICES) in Copenhagen	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Deutsch-Französisches Forschungsinstitut St. Louis (Franco-German research institute ISL)	34.9	38.7	38.3	37.5	40.0	41.0	39.3	38.3	40.7
International Centre for Cancer Research in Lyon .	2.0	1.7	2.5	2.5	2.4	3.0	3.1	3.0	3.0
Intergovernmental Panel on Climate Change (IPCC)	-	0.1	0.2	0.2	0.4	0.2	0.4	0.4	0.7
International Institute for Applied Systems Analysis (IIASA) in Vienna	1.0	1.0	1.1	-	-	-	-	-	-
European University Institute in Florence	4.0	4.6	4.5	4.6	5.2	5.7	5.8	10.3	10.8
European Organisation for Nuclear Research (CERN) in Geneva	218.5	230.2	231.7	255.6	260.4	228.0	238.1	264.0	270.7
Institute Max von Laue – Paul Langevin (ILL) in Grenoble	27.1	27.7	29.6	28.7	33.9	30.5	33.5	32.7	32.4
European Synchrotron Radiation Facility (ESRF) in Grenoble	21.0	33.4	30.2	28.5	30.1	29.1	30.1	31.0	31.9
High-flux research reactor Petten under the supplementary programme of the EU	0.0	21.6	20.8	20.8	6.4	-	-	-	-
International Atomic Energy Agency (IAEA) in Vienna	32.1	37.3	39.3	42.5	42.3	37.3	36.7	40.8	45.2
European company for the chemical processing of irradiated fuels (Eurochemic) in Mol	6.4	-	-	-	-	-	-	-	-
European Space Agency (ESA) in Paris	712.9	964.3	1188.4	1091.6	1034.0	998.5	967.0	970.0	980.0

cont. Table 12

Expenditure of the Federal Government on international science organisations and intergovernmental research institutions

– DM million –

Organisation/institution	1989 (actual)	1991 (actual)	1993 (actual)	1995 (actual)	1996 (actual)	1997 (actual)	1998 (actual)	1999 (budgeted)	2000 (budgeted)
EU research programmes, contributions to supplementary programmes pursuant to EURATOM Treaty	21.0	1.0	-	-	-	-	-	-	-
Other organisations and institutions	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0
Sub-total	**1089.6**	**1370.8**	**1595.8**	**1522.1**	**1464.9**	**1382.7**	**1362.5**	**1399.9**	**1424.9**
of which R&D	1062.9	1340.1	1563.5	1487.4	1430.3	1351.8	1330.8	1364.9	1389.2
2 Organisations/institutions based in Germany									
Deutsches Studienzentrum Venedig (supporting association: Munich)	0.5	0.8	0.6	0.7	0.7	0.6	0.6	0.7	0.7
European Organisation for Astronomical Research in the Southern Hemisphere (ESO) in Garching near Munich	18.3	27.0	32.0	35.2	38.7	37.5	39.1	37.8	39.2
European Molecular Biology Conference (EMBC) and European Molecular Biology Laboratory (EMBL) in Heidelberg	14.1	16.2	17.2	21.2	21.7	22.7	24.1	27.2	28.0
Sub-total	**32.9**	**44.0**	**49.8**	**57.1**	**61.1**	**60.9**	**63.8**	**65.6**	**67.9**
of which R&D	32.9	44.0	49.8	57.1	61.1	60.8	65.2	67.0	66.5
Total expenditure	**1122.5**	**1414.8**	**1645.6**	**1579.1**	**1526.0**	**1443.5**	**1426.4**	**1465.5**	**1492.8**
of which R&D	1095.8	1384.0	1613.3	1544.4	1491.4	1412.7	1396.0	1432.0	1455.7

Source: Federal Ministry of Education and Research

Rounding error

Table 13

R&D expenditure of the Federal Government and the *Länder* by research objective[1]

– Budget, DM million –

Research objective	1989	1991	1993	1995	1996	1997	1998[2]
Exploration and exploitation of the Earth	515	732	861	724	697	636	597
Infrastructure and general planning of land-use	466	595	525	482	473	533	536
Control of environmental pollution	804	1004	1181	1135	1203	1100	1096
Protection and improvement of human health	816	949	1007	1018	1089	1037	1004
Production, distribution and rational utilisation of energy	1520	1521	1314	1088	1131	1101	1128
Agricultural production and technology	489	935	815	823	831	845	849
Industrial production and technology ...	3026	3642	3896	4219	4352	3990	3838
Social structures and relationships	583	732	788	758	769	774	805
Exploration and exploitation of space	1336	1586	1829	1629	1583	1492	1483
Research financed from General University Funds	7748	9768	11 636	11 939	11 753	12 049	12 340
Non-oriented research	3286	4466	4805	4754	5025	4844	4961
Other civil research[3]	25	284	52	204	87	- 89	76
Defence	3023	3234	2674	2866	3203	2998	2744
Total	**23 636**	**29 450**	**31 382**	**31 639**	**32 194**	**31 312**	**31 455**

1 In accordance with the Nomenclature for the Analysis and Comparison of Science Programmes and Budgets (NABS); up to and including 1992: NABS 1983, from 1993 onwards: NABS 1992

2 Provisional.

3 Including total reduction of expenditure of BMBF, which can be broken down by research objective for actual expenditure only.

Source: Federal Ministry of Education and Research, Federal Statistical Office

Rounding error

Table 14

Basic funds[1] of the *Länder* and local government provided for science by area and *Land*

– DM million –

Land	Year[2]	Institutions of higher education including university hospitals[3]	Science and research outside higher education institutions: Total	Science and research outside higher education institutions: of which *Land*	Total basic funds of *Länder* and local government	%	of which: *Land*	of which: Local government
Baden-Württemberg	1989	2764.5	516.5	501.3	**3281.0**	*16.4*	3265.8	15.2
	1991	3157.5	585.6	567.2	**3743.1**	*13.9*	3724.7	18.4
	1993	3567.3	546.9	541.0	**4114.2**	*13.4*	4108.3	5.9
	1995	3757.3	595.4	568.4	**4352.7**	*13.2*	4325.7	27.0
	1996	3869.5	593.2	538.9	**4462.7**	*14.6*	4408.4	54.3
	1997	3746.0	545.0	504.0	**4291.0**	*13.0*	4250.0	41.0
	1998	3836.9	597.3	544.8	**4434.2**	*13.0*	4381.7	52.5
	1999	4111.1	647.2	593.1	**4758.3**	*14.1*	4704.2	54.1
Bavaria[4]	1989	2789.7	524.6	500.2	**3314.3**	*16.6*	3289.9	24.4
	1991	3279.0	666.7	616.4	**3945.7**	*14.7*	3895.4	50.3
	1993	3728.1	671.7	660.0	**4399.8**	*13.4*	4388.1	11.7
	1995	4061.7	847.0	815.3	**4908.7**	*14.9*	4877.0	31.7
	1996	4371.8	812.0	791.0	**5183.8**	*16.9*	5162.8	21.0
	1997	4360.0	788.0	775.0	**5148.0**	*15.6*	5135.0	13.0
	1998	4220.6	991.6	970.9	**5212.2**	*15.3*	5191.5	20.7
	1999	4435.9	1129.8	1108.9	**5565.7**	*16.5*	5544.8	20.9
West Berlin	1989	1672.2	159.7	159.7	**1831.9**	*9.2*	1831.9	-
Berlin[5]	1991	2261.0	406.1	406.1	**2667.1**	*9.9*	2667.1	-
	1993	2970.0	278.3	278.3	**3248.3**	*10.6*	3248.3	-
	1995	2812.4	313.3	313.3	**3125.7**	*9.5*	3125.7	-
	1996	2733.9	305.1	305.1	**3039.0**	*9.9*	3039.0	-
	1997	2617.0	293.0	293.0	**2910.0**	*8.8*	2910.0	-
	1998	2638.1	296.7	296.7	**2934.8**	*8.6*	2934.8	-
	1999	2527.2	425.7	425.7	**2952.9**	*8.8*	2952.9	-
Brandenburg	1991	.	.	.	**.**	.	.	.
	1993	265.3	159.5	159.0	**424.8**	*1.4*	424.3	0.5
	1995	431.2	212.2	211.4	**643.4**	*2.0*	642.6	0.8
	1996	489.1	211.3	210.6	**700.4**	*2.3*	699.7	0.7
	1997	534.0	179.0	179.0	**713.0**	*2.2*	713.0	0.0
	1998	523.7	177.9	177.2	**701.6**	*2.1*	700.9	0.7
	1999	497.4	191.1	190.4	**688.5**	*2.0*	687.8	0.7
Bremen	1989	229.0	37.5	37.5	**266.5**	*1.3*	266.5	-
	1991	275.6	46.8	46.8	**322.4**	*1.2*	322.4	-
	1993	311.6	57.3	57.3	**368.9**	*1.2*	368.9	-
	1995	309.4	72.2	72.2	**381.6**	*1.2*	381.6	-
	1996	313.5	74.6	74.6	**388.1**	*1.1*	388.1	-
	1997	322.0	56.0	56.0	**378.0**	*1.1*	378.0	-
	1998	342.6	66.2	66.2	**408.8**	*1.2*	408.8	-
	1999	327.6	57.5	57.5	**385.1**	*1.1*	385.1	-

cont. Table 14

Basic funds[1] of the *Länder* and local government provided for science by area and *Land*

– DM million –

Land	Year[2]	Institutions of higher education including university hospitals[3]	Science and research outside higher education institutions		Total basic funds of *Länder* and local government		of which	
			Total	of which *Land*		%	*Land*	Local government
Hamburg	1989	718.3	87.1	87.1	**805.4**	*4.0*	805.4	-
	1991	770.6	118.4	118.4	**889.0**	*3.3*	889.0	-
	1993	933.0	106.3	106.3	**1039.3**	*3.4*	1039.3	-
	1995	949.9	113.9	113.9	**1063.8**	*3.2*	1063.8	-
	1996	1081.5	110.3	110.3	**1191.8**	*3.5*	1191.8	-
	1997	1005.0	89.0	89.0	**1094.0**	*3.2*	1094.0	-
	1998	1047.3	158.7	158.7	**1206.0**	*3.6*	1206.0	-
	1999	957.7	140.0	140.0	**1097.7**	*3.1*	1097.7	-
Hesse	1989	1626.5	238.2	172.6	**1864.7**	*9.3*	1799.1	65.6
	1991	1885.1	263.8	191.4	**2148.9**	*8.0*	2076.5	72.4
	1993	2112.5	292.4	216.0	**2404.9**	*7.8*	2328.5	76.4
	1995	2117.2	270.5	204.1	**2387.7**	*7.3*	2321.3	66.4
	1996	2047.1	272.6	208.5	**2319.7**	*6.8*	2255.6	64.1
	1997	2069.0	285.0	216.0	**2354.0**	*7.0*	2285.0	69.0
	1998	2064.3	273.2	212.3	**2337.5**	*6.9*	2276.6	60.9
	1999	2152.7	272.3	210.7	**2425.0**	*6.9*	2363.4	61.6
Mecklenburg-Western Pomerania	1991	.	.	.	**.**	.	.	.
	1993	378.2	97.4	95.0	**475.6**	*1.6*	473.2	2.4
	1995	544.5	107.4	105.8	**651.9**	*2.0*	650.3	1.6
	1996	640.8	133.2	131.0	**774.0**	*2.3*	771.8	2.2
	1997	630.0	127.0	124.0	**757.0**	*2.2*	754.0	3.0
	1998	611.0	153.7	151.6	**764.7**	*2.3*	762.6	2.1
	1999	628.9	140.6	138.8	**769.5**	*2.2*	767.7	1.8
Lower Saxony	1989	1760.4	219.6	204.8	**1980.0**	*9.9*	1965.2	14.8
	1991	1899.4	385.7	365.8	**2285.1**	*8.5*	2265.2	19.9
	1993	2233.3	411.4	396.0	**2644.7**	*8.6*	2629.3	15.4
	1995	2265.0	391.8	370.1	**2656.8**	*8.1*	2635.1	21.7
	1996	2350.4	330.5	317.1	**2680.9**	*7.9*	2667.5	13.4
	1997	2290.0	361.0	342.0	**2651.0**	*7.9*	2632.0	19.0
	1998	2406.3	306.4	293.8	**2712.7**	*8.0*	2700.1	12.6
	1999	2529.0	351.7	337.7	**2880.7**	*8.2*	2866.7	14.0
North Rhine-Westphalia	1989	4158.7	545.6	411.3	**4704.3**	*23.5*	4570.0	134.3
	1991	4675.9	605.8	457.6	**5281.7**	*19.7*	5133.5	148.2
	1993	5027.2	652.3	498.0	**5679.5**	*18.5*	5525.2	154.3
	1995	5444.4	558.8	437.5	**6003.2**	*18.2*	5881.9	121.3
	1996	5625.4	616.2	496.6	**6241.6**	*18.4*	6122.0	119.6
	1997	5821.0	617.0	483.0	**6438.0**	*19.1*	6304.0	134.0
	1998	5600.7	573.8	458.3	**6174.5**	*18.2*	6059.0	115.5
	1999	5773.8	594.3	478.4	**6368.1**	*18.1*	6252.2	115.9

cont. Table 14

Basic funds[1] of the *Länder* and local government provided for science by area and *Land*

– DM million –

Land	Year[2]	Institutions of higher education including university hospitals[3]	Science and research outside higher education institutions		Total basic funds of *Länder* and local government		of which	
			Total	of which *Land*		%	*Land*	Local government
Rhineland-Palatinate	1989	741.4	147.0	136.9	**888.4**	*4.4*	878.3	10.1
	1991	865.8	131.4	120.9	**997.2**	*3.7*	986.7	10.5
	1993	917.3	127.8	113.0	**1045.1**	*3.4*	1030.3	14.8
	1995	1002.4	125.1	109.7	**1127.5**	*3.4*	1112.1	15.4
	1996	1026.7	149.3	136.3	**1176.0**	*3.5*	1163.0	13.0
	1997	1047.0	156.0	140.0	**1203.0**	*3.6*	1187.0	16.0
	1998	1092.4	152.9	140.0	**1245.3**	*3.7*	1232.4	12.9
	1999	1178.4	164.0	151.0	**1342.4**	*3.8*	1329.4	13.0
Saarland	1989	336.0	13.9	13.8	**349.9**	*1.7*	349.8	0.1
	1991	330.6	39.2	39.3	**369.8**	*1.4*	369.9	- 0.1
	1993	372.9	46.0	46.0	**418.9**	*1.4*	418.9	0.0
	1995	369.1	42.4	42.4	**411.5**	*1.3*	411.5	0.0
	1996	353.4	36.3	36.3	**389.7**	*1.1*	389.7	0.0
	1997	352.0	37.0	37.0	**389.0**	*1.2*	389.0	0.0
	1998	350.3	43.2	43.2	**393.5**	*1.2*	393.5	0.0
	1999	363.4	49.9	49.9	**413.3**	*1.2*	413.3	0.0
Saxony	1991	.	.	.	**.**	.	.	.
	1993	1326.6	413.3	411.0	**1739.9**	*5.7*	1737.6	2.3
	1995	1588.4	420.0	417.4	**2008.4**	*6.1*	2005.8	2.6
	1996	1613.1	571.6	569.6	**2184.7**	*6.4*	2182.7	2.0
	1997	1570.0	586.0	583.0	**2156.0**	*6.4*	2153.0	3.0
	1998	1618.9	530.6	529.0	**2149.5**	*6.3*	2147.9	1.6
	1999	1603.4	576.3	574.8	**2179.7**	*6.2*	2178.2	1.5
Saxony-Anhalt	1991	.	.	.	**.**	.	.	.
	1993	603.7	259.7	249.0	**863.4**	*2.8*	852.7	10.7
	1995	842.3	233.2	222.8	**1075.5**	*3.3*	1065.1	10.4
	1996	794.8	231.3	220.3	**1026.1**	*3.0*	1015.1	11.0
	1997	941.0	185.0	175.0	**1126.0**	*3.3*	1116.0	10.0
	1998	885.9	225.1	214.4	**1111.0**	*3.3*	1100.3	10.7
	1999	938.4	199.3	188.6	**1137.7**	*3.2*	1127.0	10.7
Schleswig-Holstein	1989	629.0	101.2	98.0	**730.2**	*3.6*	727.0	3.2
	1991	720.2	171.5	168.1	**891.7**	*3.3*	888.3	3.4
	1993	726.2	121.0	114.0	**847.2**	*2.8*	840.2	7.0
	1995	823.2	203.1	197.5	**1026.3**	*3.1*	1020.7	5.6
	1996	834.7	164.2	159.6	**998.9**	*2.9*	994.3	4.6
	1997	822.0	146.0	141.0	**968.0**	*2.9*	963.0	5.0
	1996	794.5	132.3	127.9	**926.8**	*2.7*	922.4	4.4
	1997	828.3	130.6	126.3	**958.9**	*2.7*	954.6	4.3

cont. Table 14

Basic funds[1] of the *Länder* and local government provided for science by area and *Land*

– DM million –

Land	Year[2]	Institutions of higher education including university hospitals[3]	Science and research outside higher education institutions		Total basic funds of *Länder* and local government		of which	
			Total	of which *Land*		%	*Land*	Local government
Thuringia	1991	.	.	.	**.**	.	.	.
	1993	782.4	160.8	154.0	**943.2**	*3.1*	936.4	6.8
	1995	871.0	223.1	217.4	**1094.1**	*3.3*	1088.4	5.7
	1996	976.2	280.5	274.2	**1256.7**	*3.7*	1250.4	6.3
	1997	839.0	260.0	255.0	**1099.0**	*3.3*	1094.0	5.0
	1998	841.7	315.2	309.8	**1156.9**	*3.4*	1151.5	5.4
	1999	914.4	327.2	322.2	**1241.6**	*3.5*	1236.6	5.0
Total	1989	17 425.8	2590.8	2323.0	**20 016.6**	*100.0*	19 748.8	267.8
	1991	22 790.7	4070.9	3747.8	**26 861.6**	*100.0*	26 538.5	323.1
	1993	26 255.5	4403.3	4095.2	**30 658.8**	*100.0*	30 350.7	308.1
	1995	28 189.5	4729.4	4419.1	**32 918.9**	*100.0*	32 608.6	310.3
	1996	29 121.9	4892.2	4580.1	**34 014.1**	*100.0*	33 702.0	312.1
	1997	28 965.0	4710.0	4392.0	**33 675.0**	*100.0*	33 357.0	318.0
	1998	28 875.0	4994.7	4694.8	**33 869.7**	*100.0*	33 569.8	299.9
	1999	29 767.7	5397.7	5094.1	**35 165.4**	*100.0*	34 861.8	303.6
of which:	1989	17 425.8	2590.8	2323.0	**20 016.6**	*100.0*	19 748.8	267.8
former West	1991	20 120.7	3420.9	3097.8	**23 541.6**	*87.6*	23 218.5	323.1
Germany	1993	22 899.3	3311.6	3026.2	**26 210.9**	*85.5*	25 925.5	285.4
including	1995	23 912.0	3533.3	3244.3	**27 445.3**	*83.4*	27 156.3	289.0
East Berlin	1996	24 607.9	3464.3	3174.4	**28 072.2**	*82.5*	27 782.3	289.9
	1997	24 452.0	3372.0	3075.0	**27 824.0**	*82.6*	27 527.0	297.0
	1998	24 394.0	3592.3	3312.8	**27 986.3**	*82.6*	27 706.8	279.5
	1999	25 185.2	3963.2	3679.3	**29 148.4**	*82.9*	28 864.5	283.9
New *Länder*	1991	.	.	.	**.**	.	.	.
excluding	1993	3356.2	1091.7	1069.0	**4447.9**	*14.5*	4425.2	22.7
East Berlin	1995	4277.5	1196.0	1174.8	**5473.5**	*16.6*	5452.3	21.2
	1996	4514.0	1427.9	1405.7	**5941.9**	*17.5*	5919.7	22.2
	1997	4512.0	1337.0	1316.0	**5849.0**	*17.4*	5828.0	21.0
	1998	4481.0	1402.5	1382.0	**5883.5**	*17.4*	5863.0	20.5
	1999	4582.5	1434.5	1414.8	**6017.0**	*17.1*	5997.3	19.7

1 Basic funds: net expenditure minus direct receipts (especially revenues of the *Länder* from patient care in university hospitals).

2 1989 former West Germany, from 1991 onwards Germany. Up to and including 1997 calculation results, 1998 provisional calculation results, from 1999 onwards budget estimates; local government estimated from 1998 onwards. 1999 without supplementary budgets. Budgeted figures are not fully comparable with actual figures due to different estimating methods. Comparability of annual figures is impaired in individual cases, in particular in the new *Länder*, as a result of changes in the functional assignment of budget items.

3 Including *Länder* share for DFG.

4 Increase in expenditure on science, research and development outside higher education institutions in 1995 and 1996 due to the programme Offensive Zukunft Bayern.

5 From 1991 onwards including East Berlin.

Source: Federal Statistical Office and calculations by the Federal Ministry of Education and Research

Table 15: not included

3.1.3 3.1.2 Business enterprise sector

Table 16

Intramural R&D expenditure by the business enterprise sector 1995 and 1997 and proportion of self-financed intramural R&D expenditure by economic activity

– DM million –

Economic activity*		Intramural R&D expenditure 1995 Total[3]	1995 of which financed by BE sector[2]	1997 Total[3]	1997 of which financed by BE sector[2]
A.B	Agriculture, hunting and forestry; fishing	113	107	128	123
C	Mining and quarrying	142	129	143	139
D	Manufacturing	49 961	45 238	52 848	46 971
DA	Manufacture of food products and beverages; manufacture of tobacco products	425	392	372	356
DB. DC	Manufacture of textiles and wearing apparel; dressing and dyeing of fur; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	316	249	372	301
DD. DE	Manufacture of wood and of products of wood and cork, except furniture; manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	X	X	X	X
DF	Manufacture of coke, refined petroleum products and nuclear fuel	X	X	X	X
DG	Manufacture of chemicals and chemical products	9480	9329	10 620	10 293
DH	Manufacture of rubber and plastic products	770	730	942	897
DI	Manufacture of other non-metallic mineral products	539	503	520	479
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	1284	1165	1385	1257
DK	Manufacture of machinery and equipment n.e.c.	5989	5775	6241	5976
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments	14 313	13 351	12 372[4]	11 143
DM	Manufacture of transport equipment	16 139	13 093	19 383[4]	15 690
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	X	X	X	X
E	Electricity, gas and water supply	223	198	179	145
F	Construction	X	X	X	X
I	Transport, storage and communication	X	X	X	X
K	Real estate, renting and business activities	1336	772	2557[4]	1745
O	Other community, social and personal service activities	X	X	X	X
G.H. J.L-N	Remaining categories	X	X	X	X
	Total	52 835[1]	47 005	56 543	49 734

* Nomenclature of Economic Activities 1993.
1 Including funds not related to specific items which, after national consultation, were added to the business enterprise sector – 1995: DM386 million
2 Estimated by Stifterverband Wissenschaftsstatistik; original data: Total R&D expenditure by origin of funds
3 See Table VII/18 for intramural R&D expenditure by business enterprises in the new *Länder* and East Berlin 1997.
4 1995 not fully comparable with 1997 owing to business enterprise restructuring and resulting change of branch in the group of reporting units.

Quelle: Stifterverband Wissenschaftsstatistik
Rundungsdifferenzen

Table 17

R&D expenditure of the business enterprise sector by economic activity

– DM million –

	Economic activity*	1995			
		Total R&D expenditure[2]	of which intramural R&D expenditure		
			Total	of which in business enterprises	of which in IfG[3]
A.B	Agriculture, hunting and forestry; fishing	145	113	110	3
C	Mining and quarrying	148	142	140	2
D	Manufacturing	55 595	49 961	49 548	413
DA	Manufacture of food products and beverages; manufacture of tobacco products	475	425	408	17
DB. DC	Manufacture of textiles and wearing apparel; dressing and dyeing of fur; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	327	316	208	108
DD. DE	Manufacture of wood and of products of wood and cork, except furniture; manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	306	X	X	X
DF	Manufacture of coke, refined petroleum products and nuclear fuel	X	X	X	X
DG	Manufacture of chemicals and chemical products	10 446	9480	9474	6
DH	Manufacture of rubber and plastic products	805	770	727	42
DI	Manufacture of other non-metallic mineral products	590	539	503	36
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	1421	1284	1195	89
DK	Manufacture of machinery and equipment n.e.c.	6512	5989	5928	61
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments	15 664	14 313	14 282	31
DM	Manufacture of transport equipment	18 554	16 139	16 130	9
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	X	X	313	X
E	Electricity, gas and water supply	348	223	200	23
F	Construction	X	X	141	X
I	Transport, storage and communication	X	X	366	X
K	Real estate, renting and business activities	1384	1336	1290	46
O	Other community, social and personal service activities	27	X	X	2
G.H. J.L-N	Remaining categories	X	X	X	X
	Total	**58 601**	**52 835[4]**	**51 955**	**494**

* Nomenclature of Economic Activities 1993.

1 1998 survey of selected business enterprises, budget of IfG; 1999 budget; as of: January 2000.

2 Total R&D expenditure covers intramural and extramural R&D expenditure.

3 Institutions for co-operative industrial research and experimental development.

(intramural and total R&D expenditure)

– DM million –

1997				1998[1]		1999[1]	
Total R&D expenditure[2]	of which intramural R&D expenditure: Total	of which: in business enterprises	of which: in IfG[3]	Total R&D expenditure[2]	of which intramural R&D expenditure	Total R&D expenditure[2]	of which intramural R&D expenditure
170	128	123	5	176	128	170	125
151	143	142	1	133	125	115	110
60 874	52 848	52 469	379	66 310	55 730	71 565	59 750
417	372	363	8	422	375	420	370
385	372	249	123	379	361	380	360
256	X	X	X	238	X	235	X
X	X	X	X	X	X	X	X
12 045	10 620	10 613	7	13 618	11 383	14 060	11 595
982	942	908	33	908	845	940	880
564	520	494	26	578	537	585	545
1537	1385	1297	88	1465	1316	1480	1330
6755	6241	6192	49	7385	6751	7580	6970
13 467[5]	12 372[5]	12 347[5]	25	14 234	12 755	14 250	12 760
23 986[5]	19 383[5]	19 376[5]	7	26 637	20 810	31 195	24 465
X	X	274	X	X	X	X	X
323	179	167	12	319	162	320	160
X	X	178	X	X	X	X	X
X	X	387	X	X	X	X	X
2913[5]	2557[5]	2457[5]	100	2845	2467	2625	2425
X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X
65 361	**56 543**	**56 036**	**506**	**70 688**	**59 329**	**75 700**	**63 300**

4) Including funds not related to specific items which, after national consultation, were added to the business enterprise sector - DM386 million

5) 1995 not fully comparable with 1997 owing to business enterprise restructuring and resulting change of branch in the group of reporting units.

Source: Stifterverband Wissenschaftsstatistik

Rounding error

Table 18

Labour force, turnover and intramural R&D expenditure of business

Economic activity* Company size		1995 Labour force[1] Thousand	1995 Turnover[1] DM million
A.B	Agriculture, hunting and forestry; fishing	5	1220
C	Mining and quarrying	120	32 317
D	Manufacturing	3749	1 216 243
DA	Manufacture of food products and beverages; manufacture of tobacco products	137	67 140
DB	Manufacture of textiles and wearing apparel; dressing and dyeing of fur	46	9486
DC	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	6	2386
DD	Manufacture of wood and of products of wood and cork, except furniture	21	5323
DE	Manufacture of pulp, paper and paper products; publishing and printing	62	20 185
DF	Manufacture of coke, refined petroleum products and nuclear fuel	22	48 415
DG	Manufacture of chemicals and chemical products	486	182 192
24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	88	27 706
DH	Manufacture of rubber and plastic products	145	34 873
DI	Manufacture of other non-metallic mineral products	132	34 456
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	376	114 515
27	Manufacture of basic metals	178	69 083
28	Manufacture of fabricated metal products, except machinery and equipment	199	45 433
DK	Manufacture of machinery and equipment n.e.c.	724	178 744
29.1 - 5	Manufacture of machinery and equipment except weapons and domestic appliances	680	167 925
29.7	Manufacture of domestic appliances n.e.c.	37	9157
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments	763	232 726
30	Manufacture of office machinery and computers	67	33 967
31	Manufacture of electrical machinery and apparatus n.e.c.	263	67 917
32	Manufacture of radio, television and communication equipment and apparatus	226	78 228
33	Manufacture of medical, precision and optical instruments, watches and clocks	207	52 615
DM	Manufacture of transport equipment	768	272 692
34	Manufacture of motor vehicles, trailers and semi-trailers	650	241 117
35	Manufacture of other transport equipment	118	31 575
35.3	Manufacture of aircraft and spacecraft	56	16 102
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	61	13 110
E	Electricity, gas and water supply	145	104 171
F	Construction	167	47 946
I	Transport, storage and communication	566	117 975

enterprises by economic activity and company size

1995				1997					
Intramural R&D expenditure						Intramural R&D expenditure			
Total	Per member of labour force	Proportion of turnover	*For infor-mation:in the new Länder and East Berlin Total*	Labour force[1]	Turnover[1]	Total	Per member of labour force	Proportion of turnover	*For infor-mation:in the new Länder and East Berlin Total*
DM million	DM thousand	%	DM million	Thousand	DM million	DM million	DM thousand	%	DM million
110	23.79	9.0	18	4	1317	**123**	29.55	9.4	16
140	1.17	0.4	1	110	31 533	**142**	1.30	0.5	2
49 548	13.22	4.1	2148	3447	1 320 380	**52 469**	15.22	4.0	2638
408	2.99	0.6	56	125	72 742	**363**	2.90	0.5	44
196	4.27	2.1	.	44	10 982	**239**	5.43	2.2	.
12	1.93	0.5	63	3	1075	**10**	2.97	0.9	63
X	X	X	X	16	3974	**X**	X	X	X
X	X	X	X	50	17 026	**X**	X	X	X
X	X	X	X	22	73 635	**X**	X	X	X
9474	19.51	5.2	294	425	185 684	**10 613**	24.97	5.7	259
2445	27.70	8.8	X	114	39 809	**3702**	32.57	9.3	X
727	5.01	2.1	46	133	33 673	**908**	6.82	2.7	58
503	3.80	1.5	78	107	30 063	**494**	4.60	1.6	76
1195	3.18	1.0	148	315	110 043	**1297**	4.12	1.2	181
466	2.62	0.7	X	143	67 119	**478**	3.33	0.7	X
729	3.67	1.6	X	172	42 924	**819**	4.77	1.9	X
5928	8.19	3.3	577	696	196 637	**6192**	8.90	3.1	628
5550	8.16	3.3	X	661	187 003	**5901**	8.92	3.2	X
232	6.27	2.5	X	30	8420	**242**	8.10	2.9	X
14 282	18.71	6.1	504	600	200 249	**12 347**	20.57	6.2	814
2058	30.59	6.1	X	63	35 102	**1317**	20.89	3.8	X
3783	14.38	5.6	X	159	42 176	**1698**	10.66	4.0	X
5295	23.46	6.8	X	205	75 202	**6408**	31.19	8.5	X
3145	15.18	6.0	X	172	47 769	**2925**	16.97	6.1	X
16 130	21.01	5.9	284	860	373 677	**19 377**	22.53	5.2	407
11 194	17.23	4.6	X	735	332 838	**13 674**	18.60	4.1	X
4936	41.83	15.6	X	125	40 840	**5702**	45.55	14.0	X
4295	77.10	26.7	X	63	21 002	**4823**	76.30	23.0	X
313	5.16	2.4	52	50	10 920	**274**	5.51	2.5	56
200	1.38	0.2	4	124	97 229	**167**	1.34	0.2	4
141	0.85	0.3	22	150	44 652	**178**	1.18	0.4	40
366	0.65	0.3	X	497	114 308	**387**	0.78	0.3	49

cont. Table 18

Labour force, turnover and intramural R&D expenditure of business

Economic activity* Company size		1995 Labour force[1] Thousand	1995 Turnover[1] DM million
K	Real estate, renting and business activities	52	12 561
73	Research and development	4	541
74	Other business activities	35	9043
O	Other community, social and personal service activities	2	984
G. H. J. L-N	Remaining categories	28	18 453
	Total	**4833**	**1 551 869**
	Business enterprises with a labour force of		
	below 100	229	50 818
	between 100 and 249	357	84 637
	between 250 and 499	361	99 932
	Sub-total	947	235 387
	between 500 and 999	337	94 327
	between 1000 and 1999	435	161 124
	between 2000 and 4999	680	273 344
	between 5000 and 9999	396	150 479
	over 10000	2038	637 207
	Sub-total	3886	1 316 481
	Total	**4833**	**1 551 869**

* Nomenclature of Economic Activities 1993.

1 Labour force and turnover of business enterprises with (intramural and extramural) R&D expenditure.

2 Funds that cannot be broken down.

Source: Stifterverband Wissenschaftsstatistik

Rounding error

enterprises by economic activity and company size

1995				1997					
Intramural R&D expenditure				Labour force[1]	Turnover[1]	Intramural R&D expenditure			
Total	Per member of labour force	Proportion of turnover	*For information: in the new Länder and East Berlin Total*			Total	Per member of labour force	Proportion of turnover	*For information: in the new Länder and East Berlin Total*
DM million	DM thousand	%	DM million	Thousand	DM million	DM million	DM thousand	%	DM million
1290	24.95	10.3	299	62	17 721	**2457**	39.38	13.9	428
325	90.04	60.0	X	10	2217	**728**	74.41	32.8	X
752	21.22	8.3	X	33	10 246	**762**	23.40	7.4	X
X	X	X	X	1	377	**X**	X	X	X
X	X	X	X	18	22 023	**X**	X	X	X
51 9552	**10.75**	**3.3**	**2557**	**4413**	**1 649 540**	**56 036**	**12.70**	**3.4**	**3208**
2800	12.25	5.5	.	236	56 631	**3228**	13.66	5.7	.
2536	7.11	3.0	.	329	88 783	**2900**	8.80	3.3	.
2124	5.89	2.1	.	318	98 348	**2291**	7.21	2.3	.
7460	7.88	3.2	1676	883	243 762	**8419**	9.53	3.5	1975
2519	7.47	2.7	.	320	102 767	**3212**	10.05	3.1	.
3703	8.51	2.3	.	403	166 871	**4694**	11.66	2.8	.
6234	9.17	2.3	.	610	289 071	**7383**	12.10	2.5	.
4489	11.33	3.0	.	382	166 116	**4767**	12.47	2.9	.
27 550	13.52	4.3	.	1815	680 953	**27 562**	15.19	4.0	.
44 495	11.45	3.4	881	3530	1 405 778	**47 618**	13.49	3.4	1233
519 552	**10.75**	**3.4**	**2557**	**4413**	**1 649 540**	**56 036**	**12.70**	**3.4**	**3208**

Table 19: not included

3.1.4 Higher education sector and non-university institutions

Table 20

Higher education intramural expenditure[1] on teaching and research

– DM million –

Type of institution	Year[2,3]	Total higher education expenditure	of which Central facilities
Universities and comprehensive universities (excluding medical facilities) colleges of education, colleges of theology and colleges of art	1989	**13 471.0**	4320.3
	1991	**18 096.3**	6207.9
	1993	**20 099.9**	6427.2
	1995	**21 663.3**	7027.8
	1996	**22 150.1**	7117.4
	1997	**22 009.3**	7210.7
	1998	**22 545.0**	.
	1999	**22 762.0**	.
of which new *Länder* and East Berlin	1991	**2577.9**	1147.8
	1993	**3297.2**	1139.0
	1995	**3857.7**	1351.2
	1996	**4051.6**	1362.7
	1997	**3939.8**	1528.8
	1998	**4135.0**	.
	1999	**4010.0**	.
Medical facilities[5/6]	1989	**5213.6**	-
	1991	**6768.0**	-
	1993	**7443.4**	-
	1995	**7781.9**	-
	1996	**8271.5**	-
	1997	**8141.1**	-
	1998	**8220.0**	.
	1999	**8290.0**	.
of which new *Länder* and East Berlin	1991	**1068.5**	-
	1993	**1185.2**	-
	1995	**1375.2**	-
	1996	**1439.3**	-
	1997	**1689.3**	-
	1998	**1700.0**	.
	1999	**1730.0**	.
Universities of applied sciences and colleges of public administration	1989	**2179.1**	644.0
	1991	**2593.3**	851.8
	1993	**3702.3**	1286.5
	1995	**4498.4**	1599.0
	1996	**4849.6**	1833.5
	1997	**5024.2**	1935.5
	1998	**4905.0**	.
	1999	**4620.0**	.

by type of institution and field of science

– DM million –

of which				
Natural sciences	Engineering	Medicine[4]	Agri-cultural sciences	Social sciences and humanities
3411.1	2061.1	-	567.6	3111.0
4351.4	2736.8	-	798.0	4001.9
4970.4	3052.0	-	894.3	4755.9
5347.8	3375.2	-	925.9	4986.5
5494.5	3424.4	-	906.0	5207.9
5510.6	3383.3	-	869.4	5035.3
.	.	.	.	.
.	.	.	.	.
414.4	420.5	-	128.0	466.8
655.9	533.3	-	148.1	820.9
797.9	612.4	-	161.5	934.7
795.4	656.9	-	147.1	1089.5
755.6	608.5	-	137.3	909.6
.	.	.	.	.
.	.	.	.	.
-	-	5213.6	.	.
-	-	6768.0	.	.
-	-	7443.4	.	.
-	-	7781.9	.	.
-	-	8271.5	.	.
-	-	8141.1	.	.
.	.	.	.	.
.	.	.	.	.
				.
-	-	1068.5	-	.
-	-	1185.2	-	.
-	-	1375.2	-	.
-	-	1439.3	-	.
-	-	1689.3	-	.
.	.	.	.	.
.	.	.	.	.
108.2	857.9	-	61.7	507.5
114.9	990.4	-	69.0	567.1
172.4	1287.0	-	103.8	852.6
221.9	531.9	-	145.3	1000.2
235.9	1589.4	-	133.2	1057.6
238.1	1591.9	-	146.6	1112.1
.	.	.	.	.
.	.	.	.	.

cont. Table 20

Higher education intramural expenditure[1] on teaching and research

– DM million –

Type of institution	Year[2,3]	Total higher education expenditure	of which Central facilities
of which new *Länder* and East Berlin	1991	43.4	15.8
	1993	713.4	303.2
	1995	1029.1	413.9
	1996	1080.0	461.7
	1997	1068.5	444.1
	1998	965.0	.
	1999	1000.0	.
Total higher education expenditure[7]	1989	20 864.2	4964.3
	1991	27 456.8	7059.7
	1993	31 245.6	7713.7
	1995	33 943.6	8626.8
	1996	35 271.2	8950.9
	1997	35 174.5	9146.3
	1998	35 670.0	.
	1999	35 672.0	.
of which new *Länder* and East Berlin	1991	3689.8	1163.5
	1993	5195.8	1442.2
	1995	6262.1	1765.1
	1996	6570.8	1824.4
	1997	6697.6	1972.9
	1998	6800.0	.
	1999	6740.0	.
of which R&D expenditure[8/9]	*1989*	*9072.4*	-
	1991	*12 018.7*	-
	1993	*13 331.9*	-
	1995	*14 429.8*	-
	1996	*14 966.6*	-
	1997	*15 014.3*	-
	1998	*15 310.0*	.
	1999	*15 460.0*	.
of which new Länder and East Berlin[10]	*1991*	*1563.8*	-
	1993	*1963.7*	-
	1995	*2274.9*	-
	1996	*2496.1*	-
	1997	*2518.0*	-
	1998	*2590.0*	.
	1999	*2540.0*	.

1 Higher education expenditure adjusted for revenues from non-teaching and non-research activities (e.g. medical care in university hospitals), calculations based on financial statistics for the higher education sector.
2 1989 former West Germany; from 1991 onwards Germany.
3 Actual expenditure up to and including 1997, estimates from 1998 onwards.
4 Including central facilities of university hospitals.
5 University hospitals including human medicine subjects at universities and comprehensive universities.
6 Break in series also due to restructuring and conversion from governmental to commercial accounting.
7 Excluding amounts added for civil servants' pensions and related benefits, grants for (post)graduates, and funds of the Deutsche Forschungsgemeinschaft which have not been accounted for.

by type of institution and field of science

– DM million –

of which				
Natural sciences	Engineering	Medicine[4]	Agri-cultural sciences	Social sciences and humanities
3.5	21.1	-	0.2	2.7
42.8	210.9	-	21.4	135.1
64.2	317.6	-	49.3	184.0
56.8	314.8	-	37.7	208.9
59.6	308.8	-	48.6	207.4
.	.	.	.	.
.	.	.	.	.
3519.3	2919.0	5214.0	629.3	3618.5
4466.2	3727.3	6768.0	866.7	4567.9
5142.8	4339.0	7443.4	998.1	5608.5
5569.7	4907.1	7781.9	1071.2	5986.7
5730.4	5013.8	8271.5	1039.1	6265.5
5748.7	4975.2	8141.1	1015.9	6147.3
.	.	.	.	.
.	.	.	.	.
417.9	441.9	1068.5	128.3	469.1
698.7	744.2	1185.2	169.5	956.0
862.1	930.1	1375.2	210.8	1118.7
852.3	971.7	1439.3	184.8	1298.4
815.2	917.3	1689.3	186.0	1117.0
.	.	.	.	.
.	.	.	.	.
2627.6	*1836.6*	*2122.4*	*405.4*	*1754.3*
3493.1	*2469.7*	*2847.8*	*573.8*	*2316.2*
3888.2	*2661.9*	*3147.9*	*641.2*	*2669.3*
4198.1	*2929.2*	*3379.7*	*733.3*	*2980.0*
4303.9	*3089.7*	*3606.6*	*667.1*	*3175.4*
4366.8	*3112.0*	*3569.7*	*648.4*	*3239.4*
.	.	.	.	.
.	.	.	.	.
355.6	*391.2*	*446.1*	*94.1*	*276.8*
515.3	*465.9*	*452.7*	*106.8*	*423.0*
611.6	*538.6*	*499.7*	*122.6*	*502.4*
605.1	*564.8*	*620.4*	*112.3*	*593.5*
606.2	*572.0*	*643.2*	*109.2*	*587.4*
.	.	.	.	.
.	.	.	.	.

8 Determination of R&D expenditure on the basis of the procedure agreed between the Conference of Ministers of Education and Cultural Affairs of the *Länder*, the Science Council, the Federal Ministry of Education and Research and the Federal Statistical Office (R&D coefficient). Expenditure by central facilities is shared between the groups of subjects, and amounts are added for civil servants' pensions and related benefits, for external funds for which proof has been furnished but which have not been accounted for by the institution, etc (cf. Chapter VI.1); grants for (post)graduates included from 1991 onwards.
9 Amounts added which are not shared between the groups of subjects have been included in R&D expenditure.
10 Excluding amounts added for DFG funds not accounted for.

Source: Federal Statistical Office, Federal Ministry of Education and Research

Rounding error

Table 21a

Non-university science expenditure by type of expenditure*

– DM million –

Type of institution	Year[1]	Total expenditure	Current expenditure (of which)		Investments (of which)	
			Total	of which staff expenditure	Total	of which construction
1 Helmholtz centres (national research centres)	1989	**3576**	2581	1469	995	339
	1993	**4218**	3528	1948	690	123
	1995	**4236**	3602	2036	634	120
	1996	**4092**	3419	2032	672	170
	1997	**4101**	3436	2059	665	199
	1998	**4316**	.	.	.	.
	1999	**4576**	.	.	.	.
of which: R&D expenditure	1989	**3576**	2581	1469	995	339
	1993	**4192**	3510	1938	682	122
	1995	**4222**	3591	2030	631	119
	1996	**4077**	3408	2025	669	170
	1997	**4086**	3424	2053	662	199
	1998	**4301**	.	.	.	.
	1999	**4556**	.	.	.	.
2 Max Planck institutes (100% R&D)[2]	1989	**1122**	938	548	184	59
	1993	**1429**	1201	696	228	105
	1995	**1585**	1321	760	265	135
	1996	**1745**	1403	819	342	171
	1997	**1731**	1400	832	332	188
	1998	**1869**	.	.	.	.
	1999	**2006**	.	.	.	.
3 Fraunhofer institutes (100% R&D)	1989	**696**	501	310	195	80
	1993	**1000**	746	472	254	71
	1995	**1262**	860	513	402	103
	1996	**1302**	939	577	363	122
	1997	**1283**	978	567	305	85
	1998	**1282**	.	.	.	.
	1999	**1351**	.	.	.	.
4 Blue List institutions	1989	**747**	640	401	107	51
	1993	**1596**	1300	820	295	115
	1995	**1701**	1386	928	315	160
	1996	**1713**	1399	955	314	161
	1997	**1671**	1384	971	287	120
	1998	**1714**	.	.	.	.
	1999	**1705**	.	.	.	.

cont. Table 21a

Non-university science expenditure by type of expenditure*

– DM million –

Type of institution	Year[1]	Total expenditure	Current expenditure: Total	Current expenditure: of which staff expenditure	Investments: Total	Investments: of which construction
of which: R&D expenditure	1989	**549**	476	312	72	35
	1993	**1350**	1082	694	268	99
	1995	**1460**	1162	797	298	152
	1996	**1462**	1173	818	289	148
	1997	**1410**	1151	822	259	103
	1998	**1455**	.	.	.	.
	1999	**1452**	.	.	.	.
5 Public institutions (excluding libraries, archives, museums; excluding Blue List institutions)	1989	**2499**	1868	1275	632	392
	1993	**3873**	3091	2117	783	534
	1995	**3883**	3104	2188	778	534
	1996	**3908**	3130	2214	778	513
	1997	**3997**	3219	2205	778	542
	1998	**4107**	.	.	.	.
	1999	**3961**	.	.	.	.
of which: R&D expenditure	1989	**1347**	1030	714	317	183
	1993	**1481**	1242	912	239	138
	1995	**1575**	1338	994	237	126
	1996	**1625**	1360	1015	265	155
	1997	**1643**	1377	1018	266	168
	1998	**1641**	.	.	.	.
	1999	**1613**	.	.	.	.
6 Scientific libraries, archives and museums (excluding Blue List institutions)	1989	**918**	695	430	223	149
	1993	**1352**	1084	699	268	173
	1995	**1345**	1109	713	236	162
	1996	**1354**	1104	711	251	197
	1997	**1398**	1134	726	265	195
	1998	**1411**	.	.	.	.
	1999	**1402**	.	.	.	.
of which: R&D expenditure	1989	**440**	300	176	141	94
	1993	**456**	364	213	92	53
	1995	**417**	337	191	80	49
	1996	**406**	328	190	78	53
	1997	**434**	340	189	94	66
	1998	**438**	.	.	.	.
	1999	**439**	.	.	.	.

cont. Table 21a

Non-university science expenditure by type of expenditure*

– DM million –

Type of institution	Year[1]	Total expenditure	of which: Current expenditure		of which: Investments	
			Total	of which staff expenditure	Total	of which construction
7 Other research institutions	1989	**533**	473	290	60	14
	1993	**1901**	1643	1080	258	95
	1995	**2259**	1937	1260	322	105
	1996	**2181**	1878	1224	303	120
	1997	**2145**	1865	1239	280	112
	1998	**2278**	.	.	.	.
	1999	**2397**	.	.	.	.
of which: R&D expenditure	1989	**533**	473	290	60	14
	1993	**1582**	1355	924	228	78
	1995	**1734**	1478	992	255	67
	1996	**1714**	1467	906	228	88
	1997	**1681**	1461	990	220	69
	1998	**1785**	.	.	.	.
	1999	**1837**	.	.	.	.
8 Total (1. - 7.)	**1989**	**10 092**	**7696**	**4723**	**2396**	**1084**
	1993	**15 369**	**12 593**	**7832**	**2776**	**1216**
	1995	**16 271**	**13 320**	**8399**	**2951**	**1319**
	1996	**16 296**	**13 272**	**8532**	**3023**	**1454**
	1997	**16 327**	**13 415**	**8599**	**2912**	**1442**
	1998	**16 978**	.	.	.	.
	1999	**17 400**	.	.	.	.
of which old *Länder* and West Berlin[3]	1993	**12 781**	.	.	.	.
	1995	**13 306**	.	.	.	.
	1996	**13 119**	.	.	.	.
	1997	**12 839**	.	.	.	.
	1998	.	.	.	.	.
	1999	.	.	.	.	.
			.	.	.	.
new *Länder* and East Berlin[3]	1993	**2516**	.	.	.	.
	1995	**2899**	.	.	.	.
	1996	**3104**	.	.	.	.
	1997	**3394**	.	.	.	.
	1998	.	.	.	.	.
	1999	.	.	.	.	.

cont. Table 21a

Non-university science expenditure by type of expenditure*

– DM million –

Type of institution	Year[1]	Total expenditure	Current expenditure: Total	Current expenditure: of which staff expenditure	Investments: Total	Investments: of which construction
of which: R&D expenditure	1989	8263	6299	3820	1964	804
	1993	11 490	9499	5849	1990	667
	1995	12 255	10 088	6276	2167	751
	1996	12 332	10 078	6429	2253	907
	1997	12 268	10 130	6471	2137	878
	1998	12 771	.	.	.	.
	1999	13 255	.	.	.	.
of which old *Länder* and West Berlin[3]	1993	9416	.	.	.	.
	1995	9939	.	.	.	.
	1996	9850	.	.	.	.
	1997	9733	.	.	.	.
	1998	.	.	.	.	.
	1999	.	.	.	.	.
new *Länder* and East Berlin[3]	1993	2006	.	.	.	.
	1995	2251	.	.	.	.
	1996	2411	.	.	.	.
	1997	2446	.	.	.	.
	1998	.	.	.	.	.
	1999	.	.	.	.	.
For information:						
Federal institutions performing R&D	1989	1824	1289	866	535	370
	1993	2857	2189	1488	669	494
	1995	2873	2184	1524	689	499
	1996	2918	2223	1553	696	479
	1997	3001	2302	1542	699	505
	1998	3102	.	.	.	.
	1999	2956	.	.	.	.
of which: R&D expenditure	1989	951	692	477	259	174
	1993	1128	930	679	199	120
	1995	1249	1042	767	207	112
	1996	1299	1060	786	239	143
	1997	1304	1063	779	241	157
	1998	1275	.	.	.	.
	1999	1269	.	.	.	.

cont. Table 21a

Non-university science expenditure by type of expenditure*

– DM million –

Type of institution	Year[1]	Total expenditure	of which: Current expenditure – Total	of which: Current expenditure – of which staff expenditure	of which: Investments – Total	of which: Investments – of which construction
Länder and local government institutions performing R&D (including Blue List institutions)	1989	**861**	736	500	124	28
	1993	**1278**	1149	761	129	42
	1995	**1283**	1180	813	103	40
	1996	**1314**	1195	839	120	42
	1997	**1219**	1122	805	96	41
	1998	**1231**	.	.	.	.
	1999	**1225**	.	.	.	.
of which: R&D expenditure	1989	**515**	441	299	74	12
	1993	**579**	524	353	55	20
	1995	**562**	519	360	43	18
	1996	**624**	561	394	63	20
	1997	**524**	485	355	39	15
	1998	**593**	.	.	.	.
	1999	**550**	.	.	.	.
University institutes	1989	**249**	200	135	49	15
	1993	**627**	549	365	78	18
	1995	**758**	687	467	71	16
	1996	**793**	707	467	86	31
	1997	**787**	717	477	69	21
	1998	**861**	.	.	.	.
	1999	**865**	.	.	.	.
of which: R&D expenditure	1989	**211**	172	119	39	13
	1993	**559**	487	328	72	17
	1995	**664**	597	410	67	15
	1996	**700**	619	411	81	30
	1997	**704**	638	426	66	21
	1998	**760**	.	.	.	.
	1999	**763**	.	.	.	.

1 1989 former West Germany, from 1993 onwards Germany.
Up to and including 1997 actual figures, 1998 provisional result, 1999 estimates based on budget appropriations. Since 1992 new surveying concept. As a result, extension of coverage and data for each institution's R&D share. Furthermore, institutions are no longer classified as belonging to certain fields of science but each institution's expenditure is broken down by field of science.

2 Including legally independent institutes.

3 Due to the restructuring of research institutions, recent data for West Berlin and East Berlin are subject to significant uncertainty.

Source: Federal Statistical Office

Rounding error

Table 21b

Non-university science expenditure by field of science*

– DM million –

Type of institution	Year[1]	Total expenditure	of which				
			Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
1 Helmholtz centres	1989	**3576**	2765	660	151	x	x
(national research centres)	1993	**4218**	2847	1075	272	x	x
	1995	**4236**	2619	1224	340	x	x
	1996	**4092**	2534	1191	343	x	x
	1997	**4101**	2350	1393	332	x	x
	1998	**4316**	.	.	.	.	.
	1999	**4576**	.	.	.	.	.
of which: R&D expenditure	1989	**3576**	2765	660	151	x	x
	1993	**4192**	2821	1075	272	x	x
	1995	**4222**	2604	1224	340	x	x
	1996	**4077**	2519	1191	343	x	x
	1997	**4086**	2334	1393	332	x	x
	1998	**4301**	.	.	.	.	.
	1999	**4556**	.	.	.	.	.
2 Max Planck institutes	1989	**1122**	806	23	206	.	86
(100% R&D)[2]	1993	**1429**	1151	-	135	-	143
	1995	**1585**	1256	-	153	-	176
	1996	**1745**	1422	-	158	-	165
	1997	**1731**	1399	-	168	-	165
	1998	**1869**	.	.	.	.	.
	1999	**2006**	.	.	.	.	.
3 Fraunhofer institutes	1989	**696**	108	555	x	x	x
(100% R&D)	1993	**1000**	191	792	x	x	x
	1995	**1262**	202	1031	x	x	x
	1996	**1302**	237	1026	x	x	x
	1997	**1283**	277	969	x	x	x
	1998	**1 82**	.	.	.	.	.
	1999	**1351**	.	.	.	.	.
4 Blue List institutions	1989	**747**	244	x	135	x	242
	1993	**1596**	849	x	133	x	427
	1995	**1701**	928	x	145	x	388
	1996	**1713**	935	x	161	x	387
	1997	**1671**	904	x	162	x	376
	1998	**1714**	.	.	.	.	.
	1999	**1705**	.	.	.	.	.

cont. Table 21b

Non-university science expenditure by field of science*

– DM million –

Type of institution	Year[1]	Total expenditure	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
of which: R&D expenditure	1989	**549**	138	x	129	x	204
	1993	**1350**	755	x	126	x	307
	1995	**1460**	824	x	137	x	307
	1996	**1462**	823	x	147	x	311
	1997	**1410**	789	x	136	x	304
	1998	**1455**	.	.	.	.	.
	1999	**1452**	.	.	.	.	.
5 Public institutions (excluding libraries, archives, museums; excluding Blue List institutions)	1989	**2499**	1107	329	331	556	177
	1993	**3873**	1304	1042	474	779	274
	1995	**3883**	1426	943	255	953	306
	1996	**3908**	1443	900	247	987	332
	1997	**3997**	1533	885	276	990	312
	1998	**4107**	.	.	.	.	.
	1999	**3961**	.	.	.	.	.
of which: R&D expenditure	1989	**1347**	450	232	135	389	140
	1993	**1481**	325	361	109	504	183
	1995	**1575**	416	316	79	572	192
	1996	**1625**	437	331	91	563	204
	1997	**1643**	446	306	115	581	195
	1998	**1641**	.	.	.	.	.
	1999	**1613**	.	.	.	.	.
6 Scientific libraries, archives and museums (excluding Blue List institutions)	1989	**918**	-	x	x	x	886
	1993	**1352**	56	x	x	x	1264
	1995	**1345**	73	x	x	x	1205
	1996	**1354**	72	x	x	x	1206
	1997	**1398**	71	x	x	x	1252
	1998	**1411**	.	.	.	.	.
	1999	**1402**	.	.	.	.	.
of which: R&D expenditure	1989	**440**	-	x	x	x	428
	1993	**456**	40	x	x	x	402
	1995	**417**	23	x	x	x	381
	1996	**406**	22	x	x	x	368
	1997	**434**	23	x	x	x	396
	1998	**438**	.	.	.	.	.
	1999	**439**	.	.	.	.	.

cont. Table 21b

Non-university science expenditure by field of science*

– DM million –

Type of institution	Year[1]	Total expenditure	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
7 Other research institutions	1989	**533**	201	x	x	x	218
	1993	**1901**	541	809	70	82	398
	1995	**2259**	634	892	99	66	568
	1996	**2181**	620	853	80	54	573
	1997	**2145**	593	848	89	46	571
	1998	**2278**	.	.	.	.	.
	1999	**2397**	.	.	.	.	.
of which: R&D expenditure	1989	**533**	201	x	x	x	218
	1993	**1582**	491	628	68	67	329
	1995	**1734**	563	650	86	42	393
	1996	**1714**	568	633	71	36	406
	1997	**1681**	542	629	83	28	399
	1998	**1785**	.	.	.	.	.
	1999	**1837**	.	.	.	.	.
8 Total	**1989**	**10 092**	**5231**	**1774**	**878**	**566**	**1642**
	1993	**15 369**	**6939**	**3814**	**1119**	**973**	**2525**
	1995	**16 271**	**7137**	**4231**	**1038**	**1172**	**2693**
	1996	**16 296**	**7263**	**4111**	**1073**	**1182**	**2666**
	1997	**16 327**	**7126**	**4237**	**1085**	**1173**	**2705**
	1998	**16 978**	.	.	.	.	.
	1999	**17 400**	.	.	.	.	.
of which old *Länder* and West Berlin[3]	1993	**12 781**	.	.	.	.	.
	1995	**13 306**	.	.	.	.	.
	1996	**13 119**	.	.	.	.	.
	1997	**12 839**	.	.	.	.	.
	1998	.	.	.	.	.	.
	1999	.	.	.	.	.	.
new *Länder* and East Berlin[3]	1993	**2516**	.	.	.	.	.
	1995	**2899**	.	.	.	.	.
	1996	**3104**	.	.	.	.	.
	1997	**3394**	.	.	.	.	.
	1998	.	.	.	.	.	.
	1999	.	.	.	.	.	.

cont. Table 21b

Non-university science expenditure by field of science*

– DM million –

Type of institution	Year[1]	Total expenditure	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
of which: R&D expenditure	**1989**	**8263**	**4469**	**1626**	**660**	**399**	**1110**
	1993	**11 490**	**5774**	**2929**	**725**	**679**	**1382**
	1995	**12 255**	**5888**	**3307**	**810**	**753**	**1497**
	1996	**12 332**	**6028**	**3265**	**840**	**725**	**1475**
	1997	**12 268**	**5810**	**3381**	**855**	**732**	**1489**
	1998	**12 771**	.	.	.	.	.
	1999	**13 255**	.	.	.	.	.
of which old *Länder* and West Berlin[3]	1993	**9416**	.	.	.	.	.
	1995	**9939**	.	.	.	.	.
	1996	**9850**	.	.	.	.	.
	1997	**9733**	.	.	.	.	.
	1998	.	.	.	.	.	.
	1999	.	.	.	.	.	.
new *Länder* and East Berlin[3]	1993	**2006**	.	.	.	.	.
	1995	**2251**	.	.	.	.	.
	1996	**2411**	.	.	.	.	.
	1997	**2446**	.	.	.	.	.
	1998	.	.	.	.	.	.
	1999	.	.	.	.	.	.
For information: Federal institutions performing R&D	1989	**1824**	841	286	x	282	x
	1993	**2857**	983	820	x	390	x
	1995	**2873**	1112	797	x	516	x
	1996	**2918**	1140	762	x	542	x
	1997	**3001**	1228	746	x	548	x
	1998	**3102**	.	.	.	.	.
	1999	**2956**	.	.	.	.	.
of which: R&D expenditure	1989	**951**	306	200	x	240	x
	1993	**1128**	247	313	x	339	x
	1995	**1249**	356	285	x	392	x
	1996	**1299**	377	303	x	379	x
	1997	**1304**	387	274	x	387	x
	1998	**1275**	.	.	.	.	.
	1999	**1269**	.	.	.	.	.

cont. Table 21b

Non-university science expenditure by field of science*

– DM million –

Type of institution	Year[1]	Total ex-pend-iture	of which: Natural sciences	Engi-neering	Medi-cine	Agri-cultural sciences	Social sciences and human-ities
Länder and local government institutions performing R&D (including Blue List institutions)	1989	**861**	383	42	27	274	135
	1993	**1278**	494	223	44	389	128
	1995	**1283**	478	146	38	437	184
	1996	**1314**	499	139	40	444	192
	1997	**1219**	421	139	40	442	176
	1998	**1231**	.	.	.	.	.
	1999	**1225**	.	.	.	.	.
of which: R&D expenditure	1989	**515**	208	31	27	136	113
	1993	**579**	216	48	44	164	106
	1995	**562**	192	31	38	180	121
	1996	**624**	229	28	40	184	143
	1997	**524**	145	32	30	195	122
	1998	**593**	.	.	.	.	.
	1999	**550**	.	.	.	.	.
University institutes	1989	**249**	94	23	x	x	58
	1993	**627**	222	178	x	x	134
	1995	**758**	274	226	x	x	154
	1996	**793**	307	224	x	x	156
	1997	**787**	284	233	x	x	156
	1998	**861**	.	.	.	.	.
	1999	**865**	.	.	.	.	.
of which: R&D expenditure	1989	**211**	72	12	x	x	54
	1993	**559**	210	135	x	x	123
	1995	**664**	252	173	x	x	137
	1996	**700**	286	177	x	x	135
	1997	**704**	264	190	x	x	137
	1998	**760**	.	.	.	.	.
	1999	**763**	.	.	.	.	.

1 1989 former West Germany, from 1993 onwards Germany.

Up to and including 1997 actual figures, 1998 provisional result, 1999 estimates based on budget appropriations. Since 1992 new surveying concept. As a result, extension of coverage and data for each institution's R&D share. Furthermore, institutions are no longer classified as belonging to certain fields of science but each institution's expenditure is broken down by field of science.

2 Including legally independent institutes.

3 Due to the restructuring of research institutions, recent data for West Berlin and East Berlin are subject to significant uncertainty.

Source: Federal Statistical Office

Rounding error

3.1.5 Technological balance of payments

Table 22

Receipts from and expenditure on patents, inventions and processes

– DM million –

Economic activity	1995 Receipts	1995 Expenditure	1995 Balance	1996 Receipts	1996 Expenditure	1996 Balance
Manufacturing	**2786**	**4843**	**-2057**	**3073**	**3512**	**-439**
of which:						
Chemicals and refined petroleum products	1314	1730	-417	1642	1560	+82
of which:						
Refined petroleum products	0	4	-4	–	3	-3
Basic metals	640	251	+389	686	254	+432
of which:						
Ferrous and non-ferrous metals, casting of metals and steel processing	6	32	-25	2	17	-15
Machinery and equipment	164	164	-1	211	175	+36
Transport equipment	470	56	+414	474	62	+411
Electrical machinery and computers	614	2191	-1577	634	1062	-428
Precision and optical instruments, tools and finished metal goods	26	149	-123	32	141	-108
Food products, beverages and tobacco	18	367	-350	26	344	-318
Rubber and plastic products	16	64	-49	29	45	-17
Other non-metallic mineral products	9	36	-27	8	36	-28
Wood and products of wood; pulp, paper & paper products; printing; leather, textiles & wearing apparel	149	38	+112	15	33	-18
Furniture, jewellery, musical instruments, sports goods, games & toys, miscellaneous; recycling	1	16	-15	1	37	-36
Other economic activities	**412**	**906**	**-493**	**623**	**1919**	**-1296**
of which:						
Construction	0	8	-8	1	6	-6
Wholesale and retail trade	189	488	-300	209	396	-188
Technical advice and planning, miscellaneous business activities	187	376	-189	378	1491	-1112
Total	**3198**	**5749**	**-2550**	**3696**	**5431**	**-1735**

Source: Deutsche Bundesbank

(excluding copyright) in the Federal Republic of Germany by economic activity

– DM million –

1997 Receipts	1997 Expenditure	1997 Balance	1998 Receipts	1998 Expenditure	1998 Balance	Economic activity
3574	**3021**	**+553**	**3989**	**3270**	**+719**	**Manufacturing**
						of which:
1679	1037	+642	2072	1237	+835	Chemicals and refined petroleum products
						of which:
–	5	-5	0	23	-23	Refined petroleum products
875	341	+534	997	363	+633	Basic metals
						of which:
2	37	-35	2	21	-20	Ferrous and non-ferrous metals, casting of metals and steel processing
196	218	-23	233	239	-6	Machinery and equipment
677	86	+591	762	103	+ 659	Transport equipment
837	1099	-261	736	1047	-312	Electrical machinery and computers
35	124	-89	55	150	-95	Precision and optical instruments, tools and finished metal goods
31	265	-234	29	253	-225	Food products, beverages and tobacco
78	55	+23	54	61	-8	Rubber and plastic products
11	35	-24	14	32	-18	Other non-metallic mineral products
24	40	-16	32	86	-54	Wood and products of wood; pulp, paper & paper products; printing; leather, textiles & wearing apparel
4	26	-22	1	39	-38	Furniture, jewellery, musical instruments, sports goods, games & toys, miscellaneous; recycling
436	**2020**	**-1584**	**540**	**2275**	**-1735**	**Other economic activities**
						of which:
0	6	-6	1	3	-2	Construction
43	260	-217	72	252	-181	Wholesale and retail trade
349	1727	-1378	389	1980	-1590	Technical advice and planning, miscellaneous business activities
4010	**5041**	**-1031**	**4529**	**5545**	**-1016**	**Total**

Table 23

Receipts from and expenditure on patents, inventions and processes (excluding

– DM million –

Country/group of countries	1993 Receipts	1993 Expenditure	1993 Balance	1994 Receipts	1994 Expenditure	1994 Balance
1. Industrialised countries...	**2146**	**5007**	**-2861**	**2275**	**4946**	**-2671**
EU countries	901	1031	-130	1080	956	+124
Belgium/Luxembourg	59	81	-22	82	87	-5
Denmark	10	30	-20	15	40	-25
Finland	10	6	+4	10	6	+4
France[1]	187	223	-36	197	223	-26
Greece	22	1	+21	21	1	+20
Ireland	11	10	+1	11	6	+5
Italy	113	52	+61	169	52	+117
Netherlands	54	372	-318	89	294	-205
Austria	145	20	+125	142	42	+100
Portugal	31	0	+31	22	0	+22
Sweden	21	75	-54	33	48	-15
Spain[2]	135	7	+128	121	12	+109
United Kingdom	104	155	-51	166	144	+22
Other European industrialised countries	144	666	-522	135	708	-573
of which:						
Norway	17	15	+2	5	11	-6
Switzerland	103	649	-546	106	693	-587
Turkey	23	1	+22	24	3	+21
Non-European industrialised countries	1101	3311	-2210	1061	3282	-2221
of which:						
Australia	22	12	+10	23	17	+6
Japan	342	138	+204	345	184	+161
Canada	18	26	-8	14	30	-16
Unites States of America	718	3135	-2417	677	3052	-2375
2. Transition countries	**134**	**16**	**+118**	**94**	**23**	**+71**
of which:						
China	27	1	+26	44	0	+44
former Soviet Union	53	3	+50	26	8	+18
Poland	3	3	0	4	2	+2
former Czechoslovakia	38	1	+37	8	5	+3
Hungary	9	7	+2	8	6	+2
3. Developing countries (including OPEC)	**358**	**18**	**+340**	**422**	**41**	**+381**
in Africa	71	2	+69	50	7	+43
in America	106	3	+103	179	8	+171
of which:						
Argentina	49	1	+48	80	1	+79
Brazil	5	1	+4	12	1	+11
Mexico	31	0	+31	69	1	+68
in Asia and Oceania	181	13	+168	194	26	+168
Total	**2639**	**5041**	**-2402**	**2792**	**5010**	**-2218**

1 Including Guiana, Guadeloupe, Martinique and Réunion.

copyright) in the Federal Republic of Germany by major partner countries

– DM million –

1995			1996			1997			1998		
Receipts	Expenditure	Balance	Receipts	Expenditure	Balance	Receipts	Expenditure	Balance	Receipts	Expenditure	Balance
2623	**5680**	**-3057**	**2969**	**5369**	**-2400**	**2930**	**4942**	**-2011**	**3610**	**5435**	**-1825**
1296	1651	-355	1122	1109	+13	1281	1213	+68	1406	1465	-59
91	91	0	78	105	-27	103	101	+2	187	119	+68
16	43	-27	11	38	-27	6	40	-34	10	48	-38
15	4	+11	9	4	+5	10	4	+6	8	4	+4
224	213	+11	184	216	-32	212	218	-6	186	329	-143
33	1	+32	13	1	+12	9	5	+5	7	2	+5
7	12	-5	11	65	-54	17	108	-91	29	88	-60
146	40	+106	143	36	+107	119	29	+90	195	45	+150
98	359	-261	85	414	-329	115	434	-319	77	485	-408
131	33	+98	109	28	+81	88	41	+47	60	41	+19
18	1	+17	20	1	+19	14	1	+13	17	1	+17
35	50	-15	28	41	-13	22	42	-20	21	39	-18
270	7	+263	230	4	+226	319	20	+299	349	8	+342
211	798	-587	200	157	+43	247	170	+77	259	255	+4
186	652	-466	130	1142	-1012	105	533	-428	193	658	-465
30	10	+20	6	9	-3	5	8	-3	10	9	+2
129	618	-489	97	1125	-1028	79	516	-437	155	642	-487
26	7	+19	25	1	+24	16	2	+14	23	2	+21
1141	3377	-2236	1717	3117	-1400	1545	3196	-1651	2011	3312	-1301
24	9	+15	40	9	+31	31	12	+19	68	12	+56
325	202	+123	297	239	+58	313	294	+19	324	269	+55
12	20	-8	15	14	+1	19	20	-1	14	20	-6
779	3145	-2366	1363	2855	-1492	1179	2870	-1690	1605	3011	-1406
120	**17**	**+103**	**102**	**16**	**+86**	**221**	**22**	**+199**	**225**	**31**	**+194**
63	1	+62	31	2	+29	38	3	+36	38	7	+32
5	5	0	21	3	+18	15	6	+10	6	7	-1
18	5	+13	25	4	+21	38	5	+33	49	5	+44
13	2	+11	15	2	+13	63	3	+60	44	3	+41
12	4	+8	7	3	+4	60	3	+57	78	4	+74
456	**52**	**+404**	**625**	**46**	**+579**	**859**	**78**	**+781**	**693**	**78**	**+615**
67	2	+65	82	1	+81	80	2	+77	54	2	+52
144	16	+128	197	21	+176	216	41	+174	235	20	+215
33	0	+33	66	1	+65	43	28	+15	48	3	+44
21	2	+19	56	3	+53	100	4	+96	51	7	+44
71	4	+67	60	11	+49	57	2	+55	118	3	+115
245	33	+212	346	24	+322	563	34	+529	404	55	+349
3198	**5749**	**-2551**	**3696**	**5431**	**-1735**	**4010**	**5041**	**-1031**	**4529**	**5545**	**-1016**

2 Including Canary Islands, Ceuta and Melilla.

Source: Deutsche Bundesbank

Table 24

German receipts from and expenditure on technical research and development[1]

– DM million –

Economic activity/ group of countries	1995 Receipts	1995 Expenditure	1995 Balance	1996 Receipts	1996 Expenditure	1996 Balance
Manufacturing	**3443**	**3660**	**- 217**	**2966**	**4398**	**- 1432**
of which:						
Chemicals and refined petroleum products	177	935	- 758	188	1234	- 1046
of which:						
Refined petroleum products	12	158	- 146	13	12	+ 1
Basic metals	1928	1304	+ 624	2020	1649	+ 371
of which:						
Machinery and equipment	49	43	+ 5	41	55	- 14
Transport equipment	1878	1243	+ 635	1 976	1572	+ 404
Electrical machinery and computers	1183	1265	- 82	558	1400	- 842
Precision and optical instruments, tools and finished metal goods	34	40	- 6	42	42	0
Food products, beverages and tobacco	24	17	+ 6	52	30	+ 22
Other manufacturing trades	97	98	- 1	106	43	+ 62
Other economic activities	**1945**	**683**	**+ 1263**	**2063**	**966**	**+1097**
of which:						
Wholesale and retail trade	88	122	- 34	136	163	- 28
Technical advice and planning, miscellaneous business activities	1814	536	+ 1278	1922	758	+1164
Total	**5388**	**4343**	**+ 1045**	**5029**	**5364**	**- 335**
of which:						
1. Industrialised countries	5213	4097	+ 1117	4756	5105	- 349
EU countries (as of: beginning of 1995) including EU organisations	3697	2705	+ 992	3488	3122	+ 366
Other European industrialised countries	271	256	+ 15	283	270	+ 13
Non-European industrialised countries	1246	1136	+ 110	985	1713	- 728
2. Transition countries	67	66	0	59	89	- 31
3. Developing countries (including OPEC)	87	154	- 68	107	134	- 27
in Africa	4	16	- 12	4	26	- 22
in America	40	45	- 5	52	19	+ 33
in Asia and Oceania	43	93	- 50	51	89	- 38
4. International organisations[2]	21	26	- 4	107	35	+ 72
Total	**5388**	**4343**	**+ 1045**	**5029**	**5364**	**- 335**

1 Mainly payments for the development of new products and processes including scientific advice. Including EU-funded projects.

2 Excluding the European Community's international organisations as well as IBZW and IIB.

Source: Deutsche Bundesbank

in foreign trade by economic activity and group of countries

– DM million –

1997 Receipts	1997 Expenditure	1997 Balance	1998 Receipts	1998 Expenditure	1998 Balance	Economic activity/ group of countries
5210	**4826**	**+384**	**4756**	**5412**	**- 656**	**Manufacturing**
						of which:
278	1683	-1404	270	2338	-2068	Chemicals and refined petroleum products
						of which:
11	16	- 5	21	52	- 31	Refined petroleum products
3957	1975	+1982	3459	1647	+1812	Basic metals
						of which:
86	93	- 7	40	114	- 74	Machinery and equipment
3869	1853	+2015	3416	1514	+1902	Transport equipment
714	1027	- 313	746	1291	- 545	Electrical machinery and computers
115	64	+51	136	63	+73	Precision and optical instruments, tools and finished metal goods
54	29	+25	30	37	- 6	Food products, beverages and tobacco
92	48	+43	116	37	+79	Other manufacturing trades
2126	**1169**	**+957**	**2692**	**1311**	**+1381**	**Other economic activities**
						of which:
213	105	+108	171	176	- 4	Wholesale and retail trade
1905	1005	+900	2513	1055	+1458	Technical advice and planning, miscellaneous business activities
7336	**5995**	**+1341**	**7448**	**6723**	**+725**	**Total**
						of which:
7031	5666	+1365	6891	6313	+578	1. Industrialised countries
4157	3248	+909	3899	3221	+677	EU countries (as of early EU organisations
307	304	+3	448	353	+96	Other European industrialised countries
2566	2113	+453	2544	2739	- 195	Non-European industrialised countries
59	134	- 75	104	156	- 52	2. Transition countries
189	159	+31	390	253	+137	3. Developing countries (including OPEC)
3	20	- 18	4	30	- 26	in Africa
124	21	+104	254	76	+178	in America
62	118	- 55	132	147	- 15	in Asia and Oceania
57	36	+21	63	.	+63	4. 4. International organisations[2]
7336	**5995**	**+1341**	**7448**	**6723**	**+725**	**Total**

3.1.6 International comparison

Table 25

Gross domestic expenditure on research and development in selected OECD countries by financing and performing sectors

– DM million –

Country	Year[1]	R&D expenditure US$ million[2]	R&D expenditure Share in GDP[3] %	Financed by: Business enterprise sector	Financed by: Government sector[4]	Financed by: Other domestic sources and abroad	Performed by: Business enterprise sector	Performed by: Government sector[4]	Performed by: Higher education sector	Performed by: PNP-sector[5]
				Percentage						
Germany[7]	1989	**30 271**	2.87	63	34	3	72	13	14	1
	1991[6]	**35 654**	2.61	62	36	2	69	14	16	0
	1993	**36 459**	2.42	62	37	2	67	15	18	.
	1995	**39 366**	2.31	61	37	2	66	15	18	.
	1996	**39 851**	2.30	61	37	2	66	15	19	.
	1997	**41 913**	2.31	62	36	3	68	15	18	.
	1998	**43 175**	2.32	62	36	3	68	15	18	.
France	1989	**21 458**	2.33	44	48	8	60	24	15	1
	1991	**25 053**	2.41	43	49	9	62	23	15	1
	1993[6]	**26 442**	2.45	47	44	9	62	21	16	1
	1995	**27 595**	2.34	48	42	10	61	21	17	1
	1996	**27 791**	2.32	49	42	10	62	20	17	1
	1997	**27 900**	2.24	50	40	10	61	20	17	1
	1998	**28 711**	2.20	.	.	.	62	20	17	1
United Kingdom	1989	**18 729**	2.15	51	36	13	69	14	15	2
	1991	**19 106**	2.11	50	35	15	67	15	17[6]	2
	1993	**21 258**	2.15	52	33	16	67	14	17	2
	1995	**21 604**	2.02	48	33	19	65	14	19	1
	1996	**22 362**	1.95	47	32	21	65	14	19	1
	1997	**22 618**	1.87	50	31	20	65	14	20	1
	1998	**.**	.	.	.	.	.	.	.	.
Italy	1989	**10 741**	1.24	46	50	4	59	22	20	.
	1991[6]	**12 069**	1.24	44	50	6	56	23	22	.
	1993	**11 482**	1.14	44	51	4	54	21	25	.
	1995[6]	**11 481**	1.01	42	53	5	53	21	26	.
	1996	**12 101**	1.02	43	51	6	54	20	27	.
	1997	**12 276**	1.00	43	51	6	53	21	26	.
	1998	**12 976**	1.03	44	51	5	54	21	25	.
Netherlands	1989	**4648**	2.12	53	42	5	59	17	21	2
	1991[6]	**5099**	2.05	48	49	4	50	18	30	2[8]
	1993	**5468**	2.00	44	49	7	49	18	30	3[8]
	1995	**6489**	2.07	46	42	12	52	18	29	1
	1996	**6853**	2.09	49	42	10	53	18	29	1
	1997	**7319**	2.12	46	39	15	55	17	27	1
	1998	**.**	.	.	.	.	.	.	.	.
Japan[8]	1989	**59 374**	2.95	72	19	9	70	8	18	4
	1991	**71 355**	3.00	73	18	9	71	8	18	4
	1993	**74 506**	2.88	68	22	10	66	9	20	5
	1995	**85 255**	2.98	67	23	10	65	10	21	4
	1996[6]	**85 271**	2.83	73	19	8	71	9	15	5
	1997	**90 208**	2.91	74	18	8	72	9	14	5
	1998	**.**	.	.	.	.	.	.	.	.

cont. Table 25

Gross domestic expenditure on research and development in selected OECD countries by financing and performing sectors

– DM million –

Country	Year[1]	R&D expenditure		Financed by			Performed by			
		US$ million[2]	Share in GDP[3] %	Business enterprise sector	Government sector[4]	Other domestic sources and abroad	Business enterprise sector	Government sector[4]	Higher education sector	PNP-sector[5]
				Percentage						
USA[9]	1989	**143 676**	2.73	52	46	2	71	11	16	3
	1991[6]	**160 652**	2.81	58	39	4	73	10	14	3
	1993	**165 868**	2.62	58	38	4	71	10	16	4
	1995	**183 694**	2.61	60	36	4	72	10	15	3
	1996	**196 995**	2.66	63	33	4	73	9	15	3
	1997	**211 928**	2.70	64	32	4	74	8	14	3
	1998	**227 934**	2.77	66	31	4	75	8	14	3
Canada	1989	**6776**	1.38	42	45	14	54	20	25	1
	1991	**7912**	1.52	41	43	15	53[6]	20	26	1
	1993	**9043**	1.60	44	40	16	57	18	25	1
	1995	**10 476**	1.58	46	35	18	60	16	23	1
	1996	**10 839**	1.60	.	.	.	61	16	22	1
	1997	**11 515**	1.60	49	32	19	63	14	22	1
	1998	**11 977**	1.61	49	32	19	64	13	22	1
Austria[10]	1989	**1617**	1.37	53	43	4	59	8	32	2
	1991	**2040**	1.49	50	47	3	.	.	.	.
	1993	**2280**	1.49	49	48	3	56	9	35	0
	1995	**2680**	1.59	49	47	4	.	.	.	.
	1996	**2827**	1.59	51	45	4	.	.	.	.
	1997	**2971**	1.60	52	44	4	.	.	.	.
	1998	**3158**	1.63	51	45	4	.	.	.	.
Switzerland[11]	1989	**3768**	2.83	74	23	3	75	4	20	1
	1991	**.**	.	.	.	.	.	.	.	.
	1992	**4208**	2.66	67	28	4	70	4	25	1
	1993	**.**	.	.	.	.	.	.	.	.
	1995	**.**	.	.	.	.	.	.	.	.
	1996	**4873**	2.74	68	27	6	71	3	24	3
	1997	**.**	.	.	.	.	.	.	.	.
	1998	**.**	.	.	.	.	.	.	.	.
Sweden[12]	1989	**4053**	2.94	59	38	3	65	4	31	0
	1991	**4201**	2.89	62	34	4	69	4	27	0
	1993[6]	**4986**	3.39	61	33	6	70	4	26	1
	1995[6]	**6069**	3.59	66	29	6	74	4	22	0
	1996	**.**	.	.	.	.	.	.	.	.
	1997	**6965**	3.85	68	25	6	75	4	22	0
	1998	**.**	.	.	.	.	.	.	.	.

1 Provisional data for 1998, based partly on national estimates, partly on OECD estimates.
2 Nominal expenditure, in US$ purchasing power parities.
3 R&D expenditure as a proportion of the gross domestic product. For international comparison (not in national statistics), GDP based on the European System of Accounts (ESA) 1979.
4 Including research financed from General University Funds.
5 PNP: Private non-profit institutions.
6 Break in series.
7 1989 former West Germany, from 1991 onwards Germany. Even years and 1997 estimated.
Available data for the PNP sector included in government sector from 1992 onwards.
8 Up to and including 1995 total R&D expenditure (and GDP share) overestimated; share of R&D performed overestimated for business enterprise and higher education sectors, underestimated for government and PNP sectors; financing shares adjusted by the Secretariat.
9 National results, adjusted by the Secretariat to meet OECD norms. Excludes most or all capital expenditure; only federal expenditure included in government sector. Government financing share underestimated from 1991 onwards.
10 Estimates except for 1993 data.
11 Government sector (performing of R&D) Federal Government only.
12 Up to and including 1993, total R&D expenditure and GDP share underestimated. Financing share of business enterprise sector overestimated up to and including 1991, shares of other sectors underestimated. Share of R&D performed underestimated for higher education and government sectors (up to and including 1993), overestimated for business enterprise sector up to and including 1991 and underestimated in 1993, underestimated for the PNP sector up to and including 1993.

Source: OECD (1999/2) and calculations by BMBF

Rounding error

Table 26

Government expenditure on research and development

– Budget, ECU[1] million –

Research objective[2]	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy[3]
1997								
1. Exploration and exploitation of the Earth	9	15	324	.	53	96	1	85
2. Infrastructure and general planning of land-use	12	16	272	.	10	84	5	28
3. Control of environmental pollution	30	31	560	.	53	259	3	152
4. Protection and improvement of human health	18	17	528	.	121	695	8	438
5. Production, distribution and rational utilisation of energy	39	29	560	.	107	600	0	254
6. Agricultural production and technology	42	95	430	.	98	473	45	138
7. Industrial production and technology	245	113	2031	.	424	588	75	561
8. Social structures and relationships	38	83	394	.	17	117	13	255
9. Exploration and exploitation of space	167	31	759	.	159	1449	6	546
10. Research financed from General University Funds	425	391	6134	.	704	2123	47	2833
11. Non-oriented research	288	253	2466	.	191	2490	15	678
12. Other civil research	60	.	- 45	.	33	310	.	.
13. Defence	7	5	1526	.	479	3609	.	275
Total expenditure	**1380**	**1078**	**15 940**	**.**	**2449**	**12 893**	**219**	**6244**
1998 provisional budget[6]								
1. Exploration and exploitation of the Earth	9	.	303	.	52	112	1	98
2. Infrastructure and general planning of land-use	12	.	272	.	17	81	6	39
3. Control of environmental pollution	25	.	556	.	68	280	2	210
4. Protection and improvement of human health	19	.	510	.	131	706	9	345
5. Production, distribution and rational utilisation of energy	37	.	572	.	100	653	0	305
6. Agricultural production and technology	42	.	431	.	110	490	24	113
7. Industrial production and technology	288	.	1 948	.	428	731	78	496
8. Social structures and relationships	58	.	409	.	15	150	14	222
9. Exploration and exploitation of space	165	.	753	.	154	1 395	6	509
10. Research financed from General University Funds	433	.	6264	.	723	2184	51	2939
11. Non-oriented research	307	.	2518	.	152	2611	37	680
12. Other civil research	58	.	38	.	34	225	.	.
13. Defence	6	.	1393	.	849	3167	.	162
Total expenditure	**1460**	**.**	**15 967**	.	**2834**	**12 786**	**230**	**6117**

11ECU = European Currency Unit; average exchange rate in 1997: ECU1 = DM1.96, 1998: ECU1 = DM1.97.

21In accordance with the Nomenclature for the Analysis and Comparison of Science Programmes and Budgets (NABS 1992).

in the countries of the European Union

– Budget, ECU[1] million –

Nether-lands	Austria	Portugal	Finland	Sweden[3]	UK	EU-15[4]	EUR-11[5]	Euro-pean Union	Research objective[2]
									1997
11	20	14	14	.	117	**784**	**627**	**60**	1. Exploration and exploitation of the Earth
105	23	16	35	.	143	**869**	**589**	**176**	2. Infrastructure and general planning of land-use
77	24	23	28	.	197	**1496**	**1209**	**168**	3. Control of environmental pollution
53	35	28	95	.	1222	**3307**	**2018**	**197**	4. Protection and improvement of human health
88	10	8	49	.	59	**1868**	**1714**	**356**	5. Production, distribution and rational utilisation of energy
105	37	62	76	.	388	**2058**	**1506**	**160**	6. Agricultural production and technology
318	73	41	327	.	148	**5103**	**4684**	**1007**	7. Industrial production and technology
55	24	24	64	.	166	**1393**	**1002**	**86**	8. Social structures and relationships
93	0	3	30	.	237	**3514**	**3214**	**49**	9. Exploration and exploitation of space
1211	731	197	316	.	1493	**17 529**	**14 720**	**.**	10. Research financed from General University Funds
293	149	40	145	.	969	**8241**	**6755**	**174**	11. Non-oriented research
132	2	24	.	.	31	**547**	**516**	**231**	12. Other civil research
84	0	2	18	.	3340	**9773**	**6002**	**.**	13. Defence
2624	**1128**	**481**	**1197**	**.**	**8511**	**56 483**	**44 555**	**2664**	**Total expenditure**
									1998 provisional budget[6]
13	21	17	16	21	123	**786**	**642**	**57**	1. Exploration and exploitation of the Earth
95	24	18	36	102	143	**845**	**600**	**143**	2. Infrastructure and general planning of land-use
73	26	27	28	15	202	**1512**	**1295**	**155**	3. Control of environmental pollution
61	31	33	94	16	1264	**3220**	**1940**	**181**	4. Protection and improvement of human health
83	7	9	80	75	54	**1974**	**1846**	**277**	5. Production, distribution and rational utilisation of energy
101	38	72	78	31	378	**1908**	**1499**	**150**	6. Agricultural production and technology
353	70	48	333	86	73	**4932**	**4772**	**966**	7. Industrial production and technology
54	26	28	68	119	190	**1353**	**1045**	**65**	8. Social structures and relationships
81	0	3	24	42	223	**3355**	**3090**	**53**	9. Exploration and exploitation of space
1238	792	207	322	862	1578	**17 593**	**15 154**	**.**	10. Research financed from General University Funds
301	166	47	148	227	1018	**8212**	**6966**	**215**	11. Non-oriented research
136	2	28	.	.	32	**552**	**521**	**276**	12. Other civil research
81	0	3	17	126	3452	**9256**	**5679**	**.**	13. Defence
2670	**1205**	**538**	**1242**	**1722**	**8729**	**56 936**	**45 049**	**2539**	**Total expenditure**

3 Provisional. / 4 Eurostat estimate; excluding Luxembourg. / 5 Euro zone (excluding Luxembourg). / 6 Portugal final budget.

Source: Statistical Office of the European Communities (Eurostat)

Table 27

Government expenditure on research and development

– Budget –

Government expenditure	Year	Belgium	Denmark	Germany[1]	Greece	Spain	France	Ireland
1. Total R&D expenditure ECU million[2] (current prices and exchange rates)	1988	665	766	10 730	113	1245	11 580	106
	1991	982	791	14 360[4]	152	2313	13 356	116
	1992	1018	764	15 395	142	2321	13 197[4]	130
	1993	1137	757[4]	16 206	160	2052	13 482	139
	1994	1188	836	16 072	178	1993	13 592	134
	1995	1278	976	16 885	259	2169	13 262	178
	1996	1337[5]	1026	16 860[4]	300[5]	2273	13 239	201
	1997	1380	1078[4]	15 940	.	2449	12 893	219
2. Total R&D expenditure ECU per capita[2] (current prices and exchange rates)	1988	67.1	149.4	174.6	11.2	32.2	206.4	29.9
	1991	98.2	153.4	179.5[4]	14.8	59.4	234.1	32.8
	1992	101.4	147.8	191.0	13.8	59.5	230.0[4]	36.6
	1993	112.8	146.0[4]	199.6	15.4	52.5	233.8	39.1
	1994	117.4	160.7	197.4	17.1	50.9	234.8	37.6
	1995	126.1	186.8	206.8	24.7	55.3	225.9	50.2
	1996	131.8[5]	195.4	206.1[4]	28.7[5]	57.9	227.2	55.6
	1997	135.7	204.4[5]	194.4	.	62.3	220.0	60.0
3. Average annual growth of R&D expenditure (%)[3]								
a) Total expenditure	1988 bis 1997	8.4	3.9	4.5	.	7.8	1.2	8.4
b) Expenditure on civil R&D	1988 bis 1997	8.5	3.9	4.9	.	7.1	3.2	8.4
4. Total R&D expenditure as a percentage of the overall budget	1988	1.46	2.17	4.49	0.67	1.84	6.02	0.91
	1991	1.84	1.93	4.00[4]	0.70	2.31	5.87	0.89
	1992	1.75	1.72	4.04	0.57	2.16	5.30[4]	0.92
	1993	1.84	1.54[4]	3.84	0.57	1.83	4.93	0.95
	1994	1.85	1.58	3.71	.	1.90	4.61	0.86
	1995	1.95	1.79	2.85	.	1.89	4.33	1.12
	1996	2.07[5]	.	3.71[4]	.	2.02	4.23	1.15
	1997	2.17	.	3.61	.	.	3.98	1.19
5. Total R&D expenditure as a percentage of the gross domestic product	1988	0.51	0.83	1.06	0.21	0.43	1.42	0.36
	1991	0.61	0.76	1.03[4]	0.21	0.54	1.37	0.31
	1992	0.59	0.70	1.01	0.19	0.52	1.29[4]	0.32
	1993	0.63	0.66[4]	0.99	0.20	0.50	1.26	0.34
	1994	0.61	0.68	0.93	0.22	0.49	1.21	0.30
	1995	0.62	0.74	0.92	0.30	0.51	1.12	0.37
	1996	0.64[5]	0.74	0.91[4]	0.31[5]	0.48	1.10	0.34
	1997	0.65	0.77[5]	0.86	.	0.52	1.05	0.34
6. Average annual growth of the overall budget (%)	1988 bis 1997 (1996)	3.0	. .	6.4	.	(8.6)	5.2	(5.4)
7. Average annual growth of the gross domestic product (%)	1988 bis 1997	5.1	4.4	6.3	15.3	8.0	3.9	9.4

1 From 1991 onwards including new *Länder* and East Berlin. / 2 ECU = European Currency Unit; average exchange rate in 1995: ECU1 = DM1.96.

in the countries of the European Union by various criteria

– Budget –

Italy	Netherland	Austria	Portugal	Finland	Sweden	UK	EUR 11	EUR 15	European Union
5693	1843	611	120	655	1895	6736	33 249	42 760	972
7028	2016	840	251	951[4]	2457[4]	7125	42 211	52 735	1646
7564	2103	919	358	860	2451[4]	6838	43 866	54 062	1762
5845	2207	1049	355	782	2058[4]	6906	43 255	53 136	2047
5380	2248	1171	345	852	2018	6702	42 976	52 711	2026
5153[5]	2401	1201	372	969[4]	2098[4]	6726	43 868[6]	53 927[6]	2298
5644	2497	1151	446	958	2299[5]	7077	44 606[6]	55 309[6]	2591
6244	2624	1128	481	1197	.	8511	44 555[6]	56 483[6]	2664
99.1	124.9	80.2	12.0	132.5	224.7	117.9	122.1	123.9	.
121.6	133.8	107.5	25.6	189.6[4]	285.1[4]	123.3	140.4	143.8	.
130.7	138.5	116.1	31.8	170.6	282.8[4]	117.9	143.5	146.5	.
100.6	144.3	131.3	39.7	154.5	236.0[4]	118.7	141.4	143.6	.
92.4	146.2	145.8	35.1	167.5	229.8	114.8	139.2	141.9	.
84.5[5]	155.4	149.2	39.9	190.0[4]	231.5[4]	114.8	141.3[6]	144.4[6]	.
98.4	161.2	142.9	45.0	185.0	260.1[5]	120.5	154.1[6]	148.4[6]	.
108.7	168.6	139.8	48.4	233.2	.	144.6	153.5[6]	151.1[6]	.
1.0	4.0	7.0	16.7	6.9	.	2.6	3.3	3.1	11.9
1.8	17.2	28.3	16.6	6.9	.	.	4.3	4.1	11.9
2.16	2.78	2.04	1.06	3.12	.	3.27	3.43	.	.
1.91	2.56	2.32	1.30	3.07[4]	3.90[4]	2.61	3.12	3.13	.
1.97	2.54	2.37	1.40	3.06	3.46[4]	2.37	3.00	3.01	.
1.70	2.52	2.33	1.76	3.00	3.17[4]	2.36	2.89	2.88	.
1.67	2.65	2.52	1.57	2.87	3.15	2.19	.	.	.
1.72[5]	2.31	2.37	1.54	2.90[4]	3.26[4]	2.27	.	.	.
1.66	2.87	2.21	.	2.89	3.63[5]	2.25	.	.	.
1.81	3.12	2.25	.	3.67	.	2.31	.	.	.
0.80	0.94	0.58	0.29	0.75	1.23	0.95	0.97	0.97	.
0.75	0.86	0.63	0.41	0.97[4]	1.27[4]	0.87	0.93	0.94	.
0.80	0.85	0.65	0.44	1.05	1.28[4]	0.84	0.91	0.92	.
0.69	0.83	0.68	0.56	1.09	1.30[4]	0.86	0.89	0.90	.
0.63	0.79	0.72	0.45	1.03	1.21	0.78	0.84	0.85	.
0.62[5]	0.79	0.70	0.50	1.01[4]	1.19[4]	0.80	0.83[6]	0.84[6]	.
0.59	0.80	0.64	0.52	0.97	1.15[4]	0.78	0.82[6]	0.82[6]	.
0.62	0.83	0.62	0.54	1.13	.	0.75	0.80[6]	0.79[6]	.
(6.4)	(2.3)	4.7	.	7.1	.	(8.1)	.	.	.
6.7	5.0	5.4	11.1	4.1	5.1	5.9	.	5.4	.

3 Calculated after conversion into ECU. / 4 Break in series. / 5 Provisional. / 6 Eurostat estimate.

Rounding error

Source: Statistical Office of the European Communities (Eurostat) and calculations by BMBF

Table 28

Patents and licences* in the balance of payments of selected countries

– US$ million –

Country		1995	1996	1997
Belgium and Luxembourg	Receipts	582	670	650
	Expenditure	1158	1195	1099
	Balance	- 576	- 525	- 449
Germany	Receipts	3130	3350	3170
	Expenditure	5920	5880	4690
	Balance	-2790	-2530	-1520
Finland	Receipts	58	66	93
	Expenditure	389	465	504
	Balance	-331	-399	-411
France	Receipts	1850	1880	2050
	Expenditure	2320	2650	2480
	Balance	-470	-770	-430
UK	Receipts	4690	4730	4820
	Expenditure	2850	3630	3470
	Balance	+1840	+1100	+1350
Ireland	Receipts	132	101	110
	Expenditure	2724	3418	4140
	Balance	-2592	-3317	-4030
Italy	Receipts	462	381	490
	Expenditure	1166	1027	1004
	Balance	-704	-646	-514
Netherlands	Receipts	2370	2398	2085
	Expenditure	3006	2878	2455
	Balance	-636	-480	-370
Austria	Receipts	133	182	185
	Expenditure	533	696	691
	Balance	-400	-514	-506
Portugal	Receipts	19	26	26
	Expenditure	237	261	285
	Balance	-218	-235	-259
Sweden	Receipts	889	997	1000
	Expenditure	1004	1006	957
	Balance	-115	-9	43
Spain	Receipts	196	214	211
	Expenditure	1267	1449	1565
	Balance	-1071	-1235	-1354

cont. Table 28

Patents and licences* in the balance of payments of selected countries

– US$ million –

Country		1995	1996	1997
Total EU countries[1]	Receipts	**14 511**	**14 995**	**14 890**
	Expenditure	**22 574**	**24 555**	**23 340**
	Balance	**- 8063**	**- 9560**	**- 8450**
USA	Receipts	30 290	32 820	33 680
	Expenditure	6920	7850	9410
	Balance	+ 23 370	+ 24 970	+ 24 270
Japan	Receipts	6010	6680	7300
	Expenditure	9420	9830	9620
	Balance	-3410	-3150	-2320
Australia	Receipts	234	253	295
	Expenditure	946	1073	1074
	Balance	- 712	- 820	- 779

* In accordance with IMF Balance of Payments Statistics (1998), including procedures, copyright and film rights (except production costs and fees/salaries).

1 Excluding Denmark and Greece (no data available).

Source: International Monetary Fund, "Balance of Payments Statistics Yearbook 1998" and calculations by BMBF

Rounding error

3.2 Personnel data

3.2.1 Personnel data – national level –

Table 29

Personnel in research and development by occupation and sector of employment*

– Full-time equivalent –

Sector (as defined by OECD)	Year	Total	of which Researchers	of which Technicians	of which Others
1. Business enterprise sector[1]	1989	296 510	113 247	88 082	95 181
	1991	321 756	141 084	86 487	94 185
	1993	293 774	128 956	81 952	82 863
	1995	283 316	129 370	78 155	75 791
	1996	276 794	126 392[5]	76 356[5]	74 046[5]
	1997	286 270	132 686	79 016	74 569
	1998	288 090	133 529[5]	79 518[5]	75 043[5]
2. Higher education sector[2]	1989	69 667	38 836	13 498	17 332
	1991	103 864	62 171	17 789	23 904
	1993	.	.	.	.
	1995	100 674	64 434	13 636	22 604
	1996	102 160	66 110	13 578	22 472
	1997	100 645	65 704	13 369	21 573
	1998	101 112	66 208	13 046	21 858
3. Government sector[3]	1989	60 269	24 319	18 746	17 205
	1991	90 711	38 614	24 071	28 023
	1993[4]	71 363	34 011	20 668	16 684
	1995	75 148	37 324	20 380	17 444
	1996	74 725	37 687	20 220	16 818
	1997	73 495	37 402	19 364	16 729
	1998	73 800	38 200	19 100	16 500
4. Total	**1989**	**426 446**	**176 402**	**120 326**	**129 718**
	1991	**516 331**	**241 869**	**128 347**	**146 112**
	1993	**.**	**.**	**.**	**.**
	1995	**459 138**	**231 128**	**112 171**	**115 839**
	1996	**453 679**	**230 189**	**110 154**	**113 336**
	1997	**460 410**	**235 792**	**111 749**	**112 869**
	1998	**463 002**	**237 937**	**111 664**	**113 401**

cont. Table 29

Personnel in research and development by occupation and sector of employment*

– Full-time equivalent –

Sector (as defined by OECD)	Year	Total	of which Researchers	Technicians	Others
of which new *Länder* and East Berlin					
1. Business enterprise sector	1991	34 922	22 764	.	.
	1993	22 032	.	.	.
	1995	23 741	14 977	3355	5409
	1996[6]	23 194	.	.	.
	1997	25 108	15 336	4930	4842
	1998[6]	25 270	.	.	.
2. Higher education sector	1991[7]	19 509	10 455	.	.
	1993	16 680	10 010	1920	4750
	1995	18 948	11 803	2475	4670
	1996	18 954	12 345	2290	4319
	1997	18 882	12 302	2298	4281
	1998	18 907	12 129	2182	4596
3. Government sector[3/8]	1991	28 400	.	.	.
	1993[4]	12 108	6856	3134	2118
	1995	14 362	8314	3615	2433
	1996	14 523	8498	3469	2556
	1997	14 567	8443	3537	2587
	1998	14 630	.	.	.
4. Total	1991	82 831	.	.	.
	1993[4]	50 820	.	.	.
	1995	57 051	35 094	9445	12 512
	1996	56 671	.	.	.
	1997	58 557	36 081	10 765	11 710
	1998	58 807	.	.	.

* 1989 former West Germany, from 1991 onwards Germany.

1 In even years, survey of selected business enterprises, budgeted figures of IfG.

2 New calculation procedure introduced in 1991, figures for 1989 revised accordingly (linked values). Owing to changes in the survey procedure applied in higher education personnel statistics, externally financed personnel has probably not been fully covered from 1992 onwards so that no reliable data on R&D personnel in the old German *Länder* and in Germany as a whole are available for the period 1992 to 1994. 1998 provisional data.

3 Government institutions and private non-profit science organisations mainly financed by government; from 1993 onwards extension of coverage. In contrast to earlier publications, the PNP sector was included in the government sector. 1998 estimate.

4 Revised.

5 Breakdown by occupation based on share of previous year.

6 Same figures as previous year for R&D personnel in the new *Länder* and East Berlin as a proportion of R&D personnel in the business enterprise sector.

7 Calculated in 1991 following the procedure agreed for the old German *Länder*, based on the average R&D coefficient of the basic funding of the institutions of higher education in the old *Länder* (100% of externally financed personnel (estimate) included in the calculations).

8 1991 estimate. Including the research personnel of the three former academies of sciences of the GDR receiving transient funding from the Federal Government and the *Länder* up to December 1991.

Source: Stifterverband Wissenschaftsstatistik, Federal Statistical Office, Federal Ministry of Education and Research

Rounding error

Table 30

R&D personnel in the business enterprise sector by economic activity

– Full-time equivalent –

Economic activity*		1995 Total	1995 of which in Business enterprises	1995 of which in IfG[1]	1997 Total	1997 of which in Business enterprises	1997 of which in IfG[1]
A,B	Agriculture, hunting and forestry; fishing	1037	1013	24	1085	1046	39
C	Mining and quarrying	375	363	12	458	449	9
D	Manufacturing	267 478	264 171	3308	265 766	262 919	2850
DA	Manufacture of food products and beverages; manufacture of tobacco products	2888	2706	182	2621	2541	81
DB,DC	Manufacture of textiles and wearing apparel; dressing and dyeing of fur; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	2512	1563	949	2678	1696	982
DD,DE	Manufacture of wood and of products of wood and cork, except furniture; manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	1403	1327	76	1372	1295	77
DF	Manufacture of coke, refined petroleum products and nuclear fuel	X	672	X	X	730	X
DG	Manufacture of chemicals and chemical products	49 081	49 012	69	47 297	47 241	56
DH	Manufacture of rubber and plastic products	5314	4924	390	5054	4757	297
DI	Manufacture of other non-metallic mineral products	3385	3139	246	2974	2790	184
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	7571	6933	638	8273	7706	567
DK	Manufacture of machinery and equipment	39 323	38 821	502	39 251	38 841	410
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments	82 297	82 119	178	71 758	71 628	130
DM	Manufacture of transport equipment	70 821	70 762	59	81 529	81 476	52
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	X	2194	X	X	2217	X
E	Electricity, gas and water supply	729	554	176	607	499	108
F	Construction	X	831	X	X	912	X
I	Transport, storage and communication	X	3032	X	X	2162	X
K	Real estate, renting and business activities	9020	8631	390	14 522	13 772	750
O	Other community, social and personal service activities	150	119	30	X	80	X
G,H,J,L-N	Remaining categories	X	637	X	X	602	X
	Total	**283 316**	**279 351**	**3 965**	**286 271**	**282 439**	**3 831**

* Nomenclature of Economic Activities 1993.

1 Institutions for co-operative industrial research and experimental development.

2 1995 not fully comparable with 1997 owing to business enterprise restructuring and resulting change of branch in the group of reporting units.

Source: Stifterverband Wissenschaftsstatistik

Rounding error

Table 31

R&D personnel in the business enterprise sector by occupation and economic activity

– Full-time equivalent –

	Economic activity*	1995 Total	1995 of which in Resear-chers[1]	1995 of which in Techni-cians	1995 of which in Others	1997 Total	1997 of which in Resear-chers[1]	1997 of which in Techni-cians	1997 of which in Others
A,B	Agriculture, hunting and forestry; fishing	1013	278	279	456	1046	280	279	486
C	Mining and quarrying	363	152	68	142	449	170	109	170
D	Manufacturing	264 171	119 061	74 078	71 032	262 916	118 794	74 539	69 583
DA	Manufacture of food products and beverages; manufacture of tobacco products	2706	885	1006	815	2541	838	1016	686
DB	Manufacture of textiles and wearing apparel; dressing and dyeing of fur	1460	517	371	572	1601	543	531	528
DC	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	103	24	37	42	95	39	34	22
DD	Manufacture of wood and of products of wood and cork, except furniture	460	159	105	195	460	162	131	167
DE	Manufacture of pulp, paper and paper products; publishing and printing	868	312	246	309	835	344	248	244
DF	Manufacture of coke, refined petroleum products and nuclear fuel	672	252	225	194	730	256	266	208
DG	Manufacture of chemicals and chemical products	49 012	12 784	21 274	14 953	47 241	12 536	20 894	13 810
24.4	Manufacture of pharmaceuticals, medical chemicals and botanical products	12 804	4129	4831	3843	17 007	5221	7067	4719
DH	Manufacture of rubber and plastic products	4924	1981	1665	1277	4757	2046	1404	1307
DI	Manufacture of other non-metallic mineral products	3139	1220	835	1085	2790	1051	821	918
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	6933	2650	2325	1958	7706	2988	2552	2166
27	Manufacture of basic metals	2255	787	876	592	2466	952	867	646
28	Manufacture of fabricated metal products, except machinery and equipment	4678	1863	1449	1367	5240	2036	1685	1520
DK	Manufacture of machinery and equipment	38 821	18 799	10165	9857	38 841	18 947	10 635	9259
29.1 - 5	Manufacture of machinery and equipment except weapons and domestic appliances	36 579	17 797	9 506	9 276	36 950	18 024	10 105	8 821
29.7	Manufacture of domestic appliances n.e.c.	1674	805	477	392	1626	813	453	360
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments[2]	82 119	48 969	16 414	16 736	71 628	44 006	14 041	13 581
30	Manufacture of office machinery and computers	10 433	7076	1571	1786	7093	5158	971	964
31	Manufacture of electrical machinery and apparatus n.e.c.	21 124	11 401	5178	4546	10 680	5434	3003	2244
32	Manufacture of radio, television and communication equipment and apparatus	28 875	17 204	5204	6467	35 427	22 059	6229	7139

cont. Table 31

R&D personnel in the business enterprise sector by occupation and economic activity

– Full-time equivalent –

Economic activity*		1995 Total	1995 of which in Researchers[1]	1995 of which in Technicians	1995 of which in Others	1997 Total	1997 of which in Researchers[1]	1997 of which in Technicians	1997 of which in Others
33	Manufacture of medical, precision and optical instruments, watches and clocks	21 686	13 288	4461	3938	18 427	11 355	3838	3234
DM	Manufacture of transport equipment[2]	70 762	29 787	18 751	22 225	81 476	34 393	21 095	25 989
34	Manufacture of motor vehicles, trailers and semi-trailers	51 250	20 640	12 153	18 457	59 714	23 876	13 913	21 925
35	Manufacture of other transport equipment	19 512	9147	6597	3767	21 762	10 517	7182	4064
35.3	Manufacture of aircraft and spacecraft	14 953	6387	5671	2896	16 783	7577	6160	3047
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	2194	721	659	814	2217	647	872	699
E	Electricity, gas and water supply	554	299	125	130	499	322	84	93
F	Construction	831	448	170	214	912	471	226	215
I	Transport, storage and communication	3032	1254	804	974	2162	1265	489	409
K	Real estate, renting and business activities[2]	8631	5378	1382	1871	13 772	8754	2240	2778
73	Research and development	2314	1250	570	494	4505	2518	995	992
74	Other business activities	4592	2919	593	1081	4291	2808	528	955
O	Other community, social and personal service activities	119	67	X	X	80	53	17	10
G,H,J,L-N	Remaining categories	637	310	X	X	602	323	112	167
	Total	**279 351**	**127 247**	**77 076**	**75 027**	**282 439**	**130 434**	**78 096**	**73 910**
	of which in SMEs[3]	*55 184*	*28 434*	*12 773*	*13 978*	*56 532*	*28 505*	*14 707*	*13 322*

* Nomenclature of Economic Activities 1993.

1 Including senior personnel in R&D administration.

2 1995 not fully comparable with 1997 owing to business enterprise restructuring and resulting change of branch in the group of reporting units.

3 Small and medium-sized enterprises (labour force below 500).

Source: Stifterverband Wissenschaftsstatistik

Rounding error

Table 32

R&D personnel in institutions for co-operative industrial research and experimental development by occupation and economic activity

– Full-time equivalent –

Economic activity*		1995				1997			
		Total	of which in Resear-chers[1]	Techni-cians	Others	Total	of which in Resear-chers[1]	Techni-cians	Others
A,B	Agriculture, hunting and forestry; fishing	24	14	9	2	39	21	15	4
C	Mining and quarrying	12	7	-	5	9	4	-	5
D	Manufacturing	3308	1697	973	637	2850	1573	786	491
DA	Manufacture of food products and beverages; manufacture of tobacco products	182	119	36	27	81	47	26	8
DB,DC	Manufacture of textiles and wearing apparel; dressing and dyeing of fur; tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	949	368	462	120	982	514	367	102
DD,DE	Manufacture of wood and of products of wood and cork, except furniture; manufacture of pulp, paper and paper products; publishing, printing and reproduction of recorded media	76	43	16	17	77	23	25	29
DF	Manufacture of coke, refined petroleum products and nuclear fuel	X	X	X	X	X	X	X	X
DG	Manufacture of chemicals and chemical products	69	27	31	12	56	24	19	14
DH	Manufacture of rubber and plastic products	390	253	65	72	297	214	36	47
DI	Manufacture of other non-metallic mineral products	246	91	87	69	184	67	73	43
DJ	Manufacture of basic metals; manufacture of fabricated metal products, except machinery and equipment	638	311	162	165	567	287	159	120
DK	Manufacture of machinery and equipment	502	314	77	111	410	270	49	91
DL	Manufacture of office machinery and computers, electrical machinery, precision and optical instruments	178	130	21	27	130	89	16	25
DM	Manufacture of transport equipment	59	33	13	13	52	30	13	10
DN	Manufacture of furniture; manufacturing n.e.c.; recycling	X	X	X	X	X	X	X	X
E	Electricity, gas and water supply	176	119	26	30	108	85	9	15
F	Construction	X	X	X	X	X	X	X	X
I	Transport, storage and communication	X	X	X	X	X	X	X	X
K	Real estate, renting and business activities	390	256	59	75	750	531	92	127
O	Other community, social and personal service activities	30	21	3	6	X	X	X	X
G,H,J,L-N	Remaining categories	X	X	X	X	X	X	X	X
	Total	3965	2123	1079	763	3831	2252	920	659

* Nomenclature of Economic Activities 1993.
1 Including senior personnel in R&D administration.

Source: Stifterverband Wissenschaftsstatistik

Rounding error

Table 33

Higher education personnel by occupation and field of science*

– Full-time equivalent –

Parameter	Year[1] t= total w= woman		Total personnel	of which: Central facilities	Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
Scientific and creative arts personnel	1989	t	.	.	.	.	.	.	.
		w	.	.	.	.	.	.	.
	1991	t	111 575	5716	25 041	19 902	23 580	3554	33 782
		w	20 080	1395	3413	1041	6224	814	7193
	1993	t	142 282	5112	31 372	25 596	32 541	4733	42 929
		w	28 816	1427	4310	1786	9465	1076	10 753
	1995	t	146 412	4693	31 865	25 989	35 412	5014	43 439
		w	30 705	1186	4526	1946	10 593	1230	11 224
	1996	t	147 249	4759	31 888	26 232	35 887	4879	43 606
		w	31 397	1272	4578	2065	10 884	1228	11 370
	1997	t	146 356	4721	31 665	25 594	36 056	4754	43 566
		w	31 830	1251	4582	2246	10 996	1178	11 577
of which New *Länder* and East Berlin[6]	1991	t	.	.	.	.	.	.	.
		w	.	.	.	.	.	.	.
	1993	t	26 187	750	5019	5340	6513	893	7672
		w	7887	404	950	675	2594	235	3031
	1995	t	29 022	557	5589	5563	7658	1047	8608
		w	8145	230	987	649	2894	280	3105
	1996	t	29 264	496	5674	5708	7651	1031	8704
		w	8057	219	986	665	2835	279	3074
	1997	t	28 689	438	5539	5543	7611	961	8598
		w	7861	193	934	653	2777	266	3038
of which: R&D personnel here: Researchers[3/4]	1989	t	38 836	-	12 163	9045	5231	1615	10 781
		w	5764	-	1600	389	1321	336	2118
	1991	t[5]	62 171	-	19 239	14 534	7748	2532	18 119
	1993	t[5]	.	-	.	.	.	.	.
	1995	t	64 434	-	20 888	13 743	8072	2970	18 760
		w	11 987	-	2967	1029	2415	729	4847
	1996	t	66 110	-	21 198	14 211	8542	2957	19 205
		w	12 505	-	3043	1119	2591	744	5008
	1997	t	65 704	-	21 111	13 860	8437	2903	19 393
		w	12 716	-	3055	1216	2573	719	5153
of which New *Länder* and East Berlin[6]	1991	t	.	-	.	.	.	.	.
		w	.	-	.	.	.	.	.
	1993	t	10 010	-	.	.	.	.	.
		w	2630	-	.	.	.	.	.
	1995	t	11 803	-	3415	2979	1430	582	3397
		w	2872	-	603	348	540	156	1225
	1996	t	12 345	-	3600	3118	1501	593	3536
		w	2954	-	626	363	556	160	1249
	1997	t	12 302	-	3516	3078	1643	571	3492
		w	2947	-	593	363	599	158	1234

cont. Table 33

Higher education personnel by occupation and field of science*

– Full-time equivalent –

Parameter	Year[1] t= total w= woman	Total personnel	of which: Central facilities	Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
Administrative, technical and other personnel	1989	161 775	60 779	14 754	10 918	63 186	3903	8236
	1991	172 201	65 989	15 164	11 763	66 677	3797	8811
	1993	224 286	86 130	18 069	15 238	87 954	5524	11 372
	1995	221 147	49 833	17 951	14 504	123 000	5356	10 503
	1996	219 758	50 972	17 662	14 631	120 456	5194	10 843
	1997	218 309	49 503	17 425	14 561	121 698	4946	10 176
of which New *Länder* and East Berlin[6]	1991 t	.	-	.	.	.	.	.
	w	.	-	.	.	.	.	.
	1993 t	42 293	16 237	2746	2890	17 650	1117	1654
	w	32 230	10 319	1855	1390	16 566	806	1295
	1995 t	45 598	10 231	2751	3124	26 741	1063	1691
	w	34 507	6430	1853	1400	22 746	764	1318
	1996 t	43 748	10 315	2639	3188	24 969	979	1 658
	w	33 066	6326	1774	1426	21 537	698	1305
	1997 t	43 110	10 111	2519	3163	24 777	890	1650
	w	32 543	6251	1670	1408	21 305	621	1288
of which: R&D personnel here: Technical and other personnel[3]	1989 t	30 831	-	6633	4526	15 621	1409	2641
	w	.	-	.	.	.	.	.
	1991 t[5]	41 693	-	8417	7188	20 660	2061	3368
	1993 t[5]	.	-	.	.	.	.	.
	1995 t	36 240	-	8197	6039	16 522	2040	3443
	w	23 547	-	4563	2057	12 969	1290	2668
	1996 t	36 050	-	8034	6078	16 366	2026	3547
	w	23 400	-	4469	2099	12 855	1275	2702
	1997 t	34 942	-	7828	5966	16 044	1891	3213
	w	22 583	-	4340	2018	12 546	1173	2506
of which New *Länder* and East Berlin[6]	1991 t	.	-	.	.	.	.	.
	w	.	-	.	.	.	.	.
	1993 t	6680	-	.	.	.	.	.
	w	5300	-	.	.	.	.	.
	1995 t	7145	-	1263	1354	3483	499	546
	w	5206	-	851	607	2963	359	426
	1996 t	6609	-	1174	1387	3030	463	556
	w	4791	-	789	620	2614	330	438
	1997 t	6580	-	1122	1403	3104	418	532
	w	4745	-	744	625	2669	292	415
Total full-time personnel in higher education	1989	.	.	.	.	.	.	.
	1991	283 776	71 705	40 205	31 665	90 257	7351	42 593
	1993	366 568	91 242	49 441	40 834	120 495	10 256	54 301
	1995	367 559	54 526	49 816	40 493	158 412	10 370	53 942
	1996	367 007	55 731	49 550	40 863	156 343	10 073	54 449
	1997	364 665	54 224	49 090	40 155	157 757	9700	53 742

cont. Table 33

Higher education personnel by occupation and field of science*

– Full-time equivalent –

Parameter	Year[1] t= total w= woman	Total per-sonnel	of which: Central facilities	Natural sciences	Engin-eering	Medicine	Agri-cultural sciences	Social sciences and humanities
of which New *Länder* and East Berlin[6]	1991	.	.	.	.	.	.	.
	1993	68 480	16 987	7764	8230	24 163	2010	9326
	1995	74 620	10 788	8340	8687	34 399	2110	10 299
	1996	73 012	10 811	8313	8896	32 620	2010	10 362
	1997	71 799	10 549	8058	8706	32 388	1851	10 248
of which: R&D personnel[3/4]	1989	69 667	-	18 799	13 572	20 852	3025	13 422
	1991	103 864	-	27 655	21 721	28 408	4593	21 488
	1993[5]	.	-	.	.	.	.	.
	1995	100 674	-	29 085	19 782	24 594	5009	22 204
	1996	102 160	-	29 231	20 288	24 908	4982	22 751
	1997	100 646	-	28 939	19 826	24 480	4794	22 605
of which New *Länder* and East Berlin[6]	1991	.	.	.	.	.	.	.
	1993	16 680	-	.	.	.	.	.
	1995	18 948	-	4679	4333	4913	1081	3942
	1996	18 954	-	4773	4505	4530	1057	091
	1997	18 882	-	4639	4481	4748	990	4024

* Full-time personnel of private and state institutions of higher education (excluding students on placement and apprentices). Part-time personnel has been considered as 0.5 FTE.

1 1989 to 1997 actual figures; 1989 former West Germany, from 1992 onwards Germany; owing to individual survey, no data available for scientific and creative arts personnel in 1989.

2 From 1994 onwards medicine including central facilities of university hospitals.

3 From 1985 onwards, R&D personnel has been determined on the basis of the procedure agreed between the Conference of Ministers of Education and Cultural Affairs of the *Länder*, the Science Council, the Federal Ministry of Education and Research and the Federal Statistical Office. In accordance with international standards, personnel of central facilities is not included in R&D personnel. R&D personnel (researchers) estimated for 1989 (former West Germany).

4 Including grants for (post)graduates from 1991 onwards.

5 Owing to changes in the survey procedure applied in higher education personnel statistics, externally financed personnel has probably not been fully covered from 1992 onwards so that no reliable data on R&D personnel in the old German *Länder* and in Germany as a whole are available for the period 1992 to 1994.

6 Due to the restructuring of higher education institutions in Berlin, recent data for the new *Länder* and East Berlin are subject to significant uncertainty.

Source: Federal Statistical Office, Federal Ministry of Education and Research

Rounding error

Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1] (t= total, w= woman)		Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
1. Helmholtz centres (national research centres)	1989	t	**21 205**	100	8286	39.1	12 919	60.9
		w	**5216**	100	816	15.6	4400	84.4
	1993	t	**22 392**	100	10 135	45.3	12 257	54.7
		w	**5753**	100	1340	23.3	4413	76.7
	1995	t	**22 399**	100	10 771	48.1	11 628	51.9
		w	**5997**	100	1558	26.0	4440	74.0
	1996	t	**22 027**	100	10 843	49.2	11 184	50.8
		w	**5924**	100	1646	27.8	4279	72.2
	1997	t	**21 908**	100	10 702	48.8	11 206	51.2
		w	**5919**	100	1689	28.5	4231	71.5
of which R&D personnel[3]	1989	t	**21 205**	100	8286	39.1	12 919	60.9
		w	**5216**	100	816	15.6	4400	84.4
	1993	t	**22 335**	100	10 100	45.2	12 236	54.8
		w	**5734**	100	1335	23.3	4399	76.7
	1995	t	**22 326**	100	10 742	48.1	11 584	51.9
		w	**5984**	100	1556	26.0	4428	74.0
	1996	t	**21 956**	100	10 814	49.3	11 141	50.7
		w	**5911**	100	1643	27.8	4268	72.2
	1997	t	**21 834**	100	10 672	48.9	11 162	51.1
		w	**5906**	100	1686	28.5	4220	71.5
2. Max Planck institutes (100% R&D)	1989	t	**8776**	100	3228	36.8	5548	63.2
		w	**3323**	100	569	17.1	2754	82.9
	1993	t	**9334**	100	4034	43.2	5301	56.8
		w	**3517**	100	769	21.9	2748	78.1
	1995	t	**9900**	100	4412	44.6	5488	55.4
		w	**3781**	100	849	22.5	2932	77.5
	1996	t	**9946**	100	4313	43.4	5633	56.6
		w	**3885**	100	881	22.7	3004	77.3
	1997	t	**9587**	100	4151	43.3	5436	56.7
		w	**3734**	100	863	23.1	2871	76.9
3. Fraunhofer institutes[4] (100% R&D)	1989	t	**3860**	100	1714	44.4	2147	55.6
		w	**1095**	100	116	10.6	980	89.5
	1993	t	**5965**	100	3878	65.0	2087	35.0
		w	**1581**	100	483	30.6	1098	69.4
	1995	t	**6229**	100	4008	64.3	2222	35.7
		w	**1633**	100	489	29.9	1144	70.1
	1996	t	**6423**	100	4252	66.2	2171	56.5
		w	**1680**	100	542	32.3	1138	77.8
	1997	t	**6311**	100	4130	65.4	2181	34.6
		w	**1665**	100	537	32.3	1128	67.7

cont. Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1] t= total w= woman		Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
4. Blue List institutions	1989	t	**6016**	100	2514	41.8	3502	58.2
		w	**2650**	100	550	20.8	2100	79.2
	1993	t	**10 616**	100	5334	50.2	5283	49.8
		w	**4819**	100	1448	30.0	3371	70.0
	1995	t	**11 273**	100	5798	51.4	5476	48.6
		w	**5118**	100	1596	31.2	3523	68.8
	1996	t	**11 272**	100	5871	52.1	5401	47.9
		w	**5152**	100	1644	31.9	3508	68.1
	1997	t	**11 098**	100	5876	52.9	5223	47.1
		w	**5186**	100	1779	34.3	3407	65.7
of which R&D personnel[3]	1989	t	**4611**	100	1958	42.5	2654	57.6
		w	**2050**	100	390	19.0	1660	81.0
	1993	t	**9024**	100	4633	51.3	4391	48.7
		w	**4123**	100	1195	29.0	2928	71.0
	1995	t	**9751**	100	5074	52.0	4678	48.0
		w	**4430**	100	1322	29.8	3108	70.2
	1996	t	**9744**	100	5166	53.0	4578	47.0
		w	**4450**	100	1374	30.9	3075	69.1
	1997	t	**9572**	100	5149	53.8	4423	46.2
		w	**4476**	100	1506	33.6	2970	66.4
5. Public institutions (excluding libraries, archives,museums; excluding Blue List institutions)	1989	t	**21 341**	100	8151	38.2	13 190	61.8
		w	**7349**	100	1193	16.2	6156	83.8
	1993	t	**28 358**	100	11 565	40.8	16 793	59.2
		w	**10 887**	100	2437	22.4	8451	77.6
	1995	t	**28 519**	100	12 066	42.3	16 454	57.7
		w	**10 957**	100	2576	23.5	8381	76.5
	1996	t	**28 486**	100	11 955	42.0	16 531	58.0
		w	**11 115**	100	2597	23.4	8519	76.6
	1997	t	**27 142**	100	11 684	43.0	15 458	57.0
		w	**10 326**	100	2613	25.3	7713	74.7
of which R&D personnel[3]	1989	t	**11 809**	100	4572	38.7	7237	61.3
		w	**4240**	100	686	16.2	3554	83.8
	1993	t	**12 452**	100	5099	40.9	7353	59.1
		w	**4809**	100	1071	22.3	3737	77.7
	1995	t	**13 052**	100	5520	42.3	7532	57.7
		w	**5121**	100	1183	23.1	3938	76.9
	1996	t	**13 326**	100	5715	42.9	7611	57.1
		w	**5315**	100	1244	23.4	4072	76.6
	1997	t	**12 458**	100	5419	43.5	7039	56.5
		w	**4770**	100	1178	24.7	3592	75.3

cont. Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1] (t= total, w= woman)		Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
6. Scientific libraries, archives and museums (excluding Blue List institutions)	1989	t	**8373**	100	2637	31.5	5736	68.5
		w	**4000**	100	1100	27.5	2900	72.5
	1993	t	**10 880**	100	3734	34.3	7146	65.7
		w	**5908**	100	1933	32.7	3976	67.3
	1995	t	**10 889**	100	3911	35.9	6978	64.1
		w	**6228**	100	2079	33.4	4149	66.6
	1996	t	**10 542**	100	4117	39.1	6426	61.0
		w	**6000**	100	2271	37.9	3729	62.2
	1997	t	**10 666**	100	4171	39.1	6496	60.9
		w	**6052**	100	2283	37.7	3769	62.3
of which R&D personnel[3]	1989	t	**3114**	100	824	26.5	2290	73.5
		w	**1270**	100	300	23.6	970	76.4
	1993	t	**3715**	100	1024	27.6	2691	72.4
		w	**1731**	100	459	26.5	1272	73.5
	1995	t	**3274**	100	1041	31.8	2233	68.2
		w	**1617**	100	481	29.7	1136	70.3
	1996	t	**3189**	100	1055	33.1	2134	66.9
		w	**1579**	100	512	32.4	1068	67.6
	1997	t	**3354**	100	1111	33.1	2243	66.9
		w	**1646**	100	521	31.7	1125	68.3
7. Other research institutions[5]	1989	t	**6896**	100	3738	54.2	3158	45.8
		w	**2650**	100	793	29.9	1857	70.1
	1993	t	**9821**	100	6027	61.4	3794	38.6
		w	**3647**	100	1396	38.3	2251	61.7
	1995	t	**13 031**	100	7910	60.7	5121	39.3
		w	**4913**	100	1957	39.8	2956	60.2
	1996	t	**12 533**	100	7851	62.6	4683	37.4
		w	**4581**	100	1827	39.9	2754	60.1
	1997	t	**12 696**	100	8261	65.1	4435	34.9
		w	**4557**	100	1957	42.9	2600	57.1
of which R&D personnel[3]	1989	t	**6896**	100	3738	54.2	3158	45.8
		w	**2650**	100	793	29.9	1857	70.1
	1993	t	**8540**	100	5245	61.4	3295	38.6
		w	**3122**	100	1200	38.4	1923	61.6
	1995	t	**10 616**	100	6527	61.5	4088	38.5
		w	**3971**	100	1624	40.9	2347	59.1
	1996	t	**10 142**	100	6372	62.8	3770	37.2
		w	**3668**	100	1493	40.7	2174	59.3
	1997	t	**10 380**	100	6771	65.2	3609	34.8
		w	**3723**	100	1622	43.6	2101	56.4

cont. Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1] t= total w= woman		Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
8. Total (1. to 7.)	**1989**	**t**	**76 465**	**100**	**30 267**	**39.6**	**46 199**	**60.4**
		w	**26 283**	**100**	**5137**	**19.5**	**21 146**	**80.5**
	1993	**t**	**97 365**	**100**	**44 705**	**45.9**	**52 660**	**54.1**
		w	**36 110**	**100**	**9804**	**27.2**	**26 306**	**72.8**
	1995	**t**	**102 240**	**100**	**48 874**	**47.8**	**53 366**	**52.2**
		w	**38 625**	**100**	**11 102**	**28.7**	**27 524**	**71.3**
	1996	**t**	**101 227**	**100**	**49 200**	**48.6**	**52 028**	**51.4**
		w	**38 336**	**100**	**11 407**	**29.8**	**26 929**	**70.2**
	1997	**t**	**99 406**	**100**	**48 973**	**49.3**	**50 433**	**50.7**
		w	**37 438**	**100**	**11 721**	**31.3**	**25 718**	**68.7**
of which: old *Länder* and West Berlin[6]	1989	t	**76 465**	100	30 267	39.6	46 199	60.4
		w	**26 283**	100	5137	19.5	21 146	80.5
	1993	t	**79 655**	100	35 504	44.6	44 151	55.4
		w	**28 220**	100	7271	25.8	20 950	74.2
	1995	t	**82 069**	100	37 975	46.3	44 094	53.7
		w	**29 285**	100	7967	27.2	21 318	72.8
	1996	t	**81 081**	100	38 001	46.9	43 080	53.1
		w	**29 076**	100	8074	27.8	21 002	72.2
	1997	t	**79 148**	100	37 773	47.7	41 375	52.3
		w	**28 094**	100	8262	29.4	19 832	70.6
new *Länder* and East Berlin[6]	1989	t	-	-	-	-	-	-
		w	-	-	-	-	-	-
	1993	t	**17 319**	100	9021	52.1	8298	47.9
		w	**7714**	100	2475	32.1	5239	67.9
	1995	t	**19 828**	100	10 683	53.9	9145	46.1
		w	**9182**	100	3060	33.3	6123	66.7
	1996	t	**19 783**	100	10 977	55.5	8806	44.5
		w	**9102**	100	3265	35.9	5837	64.1
	1997	t	**19 864**	100	10 936	55.1	8928	44.9
		w	**9172**	100	3377	36.8	5795	63.2
of which R&D personnel[3]	**1989**	**t**	**60 270**	**100**	**24 319**	**40.4**	**35 951**	**59.6**
		w	**19 844**	**100**	**3670**	**18.5**	**16 174**	**81.5**
	1993	**t**	**71 363**	**100**	**34 011**	**47.7**	**37 351**	**52.3**
		w	**24 614**	**100**	**6511**	**26.5**	**18 104**	**73.6**
	1995	**t**	**75 148**	**100**	**37 324**	**49.7**	**37 824**	**50.3**
		w	**26 536**	**100**	**7504**	**28.3**	**19 032**	**71.7**
	1996	**t**	**74 725**	**100**	**37 687**	**50.4**	**37 038**	**49.6**
		w	**26 488**	**100**	**7689**	**29.0**	**18 798**	**71.0**
	1997	**t**	**73 495**	**100**	**37 402**	**50.9**	**36 093**	**49.1**
		w	**25 919**	**100**	**7913**	**30.5**	**18 006**	**69.5**

cont. Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1]	t= total w= woman	Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
of which: old *Länder* and West Berlin[6]	1989	t	**60 270**	100	**24 319**	40.4	**35 951**	59.6
		w	**19 844**	100	**3670**	18.5	**16 174**	81.5
	1993	t	**58 890**	100	26 989	45.8	31 901	54.2
		w	**19 314**	100	4731	24.5	14 584	75.5
	1995	t	**60 454**	100	28 800	47.6	31 654	52.4
		w	**20 253**	100	5358	26.5	14 896	73.5
	1996	t	**59 849**	100	28 974	48.4	30 875	51.6
		w	**20 136**	100	5467	27.2	14 669	72.8
	1997	t	**58 556**	100	28 709	49.0	29 847	51.0
		w	**19 471**	100	5571	28.6	13 900	71.4
new *Länder* and East Berlin[6]	1989	t	-	-	-	-	-	-
		w	-	-	-	-	-	-
	1993	t	**12 108**	100	6856	56.6	5252	43.4
		w	**5139**	100	1728	33.6	3411	66.4
	1995	t	**14 362**	100	8314	57.9	6048	42.1
		w	**6131**	100	2074	33.8	4057	66.2
	1996	t	**14 523**	100	8498	58.5	6025	41.5
		w	**6199**	100	2157	34.8	4042	65.2
	1997	t	**14 567**	100	8443	58.0	6124	42.0
		w	**6287**	100	2266	36.0	4021	64.0
For information: Federal institutions performing R&D	1989	t	**14 255**	100	5237	36.7	9018	63.3
		w	**4931**	100	798	16.2	4133	83.8
	1993	t	**20 428**	100	7944	38.9	12 484	61.1
		w	**7808**	100	1675	21.5	6133	78.5
	1995	t	**19 975**	100	7984	40.0	11 992	60.0
		w	**7651**	100	1688	22.1	5963	77.9
	1996	t	**20 001**	100	7938	39.7	12 063	60.3
		w	**7796**	100	1728	22.2	6068	77.8
	1997	t	**19 160**	100	7891	41.2	11 269	58.8
		w	**7279**	100	1760	24.2	5519	75.8
of which R&D personnel[3]	1989	t	**7709**	100	2839	36.8	4869	63.2
		w	**2839**	100	426	15.0	2413	85.0
	1993	t	**8900**	100	3474	39.0	5426	61.0
		w	**3429**	100	718	20.9	2711	79.1
	1995	t	**9607**	100	3891	40.5	5716	59.5
		w	**3786**	100	819	21.6	2967	78.4
	1996	t	**9948**	100	4054	40.8	5894	59.2
		w	**3963**	100	864	21.8	3100	78.2
	1997	t	**9489**	100	4016	42.3	5473	57.7
		w	**3624**	100	856	23.6	2768	76.4

cont. Table 34

Personnel of non-university science institutions by institution and occupation*

– Full-time equivalent –

Type of institution	Year[1] t= total w= woman		Total Number	Total %	Researchers Number	Researchers %	Technical and other personnel Number	Technical and other personnel %
Länder and local government institutions performing R&D (including Blue List institutions)	1989	t	**8532**	100	3539	41.5	4993	58.5
		w	**3027**	100	494	16.3	2533	83.7
	1993	t	**9523**	100	4401	46.2	5122	53.8
		w	**3756**	100	907	24.1	2849	75.9
	1995	t	**10 181**	100	4901	48.1	5280	51.9
		w	**4014**	100	1059	26.4	2955	73.6
	1996	t	**10 043**	100	4795	47.7	5249	52.3
		w	**4016**	100	1036	25.8	2981	74.2
	1997	t	**9527**	100	4557	47.8	4970	52.2
		w	**3743**	100	1039	27.8	2704	72.2
of which R&D personnel[3]	1989	t	**5105**	100	2134	41.8	2971	58.2
		w	**1852**	100	325	17.5	1527	82.5
	1993	t	**4986**	100	2310	46.3	2676	53.7
		w	**2009**	100	488	24.3	1521	75.7
	1995	t	**4890**	100	2336	47.8	2555	52.2
		w	**1979**	100	516	26.1	1462	73.9
	1996	t	**4794**	100	2355	49.1	2439	50.9
		w	**2003**	100	535	26.7	1468	73.3
	1997	t	**4388**	100	2089	47.6	2299	52.4
		w	**1806**	100	497	27.5	1308	72.4
University institutes	1989	t	**1930**	100	1054	54.6	876	45.4
		w	**774**	100	200	25.8	574	74.2
	1993	t	**4693**	100	2673	57.0	2021	43.1
		w	**1802**	100	587	32.6	1215	67.4
	1995	t	**5033**	100	2957	58.8	2076	41.2
		w	**1938**	100	673	34.7	1265	65.3
	1996	t	**4934**	100	2934	59.5	2001	40.6
		w	**1925**	100	653	33.9	1272	66.1
	1997	t	**5058**	100	3109	61.5	1950	38.6
		w	**2050**	100	798	38.9	1252	61.1
of which R&D personnel[3]	1989	t	**1774**	100	980	55.2	794	44.8
		w	**712**	100	190	26.7	522	73.3
	1993	t	**4323**	100	2453	56.7	1869	43.2
		w	**1661**	100	538	32.4	1123	67.6
	1995	t	**4546**	100	2645	58.2	1901	41.8
		w	**1764**	100	607	34.4	1158	65.6
	1996	t	**4469**	100	2638	59.0	1831	41.0
		w	**1751**	100	585	33.4	1166	66.6
	1997	t	**4498**	100	2779	61.8	1718	38.2
		w	**1824**	100	704	38.6	1120	61.4

* Government sector (as defined by OECD).
1 1989 former West Germany, from 1993 onwards Germany; reference date 30 June (actual figures). 1993 revised in some cases.
2 Since 1992 new surveying concept; extension of coverage and data for each institution's R&D share.
3 Depending on the type of science institution, personnel is wholly or partly employed in R&D.
4 1989 excluding student assistants.
5 Including PNP institutes; 1995 extension of coverage.
6 Due to the restructuring of research institutions, recent data for West Berlin and East Berlin are subject to significant uncertainty.

Source: Federal Statistical Office

Rounding error

Table 35

Personnel of non-university science institutions by institution and field of science*

– Full-time equivalent –

Type of institution	Year[1]	Total	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
1. Helmholtz centres (national research centres)	1989	21 205	15 893	4122	1191	X	X
	1991	21 355	15 857	4264	1235	X	X
	1993	22 392	14 639	6021	1564	X	X
	1995	22 399	13 816	6520	1876	X	X
	1996	22 027	13 468	6500	1938	X	X
	1997	21 908	12 278	7524	1972	X	X
of which: R&D personnel[2]	1989	21 205	15 893	4122	1191	X	X
	1991	21 355	15 857	4264	1235	X	X
	1993	22 335	14 582	6021	1564	X	X
	1995	22 326	13 742	6520	1876	X	X
	1996	21 956	13 397	6500	1938	X	X
	1997	21 834	12 204	7524	1972	X	X
2. Max Planck institutes (100% R&D)	1989	8776	5966	214	1813	-	783
	1991	8960	6127	215	1793	-	825
	1993	9334	7651	-	742	-	942
	1995	9900	7945	-	860	-	1095
	1996	9946	8027	-	922	-	997
	1997	9587	7660	-	934	-	940
3. Fraunhofer institutes (100% R&D)	1989	3860	769	2890	X	X	X
	1991	4890	861	3737	X	X	X
	1993	5965	1020	4430	X	X	X
	1995	6229	1073	4617	X	X	X
	1996	6423	1087	4770	X	X	X
	1997	6311	1306	4441	X	X	X
4. Blue List institutions	1989	6016	1603	X	1283	X	2167
	1991	6144	1646	X	1297	X	2253
	1993	10 616	5130	X	1214	X	2684
	1995	11 273	5369	X	1264	X	2792
	1996	11 272	5524	X	1278	X	2769
	1997	11 098	5336	X	1276	X	2802
of which: R&D personnel[2]	1989	4611	993	X	1221	X	1848
	1991	4675	1012	X	1230	X	1907
	1993	9024	4626	X	1160	X	2094
	1995	9751	4910	X	1203	X	2225
	1996	9744	4953	X	1220	X	2229
	1997	9572	4740	X	1220	X	2277

cont. Table 35

Personnel of non-university science institutions by institution and field of science*

– Full-time equivalent –

Type of institution	Year[1]	Total	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
5. Public institutions (excluding libraries, archives, museums; excluding Blue List institutions)	1989	21 341	8805	2912	2286	6102	1238
	1991	22 369	9478	3117	2537	5888	1350
	1993	28 358	10 814	4420	3331	7159	2636
	1995	28 519	11 070	4419	2091	8390	2551
	1996	28 486	10 718	4329	2124	8633	2684
	1997	27 142	10 120	4312	2077	8205	2429
of which: R&D personnel[2]	1989	11 809	3429	2084	1026	4340	929
	1991	12 461	3893	2193	1136	4239	1000
	1993	12 452	2892	2173	659	5103	1624
	1995	13 052	3058	2182	773	5486	1553
	1996	13 326	3211	2298	772	5449	1596
	1997	12 458	2877	2297	710	5131	1442
6. Scientific libraries, archives and museums (excluding Blue List institutions)	1989	8373	X	X	X	X	8247
	1991	8349	X	X	X	X	8219
	1993	10 880	1065	X	X	X	9666
	1995	10 889	417	X	X	X	10 226
	1996	10 542	404	X	X	X	9883
	1997	10 666	421	X	X	X	9913
of which: R&D personnel[2]	1989	3114	X	X	X	X	3070
	1991	3177	X	X	X	X	3133
	1993	3715	864	X	X	X	2783
	1995	3274	269	X	X	X	2941
	1996	3189	267	X	X	X	2859
	1997	3354	266	X	X	X	3018
7. Other research institutions[3]	1989	4486	1279	X	X	X	1968
	1991	4384	1332	X	X	X	2069
	1993	9821	2506	4168	469	451	2228
	1995	13 031	3055	5079	1006	508	3384
	1996	12 533	2999	5280	453	488	3315
	1997	12 696	3251	5218	506	419	3304
of which: R&D personnel[2]	1989	4486	1279	X	X	X	1968
	1991	4384	1332	X	X	X	2069
	1993	8540	2206	3659	451	422	1802
	1995	10 616	2680	4009	923	393	2612
	1996	10 142	2665	4173	416	350	2537
	1997	10 380	2980	4077	479	274	2571

cont. Table 35

Personnel of non-university science institutions by institution and field of science*

– Full-time equivalent –

Type of institution	Year[1]	Total	of which: Natural sciences	Engineering	Medicine	Agricultural sciences	Social sciences and humanities
8. Total (1. to 7.)	**1989**	**74 055**	**34 314**	**11 795**	**7179**	**6164**	**14 604**
	1991[5]	**76 450**	**35 300**	**12 744**	**7450**	**5950**	**15 007**
	1993	**97 365**	**42 822**	**20 068**	**7449**	**8349**	**18 678**
	1995	**102 240**	**42 743**	**21 728**	**7287**	**9824**	**20 659**
	1996	**101 227**	**42 225**	**21 839**	**6938**	**10 054**	**20 171**
	1997	**99 406**	**40 369**	**22 465**	**7048**	**9606**	**19 919**
of which old *Länder* and West Berlin[4]	1993	79 655	35 547	16 331	6322	5737	15 719
	1995	82 069	33 945	17 786	6431	6948	16 960
	1996	81 081	33 674	17 859	5969	7153	16 427
	1997	79 148	32 030	18 472	5941	6732	15 974
new *Länder* and East Berlin[4]	1993	17 319	7275	3737	1127	2612	2568
	1995	19 828	8798	3942	856	2876	3356
	1996	19 783	8552	3960	969	2901	3402
	1997	19 864	8339	3974	1107	2874	3571
of which: R&D personnel[2]	**1989**	**57 860**	**28 328**	**10 539**	**5790**	**4402**	**8800**
	1991[5]	**59 901**	**29 082**	**11 383**	**5912**	**4301**	**9225**
	1993	**71 363**	**33 840**	**16 897**	**4629**	**6232**	**9765**
	1995	**75 148**	**33 676**	**17 993**	**5709**	**6733**	**11 037**
	1996	**74 725**	**33 606**	**18 347**	**5372**	**6656**	**10 744**
	1997	**73 495**	**32 032**	**18 948**	**5423**	**6313**	**10 779**
of which old *Länder* and West Berlin[4]	1993	58 890	28 094	14 170	4034	4097	8494
	1995	60 454	26 520	15 002	5000	4379	9553
	1996	59 849	26 479	15 220	4552	4464	9134
	1997	58 556	25 225	15 881	4521	4176	8754
new *Länder* and East Berlin[4]	1993	12 108	5746	2727	594	2135	907
	1995	14 362	7155	2991	709	2354	1153
	1996	14 523	7127	3106	820	2193	1278
	1997	14 567	6807	3047	902	2137	1673
For information: Federal institutions performing R&D	1989	14 255	5917	2446	X	3107	X
	1991	15 290	6488	2562	X	3162	X
	1993	20 428	8302	3532	X	3795	X
	1995	19 975	8442	3287	X	4776	X
	1996	20 001	8241	3198	X	5046	X
	1997	19 160	7864	3126	X	4703	X

cont. Table 35

Personnel of non-university science institutions by institution and field of science*

– Full-time equivalent –

Type of institution	Year[1]	Total	of which: Natural sciences	Engineer-ing	Medicine	Agri-cultural sciences	Social sciences and humanities
of which: R&D personnel[2]	1989	7709	1848	1743	X	2796	X
	1991	8389	2276	1809	X	2846	X
	1993	8900	2025	1904	X	3297	X
	1995	9607	2305	1944	X	3654	X
	1996	9948	2435	2079	X	3705	X
	1997	9489	2325	2071	X	3423	X
Länder and local government institutions performing R&D	1989	8532	3573	466	290	2995	1208
	1991	8603	3708	556	292	2726	1323
	1993	9523	3373	888	222	3364	1676
	1995	10 181	3447	1132	233	3614	1757
	1996	10 043	3267	1131	256	3587	1803
	1997	9527	2966	1186	237	3502	1637
of which: R&D personnel[2]	1989	5105	1964	341	290	1544	966
	1991	5122	2018	384	292	1393	1035
	1993	4986	1570	270	222	1806	1118
	1995	4890	1422	238	233	1832	1165
	1996	4794	1424	219	256	1743	1152
	1997	4388	1136	227	237	1709	1080
University institutes	1989	1930	712	145	X	X	625
	1991	1838	684	77	X	X	630
	1993	4693	1717	1129	X	X	1081
	1995	5033	1628	1331	X	X	1223
	1996	4934	1662	1287	X	X	1152
	1997	5058	1610	1459	X	X	1123
of which: R&D personnel[2]	1989	1774	603	145	X	X	578
	1991	1677	570	77	X	X	581
	1993	4323	1551	1029	X	X	995
	1995	4546	1470	1145	X	X	1099
	1996	4469	1521	1 131	X	X	1005
	1997	4498	1479	1164	X	X	994

1 Up to and including 1991 former West Germany. From 1993 onwards Germany. Reference date 30 June (actual figures). 1993 revised in some cases. Since 1992 new surveying concept, extension of coverage. Breakdown of personnel by field of science is based on the institution's spending pattern. Owing to difficulties with the application of statistical regulations, no survey was possible in 1992.

2 Depending on the type of science institution, personnel is wholly or partly employed in R&D.

3 1995 extension of coverage.

4 Due to the restructuring of research institutions, recent data for West Berlin and East Berlin are subject to significant uncertainty.

5 Former West Germany. Personnel of non-university science institutions in the new *Länder* including East Berlin estimated at 31 600 in 1991 including 28 400 R&D personnel.

Source: Federal Statistical Office

Rounding error

Table 36: not included
Table 37: not included

3.2.2 Personnel data – international level –

Table 38

R&D personnel in selected OECD countries by occupation and sector of employment

– Full-time equivalent –

Country	Year	Researchers	Technicians and others	Total R&D personnel		of which: Business enterprise sector	Higher education sector	Government and PNP[1] sectors
		Number			Per 1000 labour force	%		
Germany[3]	1989	176 401	250 046	**426 447**	14.3	69.5	16.3	14.2
	1991[2]	241 869	274 462	**516 331**	13.0	62.3	20.1	17.6
	1993	.	.	**.**	.	.	.	.
	1995	231 128	228 010	**459 138**	11.6	61.7	21.9	16.4
	1996	.	.	**453 679**	11.5	61.0	22.5	16.5
	1997	235 792	224 618	**460 410**	11.6	62.2	21.9	15.9
France	1989	120 430	168 852	**289 282**	11.7	51.8	21.9	26.3
	1991	129 780	169 421	**299 201**	12.0	52.2	22.1	25.7
	1993	145 898	168 272	**314 170**	12.5	52.3[2]	23.8	23.9[2]
	1995	151 249	167 135	**318 384**	12.6	50.9	25.3	23.8
	1996	154 839	165 966	**320 805**	12.5	50.7	25.4	23.9
	1997[2]	155 302	160 569	**315 871**	12.3	51.9	24.9	23.2
United Kingdom	1989	133 000	148 000	**281 000**	9.9	62.6	19.6	17.8
	1991	128 000[2]	133 000[2]	**261 000**	9.1	60.9[2]	22.6	16.5
	1993	135 000	135 000	**270 000**	9.5	60.7[2]	24.4	14.9[2]
	1995	146 000[2]	.	**.**	.	.	.	.
	1996	146 000	.	**.**	.	.	.	.
	1997	.	.	**.**	.	.	.	.
Italy	1989	76 074	64 422	**140 496**	5.8	46.2	31.3	22.5
	1991	75 238	68 403	**143 641**	5.8	45.6	31.7	22.7
	1993	74 434	67 737	**142 171**	6.1	43.6	33.1	23.3
	1995	75 536	66 253	**141 789**	6.1	42.5	34.2	23.3
	1996	76 441	65 847	**142 288**	6.1	42.8	34.5	22.7
	1997	76 056	65 681	**141 737**	6.0	43.3	34.6	22.1
Netherlands	1989	26 680	39 460	**66 140**	9.9	49.8	26.1	24.1
	1991[2]	.	.	**72 350**	10.3	41.4	35.6	23.0
	1993	32 200	42 220	**74 420**	10.5[5]	41.5	35.6	22.9
	1995[2]	34 038	45 218	**79 256**	10.7	47.3	31.4	21.3
	1996	34 482	46 307	**80 789**	10.7	48.8	30.2	21.0
	1997	38 055	45 912	**83 967**	10.9	50.5	29.1	20.4
Japan[4]	1989	560 276	303 106	**863 382**	13.8	61.2	29.6	9.2
	1991	598 333	311 718	**910 051**	14.0	61.9	29.0	9.1
	1993	641 083	306 372	**947 455**	14.3	61.6	29.5	8.9
	1995	673 421	274 667	**948 088**	14.2	60.5	30.6	8.9
	1996[2]	617 365	274 418	**891 783**	13.3	66.1	24.4	9.5
	1997	625 442	268 561	**894 003**	13.2	65.6	24.9	.

cont. Table 38

R&D personnel in selected OECD countries by occupation and sector of employment

– Full-time equivalent –

Country	Year	Researchers	Technicians and others	Total R&D personnel		of which: Business enterprise sector	Higher education sector	Government and PNP[1] sectors
		Number			Per 1000 labour force	%		
USA[5]	1989	924 200	.	**.**	.	.	.	.
	1991[2]	960 500	.	**.**	.	.	.	.
	1993	964 800	.	**.**	.	.	.	.
	1995	.	.	**.**	.	.	.	.
	1996	.	.	**.**	.	.	.	.
	1997	.	.	**.**	.	.	.	.
Canada	1989	62 980	48 950	**111 930**	7.9	48.4	36.0	15.6
	1991	67 140	46 840	**113 980**	7.9	47.7[2]	36.8[2]	15.5[2]
	1993	74 100	48 150	**122 250**	8.3	50.4	35.2	14.4
	1995	80 510	49 240	**129 750**	8.7	54.8	32.6	12.6
	1996	.	.	**.**	.	.	.	.
	1997	.	.	**.**	.	.	.	.
Austria	1989	8782	14 302	**23 084**	6.7	64.3	26.2	9.5
	1991	.	.	**.**	.	.	.	.
	1993	12 821	11 637	**24 458**	6.6	61.8	29.2	9.0
	1995	.	.	**.**	.	.	.	.
	1996	.	.	**.**	.	.	.	.
	1997	.	.	**.**	.	.	.	.
Switzerland	1989	16 300	34 700	**51 000**	14.4	77.1	19.0	3.9
	1991	.	.	**.**	.	.	.	.
	1992	17 710	30 160	**47 870**	12.1	70.8	25.5	3.7
	1993	.	.	**.**	.	.	.	.
	1995	.	.	**.**	.	.	.	.
	1996	21 635	28 630	**50 265**	12.7	68.5	28.7	2.8
	1997	.	.	**.**	.	.	.	.
Sweden[6]	1989	25 585	29 544	**55 129**	12.2	63.7	31.4	4.9
	1991	26 515	27 089	**53 604**	11.9	63.0	31.4	5.6
	1993[2]	29 252	27 375	**56 627**	13.1	62.4	30.8	6.8
	1995	33 665	28 970	**62 635**	14.5	66.5[2]	27.6[2]	5.9[2]
	1996	.	.	**.**	.	.	.	.
	1997	36 878	28 617	**65 495**	15.4	67.0	27.8	5.2

1 Private non-profit institutions (PNP).

2 Break in series.

3 Even years estimated. 1989 former West Germany, from 1991 onwards Germany. From 1993 onwards PNP sector included in government sector (as far as covered by surveys).

4 Up to and including 1995 R&D personnel overestimated (personnel data instead of full-time equivalent).

5 Underestimated.

6 Up to and including 1991 personnel data of government and PNP sectors and total personnel data underestimated (excluding social sciences and humanities).

Source: OECD (1999/2) and calculations by the Federal Ministry of Education and Research

3.3 Regional data

3.3.1 Regional data – financial data –

Table 39

Federal R&D expenditure by *Land*[1]

– Financing of R&D –

Land	1995		1996		1997		1998	
	Actual							
	DM million	%	DM million	%	DM million	%	DM million	%
Baden-Württemberg	2163.9	14.7	2234.7	14.9	2236.3	15.5	2541.5	17.5
Bavaria	3121.1	21.2	3165.8	21.1	3069.3	21.3	2646.0	18.3
Berlin[2]	1493.1	10.1	1545.4	10.3	1419.8	9.8	1390.7	9.6
Brandenburg	470.7	3.2	487.3	3.2	475.1	3.3	487.3	3.4
Bremen	332.4	2.3	347.2	2.3	308.6	2.1	350.1	2.4
Hamburg	653.8	4.4	646.5	4.3	614.6	4.3	578.0	4.0
Hesse	752.0	5.1	751.4	5.0	736.0	5.1	682.9	4.7
Mecklenburg-Western Pomerania	180.3	1.2	186.6	1.2	194.3	1.3	247.2	1.7
Lower Saxony	1087.9	7.4	1090.7	7.3	1006.3	7.0	1055.5	7.3
North Rhine-Westphalia	2389.4	16.2	2424.6	16.1	2427.8	16.8	2485.5	17.2
Rhineland-Palatinate	210.2	1.4	221.7	1.5	226.1	1.6	246.5	1.7
Saarland	74.7	0.5	77.9	0.5	75.1	0.5	95.3	0.7
Saxony	801.9	5.4	802.4	5.3	704.0	4.9	689.2	4.8
Saxony-Anhalt	291.6	2.0	300.8	2.0	293.3	2.0	296.1	2.0
Schleswig-Holstein	430.1	2.9	456.6	3.0	404.6	2.8	426.9	2.9
Thuringia	288.8	2.0	287.4	1.9	243.6	1.7	263.9	1.8
Länder total...	14741.9	100.0	15026.9	100.0	14434.8	100.0	14482.5	100.0
of which new *Länder* and East Berlin[3]	2617.9	17.8	2660.7	17.7	2419.0	16.8	2493.9	17.2
Abroad[4]	1805.3	12.2	1 713.5	11.4	1627.5	11.3	1688.2	11.7
Total	**16547.2**	**100.0**	**16740.4**	**100.0**	**16062.3**	**100.0**	**16170.7**	**100.0**

1 The major criterion used in breaking down federal R&D expenditure by *Land* is usually the headquarters of the institution performing R&D. For joint research funding by the Federal Government and the *Länder* under the Skeleton Agreement on Research Promotion, federal R&D expenditure was therefore broken down by the funding requirement of institutes or units supported. For federal research institutions, R&D expenditure is shown for headquarters and branches/units of an institutional nature. The impact of subcontracting and resulting transfer of funds between *Länder* has not been taken into account in breakdown by *Land*.

2 Including East Berlin.

3 Excluding project funds channelled to the new *Länder* and East Berlin via a grant recipient in the old *Länder* (including West Berlin).

4 Minor deviations compared with Table VII/10 owing to greater detail of breakdown of the regional data used.

Source: Federal Ministry of Education and Research

Rounding error

Table 40

Länder R&D expenditure by *Land*[1]

– Financing of R&D –

Land	Actual 1995 DM million	1995 %	1996 DM million	1996 %	1997 DM million	1997 %
Baden-Württemberg	1989	13.8	1962	13.3	1911	13.1
Bavaria	2284	15.9	2414	16.3	2367	16.2
Berlin[2]	1299	9.0	1237	8.4	1211	8.3
Brandenburg	334	2.3	342	2.3	336	2.3
Bremen	194	1.3	201	1.4	202	1.4
Hamburg	483	3.4	479	3.2	468	3.2
Hesse	947	6.6	886	6.0	908	6.2
Mecklenburg-Western Pomerania	285	2.0	321	2.2	315	2.2
Lower Saxony	1119	7.8	1153	7.8	1098	7.5
North Rhine-Westphalia	2617	18.2	2715	18.4	2808	19.2
Rhineland-Palatinate	442	3.1	460	3.1	474	3.2
Saarland	177	1.2	169	1.1	175	1.2
Saxony	887	6.2	1045	7.1	1047	7.2
Saxony-Anhalt	460	3.2	461	3.1	439	3.0
Schleswig-Holstein	404	2.8	404	2.7	344	2.4
Thuringia	459	3.2	519	3.5	516	3.5
Total R&D expenditure	**14 381**	**100**	**14 768**	**100**	**14 618**	**100**

1 Estimates based on *Länder* budgets (transfer of funds between the *Länder* partly not taken into account); calculation of R&D expenditure of higher education institutions financed by the *Länder* is based on the procedure agreed by the Conference of *Länder* Ministers of Education and Cultural Affairs, the Science Council, the Federal Ministry of Education and Research and the Federal Statistical Office.

Source: Federal Ministry of Education and Research

Rounding error

Table 41

Total German R&D expenditure by *Land*[1]

– Performing of R&D –

Land	Total R&D expenditure 1993 DM million	1993 %	1995 DM million	1995 %	1997 DM million	1997 %
Baden-Württemberg	17 846	23.6	18 193	23.1	19 645	23.5
Bavaria	15 266	20.2	16 116	20.4	16 678	19.9
Berlin[2]	4790	6.3	4728	6.0	5063	6.1
Brandenburg	776	1.0	991	1.3	1142	1.4
Bremen	972	1.3	1140	1.4	835	1.0
Hamburg	2051	2.7	2411	3.1	2561	3.1
Hesse	6869	9.1	7102	9.0	7345	8.8
Mecklenburg-Western Pomerania	412	0.5	487	0.6	524	0.6
Lower Saxony	4 868	6.4	5422	6.9	5592	6.7
North Rhine-Westphalia	13 576	17.9	13 161	16.7	13 888	16.6
Rhineland-Palatinate	2732	3.6	2849	3.6	3455	4.1
Saarland	393	0.5	399	0.5	429	0.5
Saxony	2040	2.7	2567	3.3	2999	3.6
Saxony-Anhalt	908	1.2	983	1.2	1004	1.2
Schleswig-Holstein	1313	1.7	1249	1.6	1267	1.5
Thuringia	847	1.1	1060	1.3	1229	1.5
Total of old and new Länder[2]	76 495	.	79 455	.	83 734	.
of which:						
Old *Länder* including West Berlin	**69 540**	91.9	**71 617**	90.8	**75 308**	90.0
New *Länder* including East Berlin	**6117**	8.1	**7242**	9.2	**8351**	10.0
German institutions based abroad	68	.	65	.	88	.
Total	**76 563**	**.**	**79 520**	**.**	**83 822**	**.**

1 Partly estimated.

2 Including higher education and business enterprise funds which cannot be broken down (1993: DM838 million, 1995: DM596 million, 1997: DM78 million).

Source: Federal Statistical Office, Stifterverband Wissenschaftsstatistik and Federal Ministry of Education and Research

Rounding error

Table 42

Intramural R&D expenditure* of the business enterprise sector by Land[1] hosting research lab

– Performing of R&D –

Land	Intramural R&D expenditure							
	1995				1997			
	Total		of which		Total		of which	
	DM million	%	in research labs of business enterprise	in research labs of IfG[2]	DM million	%	in research labs of business enterprise	in research labs of IfG[2]
Baden-Württemberg	13 755	26.2	13 674	82	15 125	26.7	15 049	76
Bavaria	12 440	23.7	12 421	19	12 747	22.5	12 721	26
Berlin[2]	1932	3.7	1910	21	2334	4.1	2320	14
Brandenburg	355	0.7	X	X	459	0.8	448	11
Bremen	740	1.4	X	X	410	0.7	X	X
Hamburg	1420	2.7	1416	4	1549	2.7	1546	3
Hesse	5531	10.5	5510	22	5813	10.3	5785	28
Mecklenburg-Western Pomerania	104	0.2	104	-	79	0.1	79	-
Lower Saxony	3235	6.2	3219	16	3405	6.0	3394	11
North Rhine-Westphalia	8103	15.4	7950	153	8754	15.5	8604	150
Rhineland-Palatinate	2188	4.2	X	X	2710	4.8	X	X
Saarland	130	0.2	130	-	147	0.3	147	-
Saxony	1134	2.2	1046	89	1456	2.6	1360	96
Saxony-Anhalt	366	0.7	346	19	398	0.7	380	18
Schleswig-Holstein	512	1.0	512	-	512	0.9	512	-
Thuringia	501	1.0	475	26	642	1.1	601	41
Total	**52 835[3]**	**.**	**51 955**	**494**	**56 543**	**100.0**	**56 037**	**506**
of which:								
Old *Länder* including West Berlin	49 732	94.8	49 398	334	53 157	94.0	52 828	329
New *Länder* including East Berlin	2716	5.2	2557	159	3386	6.0	3209	177

* All expenditures on R&D performed in the business enterprise sector, whatever the source of funds.

1 Estimates based on breakdown of R&D personnel by research lab.

2 Institutions for co-operative industrial research and experimental development.

3 Including funds not related to specific items which, after national consultation, were added to the business enterprise sector - 1995: DM386 million.

Source: Stifterverband Wissenschaftsstatistik, Federal Ministry of Education and Research

Rounding error

Table 43

Higher education R&D expenditure by *Land*

– Performing of R&D –

Land	R&D expenditure of higher education institutions[2] 1995 DM million	1995 %	1996 DM million	1996 %	1997 DM million	1997 %
Baden-Württemberg	2137.2	15.0	2210.0	14.9	2208.8	14.8
Bavaria	2192.1	15.4	2370.7	16.0	2404.9	16.1
Berlin[2]	1200.7	8.4	1165.2	7.9	1189.6	8.0
Brandenburg	177.3	1.2	204.8	1.4	222.4	1.5
Bremen	187.1	1.3	194.2	1.3	205.6	1.4
Hamburg	514.3	3.6	533.4	3.6	541.0	3.6
Hesse	1065.0	7.5	1052.0	7.1	1026.1	6.9
Mecklenburg-Western Pomerania	234.9	1.7	264.7	1.8	273.9	1.8
Lower Saxony	1160.4	8.2	1219.5	8.2	1187.7	8.0
North Rhine-Westphalia	2781.4	19.6	2948.5	19.9	3022.9	20.2
Rhineland-Palatinate	466.5	3.3	483.9	3.3	518.4	3.5
Saarland	190.2	1.3	184.9	1.2	189.3	1.3
Saxony	798.4	5.6	845.4	5.7	851.2	5.7
Saxony-Anhalt	366.4	2.6	372.7	2.5	345.7	2.3
Schleswig-Holstein	406.4	2.9	423.1	2.9	409.8	2.7
Thuringia	341.8	2.4	369.8	2.5	339.0	2.3
Total of old and new *Länder*[1]	**14 429.8**	.	**14 966.6**	.	**15 014.3**	.
of which:						
Old *Länder* including West Berlin	**11 945.2**	**84.0**	**12 346.7**	**83.2**	**12 418.3**	**83.1**
New *Länder* including East Berlin	**2274.9**	**16.0**	**2496.1**	**16.8**	**2518.0**	**16.9**

1 Including DFG funds that cannot fully be broken down by *Land*. (1995: DM209.6 million, 1996: DM123.8 million; 1997: DM78 million).

2 Including grants for (post)graduates.

Source: Stifterverband Wissenschaftsstatistik, Federal Ministry of Education and Research

Rounding error

Table 44

R&D expenditure in non-university science institutions* by *Land*

– Performing of R&D –

Land	R&D expenditure in science institutions[1] 1995 DM million	1995 %	1996 DM million	1996 %	1997 DM million	1997 %
Baden-Württemberg	2300.9	18.9	2278.0	18.6	2311.6	19.0
Bavaria	1483.6	12.2	1515.2	12.4	1525.8	12.5
Berlin[2]	1594.8	13.1	1564.4	12.8	1539.0	12.6
Brandenburg	458.3	3.8	480.9	3.9	461.0	3.8
Bremen	212.8	1.7	211.2	1.7	218.9	1.8
Hamburg	476.4	3.9	480.4	3.9	470.9	3.9
Hesse	505.8	4.1	502.0	4.1	505.5	4.2
Mecklenburg-Western Pomerania	147.9	1.2	162.1	1.3	171.5	1.4
Lower Saxony	1027.0	8.4	1093.8	8.9	999.3	8.2
North Rhine-Westphalia	2276.7	18.7	2145.3	17.5	2111.5	17.3
Rhineland-Palatinate	194.6	1.6	205.8	1.7	226.4	1.9
Saarland	79.1	0.6	83.4	0.7	92.5	0.8
Saxony	634.7	5.2	683.6	5.6	692.0	5.7
Saxony-Anhalt	250.4	2.1	260.9	2.1	260.4	2.1
Schleswig-Holstein	330.3	2.7	359.0	2.9	345.3	2.8
Thuringia	216.8	1.8	235.4	1.9	247.7	2.0
Total of old and new *Länder*	12 190.1	100.0	12 261.4	100.0	12 179.2	100.0
of which: Old *Länder* including West Berlin	**9939.3**	**81.5**	**9850.1**	**80.3**	**9732.7**	**79.9**
New *Länder* including East Berlin	**2250.9**	**18.5**	**2411.3**	**19.7**	**2446.5**	**20.1**
German institutions based abroad	64.8	.	70.3	.	88.4	.
Total	**12 254.9**	**.**	**12 331.8**	**.**	**12 267.6**	**.**

* Government sector (as defined by OECD).

1 Breakdown by duty station of the R&D personnel in the year concerned.

Source: Federal Statistical Office and calculations by the Federal Ministry of Education and Research — Rounding error

3.3.2 Regional data – personnel data –

Table 45

Total R&D personnel in the Federal Republic of Germany by *Land* *

– Full-time equivalent –

Land	Total R&D personnel 1995 Persons	%	1997 Persons	%
Baden-Württemberg	93 612	20.4	95 094	20.7
Bavaria	88 516	19.3	87 998	19.1
Berlin[2]	30 419	6.6	30 349	6.6
Brandenburg	7113	1.6	6907	1.5
Bremen	5474	1.2	4797	1.0
Hamburg	13 532	2.9	13 418	2.9
Hesse	40 403	8.8	39 167	8.5
Mecklenburg-Western Pomerania	4067	0.9	3868	0.8
Lower Saxony	33 270	7.3	33 792	7.3
North Rhine-Westphalia	77 815	17.0	76 833	16.7
Rhineland-Palatinate	17 321	3.8	17 996	3.9
Saarland	2618	0.6	2718	0.6
Saxony	20 267	4.4	22 302	4.8
Saxony-Anhalt	7674	1.7	7533	1.6
Schleswig-Holstein	8252	1.8	8188	1.8
Thuringia	8453	1.8	9079	2.0
Total of old and new *Länder*	458 807	100.0	460 039	100.0
of which:				
Old *Länder* including West Berlin	**401 755**	87.6	**401 482**	87.3
New *Länder* including East Berlin	**57 051**	12.4	**58 557**	12.7
German institutions based abroad	331	.	372	.
Total	**459 138**	.	**460 411**	.

* Higher education data based on full-time personnel of private and state institutions of higher education (actual figures) determined in accordance with the procedure agreed between the Conference of Ministers of Education and Cultural Affairs of the *Länder*, the Science Council, the Federal Ministry of Education and Research and the Federal Statistical Office; for methods see Chapter VII.1.

Source: Federal Statistical Office, Stifterverband Wissenschaftsstatistik and Federal Ministry of Education and Research

Rounding error

Table 46

R&D personnel in the business enterprise sector by economic activity and *Land*

– Full-time equivalent –

Land	Year	Total	In research labs of business enterprises					
			Total	AB Agriculture, hunting and forestry; fishing	C Mining and quarrying	D Manufacturing		
						Total	DA Food products and beverages; tobacco products	DB, DC Textiles & wearing apparel; luggage, handbags & footwear
Baden-Württemberg	1995	**66 024**	**65 385**	20	-	64 598	384	249
	1997	**68 270**	**67 752**	21	-	63 935	329	227
Bavaria	1995	**64 685**	**64 560**	146	X	61 282	428	171
	1997	**64 288**	**64 119**	147	X	60 078	441	260
Berlin	1995	**11 076**	**10 892**	-	-	9189	64	X
	1997	**12 708**	**12 563**	-	-	10 781	X	X
Brandenburg	1995	**2821**	**X**	31	-	2223	51	16
	1997	**2860**	**2744**	X	X	2313	72	17
Bremen	1995	**3477**	**X**	X	-	3108	159	X
	1997	**2490**	**X**	X	-	2186	171	12
Hamburg	1995	**7312**	**7290**	X	X	6928	437	-
	1997	**7359**	**7344**	X	X	6974	415	-
Hesse	1995	**29 549**	**29 348**	X	X	28 091	169	192
	1997	**28 637**	**28 431**	23	X	26 610	96	201
Mecklenburg-Western Pomerania	1995	**1018**	**1018**	93	-	749	36	X
	1997	**724**	**724**	74	-	460	X	X
Lower Saxony	1995	**18 383**	**18 277**	406	31	17 308	60	54
	1997	**18 763**	**18 685**	428	27	17 670	39	35
North Rhine-Westphalia	1995	**44 541**	**43 342**	65	250	40 274	463	252
	1997	**43 568**	**42 458**	121	338	39 786	400	303
Rhineland-Palatinate	1995	**12 684**	**X**	X	32	12 355	128	68
	1997	**13 082**	**X**	X	X	12 735	144	69
Saarland	1995	**777**	**777**	-	X	588	2	-
	1997	**748**	**748**	-	X	697	X	X
Saxony	1995	**9891**	**9183**	X	8	8036	129	432
	1997	**11 438**	**10 636**	X	6	9294	122	426
Saxony-Anhalt	1995	**3267**	**3067**	38	-	2423	26	6
	1997	**3073**	**2949**	33	X	2239	21	4
Schleswig-Holstein	1995	**3272**	**3272**	127	-	3009	93	-
	1997	**3340**	**3340**	X	-	3096	146	-
Thuringia	1995	**4538**	**4358**	10	X	4012	78	111
	1997	**4922**	**4575**	10	X	4062	86	133
Total	1995	**283 316**	**279 351**	**1013**	**363**	**264 171**	**2706**	**1563**
	1997	**286 270**	**282 439**	**1046**	**449**	**262 916**	**2541**	**1695**
Old *Länder* including West Berlin	1995	**259 575**	**256 963**	800	X	245 448	2374	990
	1997	**261 162**	**258 818**	876	437	243 302	2209	1106
New *Länder* including East Berlin	1995	**23 741**	**22 388**	213	X	18 723	332	572
	1997	**25 108**	**23 621**	170	12	19 615	331	589

cont. Table 46

R&D personnel in the business enterprise sector by economic activity and *Land*

– Full-time equivalent –

In research labs of business enterprises									
D Manufacturing									E Electricity, gas and water supply
DD, DE Wood and paper products; publishing and printing	DF Coke, refined petroleum products and nuclear fuel	DG Chemicals and chemical products	DH Rubber and plastic products	DI Other non-metallic mineral products	DJ Basic metals; fabricated metal products	DK Machinery and equipment	DL Office machinery and computers, electrical machinery	DM Transport equipment	
204	X	4124	1250	335	1035	9007	25 166	22 394	75
217	.	4434	567	278	1282	9338	16 533	30 314	87
223	X	4584	517	473	748	7931	26 667	19 125	108
170	X	3719	817	359	855	7985	23 238	21 857	X
15	-	2205	X	X	X	1533	4443	X	X
X	-	2092	X	X	X	1691	6004	731	X
18	-	464	21	X	X	243	559	590	-
21	-	170	32	X	X	270	514	861	8
X	-	45	-	-	29	257	378	2232	X
-	-	47	-	-	X	188	364	X	-
-	200	1126	X	X	X	554	1185	2935	X
-	252	1126	X	X	42	565	1203	3075	X
115	-	10 617	417	287	794	2520	6653	6296	X
106	-	9789	387	319	876	2584	5670	6560	X
26	X	27	X	28	67	235	86	203	-
X	-	28	X	16	58	127	81	62	-
146	-	1694	1025	84	248	1721	2484	9692	9
48	-	1084	1083	156	315	2019	2456	10 353	X
321	X	12 968	670	709	2305	8148	9172	4761	295
425	157	13 426	847	575	2438	7576	8950	4514	290
33	X	9165	221	505	235	841	417	501	X
50	X	9394	195	436	216	672	660	X	-
-	-	30	-	X	151	207	27	X	X
-	X	82	X	X	147	209	36	X	13
77	X	701	X	200	545	2858	2009	569	X
115	X	651	220	187	656	2894	3062	584	X
14	59	772	70	35	211	700	307	190	-
13	63	658	85	51	202	621	268	210	-
20	-	204	54	X	91	1080	1 168	290	2
X	-	242	X	X	69	1099	1 207	X	X
111	X	287	110	266	239	987	1 399	X	X
97	X	300	166	239	250	1003	1 383	159	X
1327	**672**	**49 012**	**4924**	**3139**	**6933**	**38 821**	**82 119**	**70 762**	**554**
1295	**730**	**47 241**	**4757**	**2790**	**7706**	**38 841**	**71 628**	**81 476**	**499**
1066	467	46 633	4514	2540	5704	33 478	77 269	68 883	529
1029	X	45 310	4228	2238	6288	33 683	65 818	79 338	465
261	204	2378	409	599	1229	5343	4849	1929	25
267	X	1930	529	552	1418	5158	5810	2138	34

cont. Table 46

R&D personnel in the business enterprise sector by economic activity and *Land*

– Full-time equivalent –

Land	Year	In research labs of business enterprises: F Construc-tione	I Transport, storage and communic-ation	K Real estate, renting and business activities	O Other community, social and personal service activities	G, H, J, L-N Remaining categories	In research labs of institutions for co-operative industrial research and experimental development
Baden-	1995	52	X	483	X	142	640
Württemberg	1997	67	X	3522	X	107	518
Bavaria	1995	105	X	2148	X	54	125
	1997	104	X	3441	X	51	169
Berlin	1995	X	X	1174	X	X	183
	1997	X	X	1297	X	X	145
Brandenburg	1995	30	X	203	X	X	X
	1997	X	X	250	18	X	116
Bremen	1995	X	X	16	-	X	X
	1997	-	X	X	-	X	X
Hamburg	1995	40	69	181	-	30	23
	1997	16	60	247	-	13	15
Hesse	1995	119	X	202	X	121	201
	1997	123	X	789	X	37	206
Mecklenburg-Western	1995	X	-	142	-	-	-
Pomerania	1997	13	X	144	X	26	-
Lower Saxony	1995	16	X	463	X	17	107
	1997	20	X	507	X	17	78
North Rhine-	1995	237	562	1541	X	116	1199
Westphalia	1997	217	283	1326	X	X	1110
Rhineland-Palatinate	1995	X	X	X	-	X	X
	1997	36	X	73	-	X	X
Saarland	1995	X	-	X	-	X	-
	1997	X	-	X	-	X	-
Saxony	1995	54	X	984	21	32	708
	1997	70	X	1130	21	68	802
Saxony-Anhalt	1995	61	X	526	X	11	200
	1997	67	X	533	X	58	124
Schleswig-	1995	-	X	110	-	X	-
Holstein	1997	-	X	115	-	-	-
Thuringia	1995	43	-	242	20	30	180
	1997	72	-	359	14	57	347
Total	1995	**831**	**3032**	**8631**	**119**	**637**	**3 965**
	1997	**912**	**2162**	**13 772**	**80**	**602**	**3 831**
Old *Länder*	1995	596	2585	6063	X	529	2612
including West Berlin	1997	599	1878	10 881	15	364	2344
New *Länder*	1995	235	447	2568	X	109	1353
including East Berlin	1997	313	284	2891	65	238	1487

Source: Stifterverband Wissenschaftsstatistik

Table 47

Higher education R&D personnel by *Land* *

– Full-time equivalent –

Land	R&D personnel of higher education institutions 1995 Persons	1995 %	1996 Persons	1996 %	1997 Persons	1997 %	1998[1] Persons	1998[1] %
Baden-Württemberg	14 736	14.6	15 254	14.9	14 540	14.4	15 052	14.9
Bavaria	13 891	13.8	14 311	14.0	13 933	13.8	13 954	13.8
Berlin	9400	9.3	8889	8.7	8555	8.5	8354	8.3
Brandenburg	1381	1.4	1513	1.5	1326	1.3	1380	1.4
Bremen	1133	1.1	1288	1.3	1407	1.4	1616	1.6
Hamburg	3431	3.4	3502	3.4	3261	3.2	3101	3.1
Hesse	7639	7.6	7341	7.2	7543	7.5	7166	7.1
Mecklenburg-Western Pomerania	1927	1.9	1896	1.9	1967	2.0	2004	2.0
Lower Saxony	8232	8.2	8596	8.4	8304	8.3	8397	8.3
North Rhine-Westphalia	19 492	19.4	19 691	19.3	20 122	20.0	20 496	20.3
Rhineland-Palatinate	3494	3.5	3632	3.6	3573	3.6	3499	3.5
Saarland	1406	1.4	1412	1.4	1399	1.4	1383	1.4
Saxony	6513	6.5	6932	6.8	6781	6.7	6692	6.6
Saxony-Anhalt	2860	2.8	2789	2.7	2870	2.9	2930	2.9
Schleswig-Holstein	2618	2.6	2611	2.6	2432	2.4	2486	2.5
Thuringia	2520	2.5	2503	2.5	2633	2.6	2603	2.6
Total of old and new *Länder*	**100 674**	**100 .0**	**102 160**	**100 .0**	**100 646**	**100 .0**	**101 112**	**100 .0**
of which:								
Old *Länder* including West Berlin	**81 726**	**81.2**	**83 186**	**81.4**	**81 764**	**81.2**	.	.
New *Länder* including East Berlin	**18 948**	**18.8**	**18 974**	**18.6**	**18 882**	**18.8**	.	.

* Based on the personnel of private and state institutions of higher education (actual figures) determined in accordance with the procedure agreed between the Conference of Ministers of Education and Cultural Affairs of the *Länder*, the Science Council, the Federal Ministry of Education and Research and the Federal Statistical Office; for methods see Chapter VII.1. Including grants for (post)graduates.

1 Provisional data.

Source: Federal Statistical Office and Federal Ministry of Education and Research

Rounding error

Table 48

R&D personnel in non-university science institutions* by *Land*

– Full-time equivalent –

Land	R&D personnel in science institutions[1]					
	1995		**1996**		**1997**	
	Persons	%	Persons	%	Persons	%
Baden-Württemberg	12 852	17.2	12 284	16.5	12 284	16.8
Bavaria	9940	13.3	9845	13.2	9777	13.4
Berlin	9943	13.3	9579	12.9	9086	12.4
Brandenburg	2911	3.9	2762	3.7	2721	3.7
Bremen	864	1.2	844	1.1	900	1.2
Hamburg	2789	3.7	2809	3.8	2798	3.8
Hesse	3215	4.3	3214	4.3	2987	4.1
Mecklenburg-Western Pomerania	1122	1.5	1180	1.6	1177	1.6
Lower Saxony	6655	8.9	7160	9.6	6725	9.2
North Rhine-Westphalia	13 782	18.4	13 659	18.4	13 143	18.0
Rhineland-Palatinate	1143	1.5	1267	1.7	1341	1.8
Saarland	435	0.6	503	0.7	571	0.8
Saxony	3863	5.2	3952	5.3	4083	5.6
Saxony-Anhalt	1547	2.1	1577	2.1	1590	2.2
Schleswig-Holstein	2362	3.2	2238	3.0	2416	3.3
Thuringia	1395	1.9	1498	2.0	1524	2.1
Total of old and new *Länder*	74 817	100.0	74 371	100.0	73 123	100.0
of which:						
Old *Länder* including West Berlin	**60 454**	**80.8**	**59 849**	**80.5**	**58 556**	**80.1**
New *Länder* including East Berlin	**14 362**	**19.2**	**14 523**	**19.5**	**14 567**	**19.9**
Abroad	331		353		372	
Total	**75 148**		**74 725**		**73 495**	

* Government sector (as defined by OECD).
1 Reference date 30 June (actual figures).

Source: Federal Statistical Office

Rounding error

3.4 Further tables

Table 49

Foreign trade by R&D-intensive commodities (selected OECD countries, 1995 to 1997)

– %* –

	Germany			France			UK			Italy			Netherlands		
	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997
Cutting-edge technology	12.4	11.8	10.9	8.0	8.1	7.7	8.4	9.4	9.4	3.0	3.2	2.7	4.5	3.7	5.2
Advanced technology	18.4	17.9	16.8	6.4	6.2	6.3	6.1	6.5	6.5	5.9	6.2	5.6	3.4	3.3	3.7
R&D-intensive goods	16.0	15.5	14.4	7.0	7.0	6.8	7.0	7.7	7.7	4.7	5.0	4.4	3.8	3.4	4.3
of which															
Biotechnology/ Biotech substit. sector[1]	17.8	16.8	14.8	8.9	8.9	8.9	9.1	9.4	8.8	4.3	4.5	4.1	6.1	5.7	6.5
Radioactive materials	3.5	3.7	2.6	31.6	28.2	22.2	14.4	13.5	13.6	0.8	0.5	0.3	4.8	5.0	5.8
Other chemicals	19.2	18.7	17.9	7.9	7.9	7.7	8.2	8.6	8.2	4.5	4.9	4.8	7.2	5.3	6.8
Mechanical engineering	22.5	21.6	20.4	5.4	5.3	5.3	4.7	4.9	5.0	11.0	12.2	11.7	2.4	2.4	2.3
Automobiles	20.3	20.3	19.7	6.5	6.4	6.6	4.6	5.3	5.3	4.0	3.7	3.0	1.4	1.6	1.6
Aircraft and spacecraft	11.1	9.9	10.3	18.7	16.5	14.3	12.2	13.2	14.7	2.9	3.5	2.6	3.1	1.2	1.1
Information technology	7.9	7.6	6.8	5.2	5.6	5.5	8.3	9.2	8.6	2.6	2.6	2.1	5.0	5.1	6.8
Electrical engineering, n.e.c.	18.6	17.7	16.5	6.9	7.0	6.6	5.4	6.0	6.0	3.7	3.9	3.5	3.3	2.4	3.7
Measuring & control technol.	17.5	16.8	15.2	5.8	5.5	5.4	8.7	9.2	9.6	3.5	3.8	3.3	3.2	3.3	3.6
Photogr. & optic. products	12.6	11.7	11.2	5.0	4.7	4.2	4.0	4.3	3.6	7.6	8.5	7.5	4.1	4.9	10.5
Other R&D-intensive goods	12.9	11.5	11.4	5.3	4.9	5.0	7.7	11.1	12.4	5.2	5.4	5.2	2.9	2.3	3.3

	EU-15			Switzerland			USA			Japan			Korea		
	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997	1995	1996	1997
Cutting-edge technology	45.8	46.4	46.0	1.9	1.9	1.6	22.9	24.9	25.9	18.0	15.9	14.6	6.0	4.5	5.1
Advanced technology	54.2	54.7	53.1	3.3	3.2	3.0	12.3	12.8	13.8	18.1	16.4	16.7	2.5	2.7	2.6
R&D-intensive goods	50.8	51.5	50.2	2.8	2.7	2.4	16.5	17.5	18.8	18.1	16.2	15.8	3.9	3.4	3.6
of which															
Biotechnology/ Biotech substit. sector[1]	63.9	64.3	63.4	9.6	9.2	8.7	14.7	14.9	16.1	7.0	6.7	6.9	0.8	0.9	0.9
Radioactive materials	59.2	53.7	47.2	0.3	0.2	0.2	26.3	27.5	33.9	0.9	0.8	0.7	0.1	0.0	0.0
Other chemicals	63.3	62.5	62.3	5.9	6.2	5.7	13.2	14.0	14.4	10.0	9.6	9.4	2.4	2.3	2.5
Mechanical engineering	57.8	58.1	56.4	5.2	4.8	4.6	13.0	13.5	15.4	17.6	16.4	16.1	1.8	1.9	2.0
Automobiles	53.6	54.7	52.3	0.1	0.1	0.1	7.8	7.9	8.0	19.0	17.1	18.9	3.0	3.5	3.3
Aircraft and spacecraft	53.2	49.2	47.5	1.2	1.4	1.1	36.9	40.8	42.9	1.4	1.6	2.0	1.0	0.4	0.7
Information technology	38.9	41.3	41.1	0.6	0.6	0.5	19.7	21.1	21.8	26.3	23.1	20.9	8.2	6.6	7.5
Electrical engineering, n.e.c.	48.1	47.5	47.1	2.8	2.7	2.5	15.4	16.6	17.7	19.6	17.7	17.5	4.5	3.6	2.2
Measuring & control technol.	49.1	49.0	46.8	4.4	4.0	3.4	25.6	26.6	28.7	15.2	13.9	13.6	1.1	0.9	1.5
Photogr. & optic. products	41.2	42.1	44.8	2.1	2.3	2.2	12.7	13.4	13.9	38.5	36.0	33.0	3.0	2.9	2.7
Other R&D-intensive goods	49.0	48.4	50.6	1.9	2.0	2.1	28.3	29.3	26.1	10.2	9.5	10.0	0.9	1.0	1.2

* R&D intensity here relates to products and not to branches of industry. The group of R&D-intensive goods is divided into two categories: cutting-edge technology, where R&D expenditure accounts for at least 8.5% of turnover, and advanced technology, where R&D expenditure is between 3.5 and 8.5%.

1 Includes bioengineered chemical products and traditional chemical products for which the biotechnology field could provide substitutes.

Sources: OECD: Foreign Trade By Commodities. – Calculations of the Niedersächsisches Institut für Wirtschaftsforschung

Table 50a

Basic data on education

– Participation in education –

	in	1995	1996	1997	1998
1. Apprentices					
male	1000	951.2	958.7	974.4	994.1
female	1000	628.1	633.5	647.8	663.7
total	1000	**1579.3**	**192.2**	**1622.2**	**1657.8**
2. Persons qualified to enter higher education					
2.1 absolute					
male	1000	150.7	151.7	155.0	154.2
female	1000	157.1	163.6	168.5	172.9
total	1000	**307.8**	**315.3**	**323.5**	**327.1**
2.2 % of age group[1]	%	*35.9*	*36.0*	*36.8*	*36.2*
3. New entrants					
3.1 absolute					
male	1000	137.1	139.3	137.3	140.3
female	1000	125.3	128.2	130.1	132.2
total	1000	**262.4**	**267.5**	**267.4**	**272.5**
3.2 % of age group[2]	%	*30.4*	*30.6*	*30.0*	*30.7*
4. Students in higher education					
male	1000	1083.3	1054.7	1029.6	999.9
female	1000	774.6	783.4	794.5	801.3
total	1000	**1857.9**	**1838.1**	**1824.1**	**1801.2**
5. Examinations passed					
5.1 Diplom (university)					
male	1000	64.7	65.6	65.4	60.7
female	1000	41.0	43.0	44.0	42.4
total	1000	**105.7**	**108.6**	**109.4**	**103.1**
5.2 Teaching qualification					
male	1000	7.2	7.6	8.2	8.6
female	1000	19.6	20.1	19.7	19.7
total	1000	**26.7**	**27.7**	**27.9**	**28.3**
5.3 Diplom (Fachhochschule)					
male	1000	49.3	48.6	49.3	45.6
female	1000	25.8	26.3	26.3	25.7
total	1000	**75.1**	**74.9**	**75.6**	**71.3**
5.1 – 5.3 Total	1000	**207.5**	**211.2**	**212.9**	**202.7**
5.4 Doctor's degrees					
male	1000	15.3	15.7	19.4	16.7
female	1000	7.0	7.1	7.8	8.2
total	1000	**22.4**	**22.8**	**27.2**	**24.9**
5.5 Habilitation (university lecturer's qualification)					
male	Number	1321	1401	1467	1622
female	Number	211	208	273	293
total	Number	**1532**	**1609**	**1740**	**1915**

1 Per cent of the average age group of 18- to 21-year-olds.
2 Up to and including 1996 per cent of the average age group of 19- to 21-year-olds, from 1997 onwards of 19- to 25-year-olds.

Source: Basic and Structural Data 1999/2000, Federal Ministry of Education and Research

Rounding error

Table 50b

Basic data on education

– Expenditure on education –

	in	1995	1996	1997	1998
1. Expenditure on education by Federal Government, *Länder* and loc.government[1]					
Total	DM million	160 679	163 708	164 996	165 417
per capita	DM	1970	2001	2012	2017
of which:					
Federal Government	%	*3.5*	*3.4*	*3.2*	*3.1*
Länder	%	*75.3*	*75.9*	*76.3*	*76.8*
Local government	%	*21.1*	*20.7*	*20.5*	*20.1*
2. 2. Expenditure on education by Federal Government, *Länder* and local government by sector[1]					
Total	DM million	160 679	163 708	164 996	165 417
of which:					
Pre-school education[2]	DM million	15 980	16 439	16 974	16 776
Schools	DM million	85 588	86 956	87 349	87 194
Länder	DM million	67 571	69 450	70 190	70 333
Local government	DM million	18 015	17 505	17 158	16 860
Institutions of higher education[2]	DM million	47 296	48 547	49 168	50 030
Federal Government	DM million	2468	2397	2348	2340
Länder	DM million	44 828	46 150	46 820	47 690
Continuing education	DM million	4672	4853	4957	4819
Assistance schemes	DM million	7143	6913	6548	6598
3. Personnel expenditure					
Total	DM million	102 213	103 687	104 453	.
of which:					
Schools	DM million	64 053	65 390	65 917	.
Institutions of higher education	DM million	28 633	28 902	29 361	.

1 As defined in education budget (BLK concept, excluding joint research funding by the Federal Government and the *Länder*), net expenditure; actual figures up to and including 1997; 1998 (provisional) actual figures for Federal Government and *Länder*, estimates for local government and special-purpose associations.
2 Expenditure by the *Länder* Hamburg, Bremen and Berlin on kindergartens included only partly; from 1992 onwards some figures include crèches, after-school care centres and out-of-school youth education as defined by public finance statistics.
3 Including university hospitals, excluding DFG collaborative research centres.

Source: Basic and Structural Data 1999/2000, Federal Ministry of Education and Research

Rounding error

Table 51a

Reference data concerning population, labour force, etc.

– Regional structural data –

Indicator	in	1995	1996	1997	1998[3]
1. Population (annual average)					
Total	1000	81 661	81 896	82 052	82 029
2. Labour force (annual average)[2]					
Total	1000	34 860	34 423	33 962	33 970
3. Gross domestic product (GDP)[1]					
3.1 Current prices	DM billion	3523.0	3586.0	3666.6	3784.2
- increase on previous year	%	3.8	1.8	2.2	3.2
- per capita	DM	43 142	43 787	44 686.5	46 132
- per person in employment	DM	101 061	104 175	107 961.8	111 398
3.2 1995 prices	DM billion	3523.0	3549.6	3601.1	3678.6
- increase on previous year	%	1.7	0.8	1.5	2.2
4. Gross national income[1]					
(gross national product)					
Current prices	DM billion	3504.4	3570.1	3649.4	3754.1
- increase on previous year	%	3.7	1.9	2.2	2.9
5. Gross value added[1]					
Current prices	DM billion	3313.7	3374.2	3449.9	3553.7
- increase on previous year	%	3.9	1.8	2.2	3.0
- by economic activity					
Agriculture & forestry, fishing	DM billion	42.2	44.1	44.3	43.9
Manufacturing excluding construction	DM billion	837.8	842.3	861.6	903.4
Construction	DM billion	223.0	213.0	204.8	193.4
Wholesale & retail trade, hotels & restaurants,	DM billion	585.8	584.8	602.9	622.2
transport	DM billion	911.4	958.6	994.8	1035.0
Financial intermediation, renting and business activities	DM billion	713.6	731.4	741.5	755.9
Other community, social and personal service activities					
6. Price index					
Average cost of living index	1995=100	100.0	101.4	103.3	104.3
7. Foreign trade					
Imports	DM billion	664.2	690.4	772.1	814.0
- percentage of GDP	%	18.9	19.3	21.1	21.5
Exports	DM billion	749.5	788.9	888.6	950.1
- percentage of GDP	%	21.3	22.0	24.2	25.1
Foreign trade balance	DM billion	+85.3	+98.5	+116.5	+136.1

cont. Table 51a

Reference data concerning population, labour force, etc.

– Regional structural data –

Indicator	in	1995	1996	1997	1998[3]
8. Government expenditure					
Total[4]	DM billion	1199.2	1192.6	1182.2	1197.7
of which:					
- Federal Government[5]	*DM billion*	*484.6*	*489.2*	*477.2*	507.3
- Länder[5]	*DM billion*	*414.4*	*418.9*	*417.6*	419.0
- per capita	DM	14 685	14 562	14 408	14 601

1 In accordance with the European System of Accounts (ESA) 1995; for breakdown by *Land* see Table VII/51b.

2 Modified domestic concept.

3 Provisional.

4 Federal Government, equalisation fund, ERP, EU contributions, *Länder* (West and East Germany), local government (West and East Germany), German unification fund and debt processing fund. As defined by public finance statistics.

5 Excluding equalisation fund, ERP, EU contributions, German unification fund and debt processing fund.

6 Including public hospitals and special payments.

Source: Federal Statistical Office and calculations by the Federal Ministry of Education and Research

Rounding error

Table 51b

Reference data concerning population,

– Regional structural data –

Land	Population (annual average)					
	1995		1997		1998	
	1000	%	1000	%	1000	%
Baden-Württemberg	10 295	12.6	10 387	12.7	10 408	12.7
Bavaria	11 954	14.6	12 056	14.7	12 069	14.7
Berlin	3471	4.3	3445	4.2	3414	4.2
Brandenburg	2539	3.1	2563	3.1	2582	3.1
Bremen	680	0.8	676	0.8	671	0.8
Hamburg	1707	2.1	1707	2.1	1702	2.1
Hesse	5994	7.3	6031	7.4	6032	7.4
Mecklenburg-Western Pomerania	1828	2.2	1814	2.2	1803	2.2
Lower Saxony	7746	9.5	7831	9.5	7853	9.6
North Rhine-Westphalia	17 847	21.9	17 963	21.9	17 971	21.9
Rhineland-Palatinate	3963	4.9	4010	4.9	4020	4.9
Saarland	1084	1.3	1083	1.3	1077	1.3
Saxony	4575	5.6	4536	5.5	4506	5.5
Saxony-Anhalt	2750	3.4	2714	3.3	2690	3.3
Schleswig-Holstein	2717	3.3	2750	3.4	2761	3.4
Thuringia	2511	3.1	2485	3.0	2470	3.0
Total	**81 661**	**100.0**	**82 052**	**100.0**	**82 029**	**100.0**
of which:						
Former West Germany	66 156	81.0	66 647	81.2	66 697	81.3
New *Länder* including East Berlin	15 505	19.0	15 405	18.8	15 332	18.7

1 Modified domestic concept.

2 Figures in this table have not yet been converted to the European System of Accounts (ESA) 1995 and hence differ from those in other tables.

Source: Federal Statistical Office and calculations by the Federal Ministry of Education and Research.

labour force, etc.

– Regional structural data –

Labour force (annual average)[1]						Gross domestic product (nominal)[2]					
1995		1997		1998		1995		1997		1998	
1000	%	1000	%	1000	%	DM billion	%	DM billion	%	DM billion	%
4648	13.3	4568	13.5	4597	13.5	492	14.3	520	14.4	546	14.5
5490	15.7	5392	15.9	5388	15.9	576	16.7	615	17.0	643	17.1
1539	4.4	1450	4.3	1422	4.2	152	4.4	155	4.3	156	4.1
1062	3.0	1010	3.0	997	2.9	68	2.0	76	2.1	78	2.1
352	1.0	345	1.0	343	1.0	38	1.1	40	1.1	42	1.1
920	2.6	897	2.6	897	2.6	133	3.9	141	3.9	146	3.9
2620	7.5	2570	7.6	2570	7.6	327	9.5	341	9.4	353	9.4
758	2.2	722	2.1	713	2.1	45	1.3	48	1.3	48	1.3
3127	9.0	3053	9.0	3047	9.0	300	8.7	316	8.7	331	8.8
7257	20.8	7110	20.9	7159	21.1	768	22.3	800	22.1	827	22.0
1485	4.3	1466	4.3	1471	4.3	151	4.4	156	4.3	161	4.3
436	1.3	430	1.3	433	1.3	43	1.3	44	1.2	46	1.2
1946	5.6	1861	5.5	1866	5.5	115	3.4	124	3.4	125	3.3
1113	3.2	1042	3.1	1041	3.1	67	1.9	70	1.9	71	1.9
1087	3.1	1063	3.1	1054	3.1	107	3.1	114	3.1	117	3.1
1022	2.9	976	2.9	972	2.9	60	1.7	65	1.8	66	1.8
34 860	**100.0**	**33 962**	**100.0**	**33 970**	**100.0**	**3443**	**100.0**	**3624**	**100.0**	**3758**	**100.0**
28464	81.7	27 884	82.1	27 915	82.2	3050	88.6	3203	88.4	3329	88.6
6396	18.3	6078	17.9	6055	17.8	393	11.4	421	11.6	429	11.4

Rounding error

Index

N

O

P

Q

R

S

T

Abbreviations

AA	Auswärtiges Amt (Federal Foreign Office)
ABRIXAS	German satellite for X-ray astronomy
AI	Artificial Intelligence
AIDS	Acquired Immune Deficiency Syndrome
AiF	Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e.V. (German Federation of Industrial Co-operative Research Associations "Otto von Guericke"), Cologne
AIP	Astrophysikalisches Institut Potsdam
ARIANE 5/ATV	Automated Transfer Vehicle
ARL	Akademie für Raumforschung und Landesplanung, Hannover
ARTES-9	Navigation programme
ASKI	Arbeitskreis selbständiger Kulturinstitute (BMI) (Working Group of Independent Cultural Institutes)
ASMB	Arbeitsgruppen für Strukturelle Molekularbiologie (Research Units for Structural Molecular Biology) of the MPG at DESY
AST	Fraunhofer-Anwendungszentrum für Systemtechnik des Fraunhofer-Instituts für Informations- und Datenverarbeitung (Fraunhofer Application Centre for System Technology of the Fraunhofer Institute for Information and Data Processing IITB), Ilmenau
ATB	Institut für Agrartechnik Bornim (Institute of Agricultural Engineering), Potsdam-Bornim
ATI	Agentur für Technologietransfer und Innovationsförderung (Agency for Technology Transfer and Innovation Support)
ATU	Fraunhofer-Arbeitsgruppe für Toxikologie und Umweltmedizin (Fraunhofer Working Group on Toxicology and Environmental Medicine), Hamburg
AuT	Programm "Arbeit und Technik" (Work and Technology Programme)
AvH	Alexander von Humboldt-Stiftung (Alexander von Humboldt Foundation), Bonn
AVR	High-temperature test reactor at the Forschungszentrum Jülich GmbH
AWI	Stiftung Alfred-Wegener-Institut für Polar- und Meeresforschung (Alfred Wegener Institute for Polar and Marine Research), Bremerhaven
AWV	Arbeitsgemeinschaft für wirtschaftliche Verwaltung e.V. (Association for an Efficient Administration)
BAFF	Bundesanstalt für Fleischforschung (Federal Centre for Meat Research), Kulmbach
BAGKF	Bundesanstalt für Getreide-, Kartoffel- und Fettforschung (Federal Centre for Cereal, Potato and Lipid Research), Detmold
BAH	Biologische Anstalt Helgoland (Biological Institute on Helgoland), Hamburg
BAM	Bundesanstalt für Materialforschung und -prüfung (Federal Institute for Materials Research and Testing), Berlin
BafM	Bundesanstalt für Milchforschung (Federal Dairy Research Centre), Kiel
BASt	Bundesanstalt für Straßenwesen (Federal Road Research Institute), Bergisch-Gladbach
BAuA	Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (Federal Institute for Occupational Safety and Health), Dortmund
BAW	Bundesanstalt für Wasserbau (Federal Waterways Engineering and Research Institute), Karlsruhe
BAZ	Bundesanstalt für Züchtungsforschung an Kulturpflanzen (Federal Centre for Breeding Research on Cultivated Plants), Quedlinburg
BBA	Biologische Bundesanstalt für Land- und Forstwirtschaft (Federal Biological Research Centre for Agriculture and Forestry), Braunschweig
BBD	Bundesbaudirektion (Federal Building Office)
BBR	Bundesamt für Bauwesen und Raumordnung (Federal Office for Building and Regional Planning)
BESSY I	Berliner Elektronen-Speicherring für Synchrotronstrahlung
BESSY II	Hochbrillianz-Synchrotronstrahlungsquelle, Berlin-Adlershof
BFAFi	Bundesforschungsanstalt für Fischerei (Federal Research Centre for Fisheries), Hamburg
BfArM	Bundesinstitut für Arzneimittel und Medizinprodukte (Federal Institute for Drugs and Medical Devices), Berlin
BFAV	Bundesforschungsanstalt für Viruskrankheiten der Tiere (Federal Research Centre for Virus Diseases of Animals), Tübingen
BFE	Bundesforschungsanstalt für Ernährung (Federal Research Centre for Nutrition), Karlsruhe
BfG	Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology), Koblenz
BFH	Bundesforschungsanstalt für Forst- und Holzwirtschaft (Federal Research Centre for Forestry and Forest Products), Hamburg
BfLR	Bundesforschungsanstalt für Landeskunde und Raumordnung (Federal Research Institute for Regional Geography and Regional Planning), Bonn
BfN	Bundesamt für Naturschutz (Federal Agency for Nature Conservation), Bonn
BfS	Bundesamt für Strahlenschutz (Federal Office for Radiation Protection), Salzgitter
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources), Hannover
BgVV	Bundesinstitut für gesundheitlichen Verbraucherschutz und Veterinärmedizin (Federal Institute for Health Protection of Consumers and Veterinary Medicine), Berlin
BIB	Bundesinstitut für Bevölkerungsforschung (Federal Institute for Population Research), Wiesbaden
BIBB	Bundesinstitut für Berufsbildung (Federal Institute for Vocational Training), Bonn
BIOst	Bundesinstitut für ostwissenschaftliche und internationale Studien (Federal Institute for Russian, East European and International Studies), Cologne
BISp	Bundesinstitut für Sportwissenschaft (Federal Institute of Sports Science), Cologne
BJTU	Beteiligungskapital für junge Technologie-

	unternehmen (direct-investment capital for young technology-based companies)
BK	Bundeskanzleramt (Federal Chancellery)
BKG	Bundesamt für Kartographie und Geodäsie (Federal Agency for Cartography and Geodesy), Frankfurt/Main
BLE	Blaue-Liste-Einrichtungen (Blue List institutions)
BLK	Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung (Bund-Länder Commission for Educational Planning and Research Promotion), Bonn
BMA	Bundesministerium für Arbeit und Sozialordnung (Federal Ministry of Labour and Social Affairs)
BMBF	Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research)
BMF	Bundesministerium der Finanzen (Federal Ministry of Finance)
BMFSFJ	Bundesministerium für Familie, Senioren, Frauen und Jugend (Federal Ministry for Family Affairs, Senior Citizens, Women and Youth)
BMG	Bundesministerium für Gesundheit (Federal Ministry for Health)
BMI	Bundesministerium des Innern (Federal Ministry of the Interior)
BMJ	Bundesministerium der Justiz (Federal Ministry of Justice)
BML	Bundesministerium für Ernährung, Landwirtschaft und Forsten (Federal Ministry of Food, Agriculture and Forestry)
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
BMVBW	Bundesministerium für Verkehr, Bau- und Wohnungswesen (Federal Ministry of Transport, Building and Housing)
BMVg	Bundesministerium der Verteidigung (Federal Ministry of Defence)
BMWi	Bundesministerium für Wirtschaft und Technologie (Federal Ministry of Economics and Technology)
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (Federal Ministry for Economic Co-operation and Development)
BNI	Bernhard-Nocht-Institut für Tropenmedizin (Bernhard Nocht Institute for Tropical Medicine), Hamburg
BPA	Presse- und Informationsamt der Bundesregierung (Press and Information Office of the Federal Government)
BRH	Bundesrechnungshof (Federal Audit Office)
BSH	Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency of Germany), Hamburg
BTU	Beteiligungskapital für kleine Technologieunternehmen (direct-investment capital for small technology-based companies)
B-WiN	Breitband-Wissenschaftsnetz (broadband science network)
CAESAR	Centre of Advanced European Studies and Research
CCMS	Committee on the Challenges of Modern Society (NATO)
CCMWF	European Centre for Medium-range Weather Forecasts, Reading (UK)
CCOL	Co-ordination Committee on the Ozone Layer
CEO	Centres of Earth Observation
CERI	Centre for Educational Research and Innovation (OECD)
CERN	European Organisation for Nuclear Research/ European Laboratory for Particle Physics, Geneva
CERT	Committee on Energy Research and Technology
CFCs	Chlorofluorocarbons
CGIAR	Consultative Group on International Agricultural Research, Washington, D.C.
CICCP	Committee for Information, Computer and Communication Policy (OECD)
CIS	Commonwealth of Independent States
COF	Columbus Orbital Facility
CO2	Carbon dioxide
COSINE	Co-operation for Open Systems Interconnection Networking in Europe
COST	European Co-operation in the Field of Scientific and Technical Research, Brussels
COSY	Compaktsynchrotron (for X-ray lithography) at BESSY
CRD	Committee for Research and Development, Paris
CSD	United Nations Commission on Sustainable Development
CSTP	Committee for Scientific and Technological Policy (OECD)
DAAD	Deutscher Akademischer Austauschdienst e.V. (German Academic Exchange Service), Bonn
DAAK/GAAC	Stiftung Deutsch-Amerikanisches Akademisches Konzil (German-American Academic Council Foundation), Bonn
DAI	Deutsches Archäologisches Institut (German Archeological Institute), Berlin
DARA	Deutsche Agentur für Raumfahrtangelegenheiten GmbH (German Space Agency), Bonn
DASA	Daimler-Benz-Aerospace
DBI	Deutsches Bibliotheksinstitut, Berlin
DBM	Deutsches Bergbaumuseum, Bochum
DBU	Deutsche Bundesstiftung Umwelt (German Federal Foundation for the Environment), Osnabrück
DEKORP	Deutsches Kontinentales Reflexionsseismisches Programm (German Continental Reflection Seismic Programme)
DESY	Stiftung Deutsches Elektronen-Synchrotron, Hamburg
DFA	Deutsche Forschungsanstalt für Lebensmittelchemie (German Research Institute for Food Chemistry), Garching
DFG	Deutsche Forschungsgemeinschaft e.V., Bonn
DFI	Diabetes research institute at the Heinrich-Heine-Universität Düsseldorf
DFKI	Deutsches Forschungsinstitut für Künstliche Intelligenz (German Research Centre for Artificial Intelligence)
DFN	Deutsches Forschungsnetz (German Research Network)
DGD	Deutsche Gesellschaft für Dokumentation (now: DGI)
DGI	Deutsche Gesellschaft für Informationswissenschaft und Informationspraxis e.V. (Association for Information Science and Practice)
DGFI	Deutsches Geodätisches Forschungsinstitut, Frankfurt/Main
DGK	Deutsche Geodätische Kommission

DGFK	Deutsche Gesellschaft für Friedens- und Konfliktforschung e.V., Bonn
DHHS	US Department of Health and Human Services
DHI	Deutsches Hydrographisches Institut, Hamburg (now: BSH)
DHI	Deutsches Historisches Institut (German Historical Institute)
DHIA	Stiftung Deutsche Historische Institute im Ausland (Foundation German Historical Institutes Abroad)
DIE	Deutsches Institut für Entwicklungspolitik GmbH (German Development Institute), Berlin
DIE	Deutsches Institut für Erwachsenenbildung e.V. (German Institute for Adult Education), Frankfurt/Main
DIEF	Deutsches Institut für Ernährungsforschung (German Institute of Human Nutrition), Bergholz-Rehbrücke
DIfE	Deutsches Institut für Ernährungsforschung (German Institute of Human Nutrition), Potsdam-Rehbrücke
DIFF	Deutsches Institut für Fernstudienforschung (German Institute for Research into Distance Education), Tübingen University
DIJ	Deutsches Institut für Japanstudien (German Institute for Japanese Studies), Tokyo
DIMDI	Deutsches Institut für medizinische Dokumentation und Information (German Institute for Medical Documentation and Information), Cologne
DIPF	Deutsches Institut für Internationale Pädagogische Forschung (German Institute for International Educational Research), Frankfurt/Main
DIW	Deutsches Institut für Wirtschaftsforschung (German Institute of Economic Research), Berlin
DJI	Deutsches Jugendinstitut (German Youth Institute), Munich
DKFZ	Stiftung Deutsches Krebsforschungszentrum (German Cancer Research Centre), Heidelberg
DKRZ	Deutsches Klimarechenzentrum (German Climate Computing Centre), Hamburg
DLR	Deutsches Zentrum für Luft- und Raumfahrt e.V. (German Aerospace Centre), Cologne
DM	Deutsches Museum, Munich
DNW	Deutsch-Niederländischer Windkanal (German-Netherlands Wind Tunnel), Emmeloord (Netherlands)
DoE	US Department of Energy
DPG	Deutsche Physikalische Gesellschaft (German Physical Society)
DPZ	Deutsches Primatenzentrum GmbH (German Primate Centre), Göttingen
DRG	Defence Research Group (NATO)
DSM	Deutsches Schifffahrtsmuseum (German Maritime Museum), Bremerhaven
DSMZ	Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (German Collection of Microorganisms and Cell Cultures), Braunschweig
DÜI	Deutsches Überseeinstitut (German Overseas Institute), Hamburg
DWD	Deutscher Wetterdienst (German Meteorological Service), Offenbach
DYSMON	Dynamik in Sulfid- und Methanbiotopen der Ost- und Nordsee (dynamics in sulphide and methane biotopes in the Baltic Sea and the North Sea)
DZA	Deutsches Zentrum für Altersfragen (German Centre of Gerontology), Berlin
DZFA	Deutsches Zentrum für Alternsforschung (German Centre for Research on Ageing), Heidelberg
ECU	European Currency Unit
EMBC	European Molecular Biology Conference, Heidelberg
EMBL	European Molecular Biology Laboratory, Heidelberg
BMBO	European Molecular Biology Organisation, Heidelberg
EMI	Fraunhofer-Institut für Kurzzeitdynamik "Ernst-Mach-Institut" (Fraunhofer Institute for High Speed Dynamics), Freiburg
ERP	European Recovery Programme
ESA	European Space Agency, Paris
ESF	European Science Foundation
ESO	European Southern Observatory, Garching
ESOC	European Space Operations Centre, Darmstadt
ESRF	European Synchrotron Radiation Facility, Grenoble
ESRIN	European Space Resetitutearch Ins, Frascati (Italy)
ESRO	European Space Research Organisation
ESTEC	European Space Research and Technology Centre, Nordwijk (Netherlands)
ETW	Europäischer Transschall-Windkanal (European Transsonic Wind Tunnel), Köln-Porz
EU	European Union
EURATOM	European Atomic Energy Community, Brussels
EUREKA	Initiative for stronger technological co-operation in Europe
EUROHORCs	European Heads of Research Councils
EUROMAR	EUREKA project for the development and application of modern technologies in studying the ecological relations in the European seas
EUROMIR 95	Space mission
EURONET	European data transmission network
EUROTRAC	European experiment on the transport and transformation of environmentally relevant trace constituents in the troposphere over Europe
EUTELSAT	European Telecommunications Satellite Organisation
FAL	Bundesforschungsanstalt für Landwirtschaft (Federal Agricultural Research Centre), Braunschweig-Völkenrode
FBH	Ferdinand-Braun-Institut für Höchstfrequenztechnik, Berlin
FBN	Forschungsinstitut für die Biologie landwirtschaftlicher Nutztiere (Research Institute for the Biology of Farm Animals), Dummerstorf
FEL	Freie Elektronen Laser (Free Electron Laser)
FEP	Fraunhofer Institut für Elektronenstrahl- und Plasmatechnik (Fraunhofer Institute for Electron Beam and Plasma Technology), Dresden
FESTIP	Future European Space Transportation Investigation Programme
FGAN	Forschungsgesellschaft für Angewandte Naturwissenschaften (Research Establishment for Applied Science), Wachtberg-Werthoven
FH	Fachhochschule (university of applied sciences)
FhAZ	Fraunhofer-Anwendungszentrum (Fraunhofer Application Centre)

FhG	Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V. (Fraunhofer Society for the Advancement of Applied Research), Munich
FIS	Forschungsinstitut und Naturmuseum Senckenberg (Research Institute and Natural History Museum Senckenberg), Frankfurt/Main
FIS Bildung	Fachinformationssystem Bildung (specialised education information system)
FIZ-Chemie	Fachinformationszentrum Chemie GmbH (Chemistry Information Centre), Berlin
FIZ Ka	Fachinformationszentrum Karlsruhe (specialised information centre)
FKE	Forschungsinstitut für Kinderernährung (Research Institute of Child Nutrition), Dortmund
FMP	Forschungsinstitut für Molekulare Pharmakologie (Research Institute of Molecular Pharmacology), Berlin
FÖV	Forschungsinstitut für öffentliche Verwaltung bei der Hochschule für Verwaltungswissenschaften (Research Institute for Public Administration at the German University of Administrative Sciences), Speyer
FRM II	Forschungsreaktor in München (research reactor in Munich)
FS/RV	Forschungsschiff (research vessel)
FUB	Freie Universität Berlin
FUTOUR	Förderung und Unterstützung Technologieorientierter Unternehmensgründungen (Funding and Support for New Technology-based Companies)
FVB	Forschungsverbund Berlin e.V.
FZB	Forschungszentrum Borstel Zentrum für Medizin und Biowissenschaften, Borstel
FZJ	Forschungszentrum Jülich GmbH (Research Centre Jülich), Jülich
FZK	Forschungszentrum Karlsruhe GmbH Technik und Umwelt (Karlsruhe Research Centre Technology and Environment), Karlsruhe
FZR	Forschungszentrum Rossendorf (Research Centre Rossendorf)
FWG	Forschungsanstalt der Bundeswehr für Wasserschall und Geophysik (Bundeswehr Institute for Underwater Sound and Geophysical Research), Kiel
FZW	Forschungszentrum Waldökosysteme-Waldsterben (Forest Ecosystems Research Centre), Göttingen University
GACVS	German-American Center for Visiting Scholars
GALILEO	Name of the interplanetary space probe for the exploration of Jupiter
GBF	Gesellschaft für Biotechnologische Forschung mbH (National Research Centre for Biotechnology), Braunschweig
GDCh	Gesellschaft Deutscher Chemiker
GDP	Gross domestic product
GEOMAR	Forschungszentrum für marine Geowissenschaften (Research Centre for Marine Geosciences), Kiel
GERD	Gross domestic expenditure on R&D
GESIS	Gesellschaft Sozialwissenschaftlicher Infrastruktureinrichtungen e.V., Mannheim
GFZ	Stiftung GeoForschungsZentrum Potsdam, Potsdam
GGA	Institut für Geowissenschaftliche Gemeinschaftsaufgaben, Hannover
GIF	German-Israeli Foundation for Scientific Research and Development
GKSS	GKSS-Forschungszentrum Geesthacht GmbH (GKSS Research Centre Geesthacht), Geesthacht
GLONASS	Russian global satellite navigation system
GMD	GMD-Forschungszentrum Informationstechnik GmbH (GMD National Research Centre for Information Technology), St. Augustin
GNM	Germanisches Nationalmuseum, Nürnberg
GNP	Gross national product
GNSS	Global Navigation Satellite System
GOAP	Greifswalder Bodden und Oderästuar Austauschprozesse (exchange processes in the Greifswalder Bodden and Oder estuary)
GOOS	Global Ocean Observing System
GPS	Global Positioning System
GSF	GSF-Forschungszentrum für Umwelt und Gesundheit GmbH (GSF National Research Centre for Environment and Health), Neuherberg
GSI	Gesellschaft für Schwerionenforschung mbH, Darmstadt
G7 countries	USA, Japan, Canada, France, Italy, United Kingdom, Germany
HBFG	Hochschulbauförderungsgesetz (University Construction Act)
HDR	Superheated steam reactor
HELCOM	Helsinki Commission
HEP	Hochschulerneuerungsprogramm (Programme for the Renewal of Higher Education and Research in the New Länder)
HERA	Hadron-Elektron-Ringbeschleuniger-Anlage (Hadron-Electron Ring Accelerator) at DESY, Hamburg
HFSPO	Human Frontier Science Program Organisation
HGF	Hermann von Helmholtz-Gemeinschaft Deutscher Forschungszentren (Hermann von Helmholtz Association of National Research Centres)
HHI	Heinrich-Hertz-Institut für Nachrichtentechnik Berlin GmbH, Berlin
HI	Herder Institut e.V. (Herder Institute), Marburg
HIS	Hochschul-Informations-System GmbH (Higher Education Information System), Hannover
HLR	High-flux reactor of the ILL, Grenoble
HMI	Hahn-Meitner-Institut Berlin GmbH (Hahn Meitner Institute), Berlin
HPI	Heinrich-Pette-Institut für experimentelle Virologie und Immunologie (Heinrich Pette Institute for Experimental Virology and Immunology) at Hamburg University
HRG	Hochschulrahmengesetz (framework act for higher education)
HSP	Hochschulsonderprogramm (special funding programme for higher education and research)
HTR	High-temperature reactor
HWWA	Hamburgisches Welt-Wirtschafts-Archiv (Hamburg Institute of International Economics)
IAB	Institut für Arbeitsmarkt- und Berufsforschung der Bundesanstalt für Arbeit (Institute for Employment Research of the Federal Labour Office), Nürnberg
IAEA	International Atomic Energy Agency, Vienna

IAF	Fraunhofer-Institut für Angewandte Festkörperphysik (Fraunhofer Institute for Applied Solid State Physics), Freiburg
IAO	Fraunhofer-Institut für Arbeitswirtschaft und Organisation (Fraunhofer Institute for Industrial Engineering), Stuttgart
IAMO	Institut für Agrarentwicklung in Mittel- und Osteuropa (Institute of Agricultural Development in Central and Eastern Europe), Halle
IAP	Leibniz-Institut für Atmosphärenphysik (Leibniz Institute of Atmospheric Physics) at the University of Rostock, Kühlungsborn
IAP	Fraunhofer-Institut für Angewandte Polymerforschung (Fraunhofer Institute for Applied Polymer Research), Teltow
IASC	International Artic Science Committee
IBC	International Bioethics Committee (UNESCO)
IBIS	Electronic library information system
IBMT	Fraunhofer-Institut für Biomedizinische Technik (Fraunhofer Institute for Biomedical Engineering), St. Ingbert
IBP	Fraunhofer-Institut für Bauphysik (Fraunhofer Institute for Building Physics), Stuttgart
ICDP	International Continental Drilling Program
ICES	International Council for the Exploration of the Sea
ICSU	International Council for Science (formerly: International Council of Scientific Unions)
ICT	Fraunhofer-Institut für Chemische Technologie (Fraunhofer Institute for Chemical Technology), Pfinztal-Berghausen
IDS	Institut für Deutsche Sprache (Institute for the German Language), Mannheim
IDW	Informationsdienst Wissenschaft (science information service)
IEA	International Energy Agency, Paris (OECD)
IEMB	Institut für Erhaltung und Modernisierung von Bauwerken e.V. (Institute for Rehabilitation and Modernisation of Buildings), Berlin
IFA/IfADo	Institut für Arbeitsphysiologie an der Universität Dortmund (Institute for Occupational Physiology at the University of Dortmund)
IFAM	Fraunhofer-Institut für Fertigungstechnik und Materialforschung (Fraunhofer Institute for Manufacturing and Advanced Materials), Bremen
IfE	Institut für Erdöl- und Erdgasforschung, Clausthal-Zellerfeld
IFF	Fraunhofer-Institut für Fabrikbetrieb und -automatisierung (Fraunhofer Institute for Factory Operation and Automation), Magdeburg
IfG	Institutionen für industrielle Gemeinschaftsforschung und experimentelle Gemeinschaftsentwicklung (institutions for co-operative- industrial research and experimental development)
IFG	Institut für Frau und Gesellschaft
IfL	Institut für Länderkunde e.V. (Institute of Regional Geography), Leizpig
IfM	Institut für Meereskunde an der Universität Kiel (Institute of Marine Research at the University of Kiel)
IfM	Institut für Mittelstandsforschung
IfN	Leibniz-Institut für Neurobiologie (Leibniz Institute for Neurobiology), Magdeburg
Ifo	Ifo-Institut für Wirtschaftsforschung e.V. (Ifo Institute for Economic Research), Munich
IFT	Fraunhofer-Institut für Festkörpertechnologie (Fraunhofer Institute for Solid State Technology), Munich
IfT	Institut für Troposphärenforschung e.V. (Institute for Tropospheric Research), Leipzig
IFU	Fraunhofer-Institut für Atmosphärische Umweltforschung (Fraunhofer Institute for Atmospheric Environmental Research), Garmisch-Partenkirchen
IfW	Institut für Weltwirtschaft an der Universität Kiel (Kiel Institute of World Economics)
IFW	Institut für Festkörper- und Werkstoffforschung Dresden (Institute for Solid State and Materials Research Dresden)
IfZ	Institut für Zeitgeschichte (Institute of Contemporary History), Munich
IGB	Fraunhofer-Institut für Grenzflächen- und Bioverfahrenstechnik (Fraunhofer Institute for Interfacial Engineering and Biotechnology), Stuttgart
IGB	Institut für Gewässerökologie und Binnenfischerei (Institute of Freshwater Ecology and Inland Fisheries), Berlin
IGBP	International Geosphere-Biosphere Programme
IGCP	International Geological Correlation Programme (UNESCO)
IGD	Fraunhofer-Institut für Graphische Datenverarbeitung (Fraunhofer Institute for Computer Graphics Research), Darmstadt
IGZ	Institut für Gemüse- und Zierpflanzenbau (Institute of Vegetable and Ornamental Crops), Großbeeren/Erfurt
IHDP	International Human Dimensions Programme on Global Environmental Change
IHP	International Hydrological Programme (UNESCO)
IHP	Institut für Halbleiterphysik (Institute of Semiconductor Physics), Frankfurt/Oder
IIASA	Internationales Institut für Angewandte Systemanalyse (International Institute for Applied Systems Analysis), Laxenburg (Austria)
IIS	Fraunhofer-Institut für Integrierte Schaltungen (Fraunhofer Institute for Integrated Circuits), Erlangen
IITB	Fraunhofer-Institut für Informations- und Datenverarbeitung (Fraunhofer Institute for Information and Data Processing), Karlsruhe
IKTS	Fraunhofer-Institut für Keramische Technologien und Sinterwerkstoffe (Fraunhofer Institute for Ceramic Technologies and Sintered Materials), Dresden
IKZ	Institut für Kristallzüchtung (Institute of Crystal Growth), Berlin
ILL	Institute Max von Laue – Paul Langevin, Grenoble
ILT	Fraunhofer-Institut für Lasertechnik (Fraunhofer Institute for Laser Technology), Aachen
IMB	Institut für Molekulare Biotechnologie e.V. (Institute of Molecular Biotechnology), Jena
IML	Fraunhofer-Institut für Materialfluss und Logistik (Fraunhofer Institute for Material Flow and Logistics), Dortmund
IMS	Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Fraunhofer Institute for Microelectronic Circuits and Systems), Dresden

IMMS Forschungsinstitut für Mikroelektronik- und Mechatroniksysteme an der TU Ilmenau
INP Institut für Niedertemperaturplasmaphysik e.V., Greifswald
INSTI Innovationsstimulierung der deutschen Wirtschaft durch wissenschaftlich-technische Informationen (stimulating innovation in German industry by providing scientific and technical information)
INT Fraunhofer-Institut für Naturwissenschaftlich-Technische Trendanalysen (Fraunhofer Institute for Technological Trend Analysis), Euskirchen
INTAS International Association for the Promotion of Co-operation with Scientists from the Independent States of the Former Soviet Union, Brussels
IOC Intergovernmental Oceanographic Commission, Paris (UNESCO)
IODE International Oceanographic Data Exchange
IOF Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Fraunhofer Institute for Applied Optics and Precision Engineering), Jena
IÖR Institut für Ökologische Raumentwicklung e.V., Dresden
IOM Institut für Oberflächenmodifizierung e.V. (Institute for Surface Modification), Leipzig
IOW Institut für Ostseeforschung an der Universität Rostock (Baltic Sea Research Institute), Warnemünde
IPA Fraunhofer-Institut für Produktionstechnik und Automatisierung (Fraunhofer Institute for Manufacturing Engineering and Automation), Stuttgart
IPB Institut für Pflanzenbiochemie (Institute of Plant Biochemistry), Halle
IPCC Intergovernmental Panel on Climate Change
IPF Institut für Polymerforschung Dresden e.V. (Institute of Polymer Research Dresden)
IPHT Institut für Physikalische Hochtechnologie e.V. Jena (Institute for Physical High Technology Jena)
IPK Fraunhofer-Institut für Produktionsanlagen und Konstruktionstechnik (Fraunhofer Institute for Production Systems and Design Technology), Berlin
IPK Institut für Pflanzengenetik und Kulturpflanzenforschung Gatersleben (Institute for Plant Genetics and Crop Plant Research Gatersleben)
IPM Fraunhofer-Institut für Physikalische Messtechnik (Fraunhofer Institute for Physical Measurement Techniques), Freiburg
IPN Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel (Institute for Science Education at the University of Kiel)
IPP Max-Planck-Institut für Plasmaphysik (Max Planck Institute for Plasma Physics), Garching
IPT Fraunhofer-Institut für Produktionstechnologie (Fraunhofer Institute for Production Technology), Aachen
IRB Informationszentrum Raum und Bau (Fraunhofer Information Centre for Regional Planning and Building), Stuttgart
IRS Information Retrieval Service, Frascati (Italy)
IRS Institut für Regionalentwicklung und Strukturplanung e.V., Erkner
ISAS Institut für Spektrochemie und angewandte Spektroskopie (Institute of Spectrochemistry and Applied Spectroscopy), Dortmund
ISC Fraunhofer-Institut für Silicatforschung (Fraunhofer Institute for Silicate Research), Würzburg
ISDN Integrated Services Digital Network
ISE Fraunhofer-Institut für Solare Energiesysteme (Fraunhofer Institute for Solar Energy Systems), Freiburg
ISE Fraunhofer-Institut für Systemtechnik und Innovationsforschung (Fraunhofer Institute for Systems and Innovation Research), Karlsruhe
ISIT Fraunhofer-Institut für Siliziumtechnologie (Fraunhofer Institute for Silicon Technology), Itzehoe
ISL Deutsch-Französisches Forschungsinstitut Saint-Louis (France)
ISS Institut für Sozialarbeit und Sozialpädagogik (Institute for Social Work and Social Education), Frankfurt/Main
ISST Fraunhofer-Institut für Software- und Systemtechnik (Fraunhofer Institute for Software and Systems Engineering), Berlin
ISO International Organisation for Standardisation
IST Fraunhofer-Institut für Schicht- und Oberflächentechnik (Fraunhofer Institute for Thin Films and Surface Engineering), Braunschweig
ITA Fraunhofer-Institut für Toxikologie und Aerosolforschung (Fraunhofer Institute for Toxicology and Aerosol Research), Hannover
ITER International Thermonuclear Experimental Reactor
IUCT Fraunhofer-Institut für Umweltchemie und Ökotoxikologie (Fraunhofer Institute for Environmental Chemistry and Ecotoxicology), Schmallenberg/Grafschaft
IVBB Informationsverbund Berlin-Bonn (Intranet of the German Federal Government)
IVV Fraunhofer-Institut für Verfahrenstechnik und Verpackung (Fraunhofer Institute for Process Engineering and Packaging), Freising
IWC International Whaling Commission
IWF Institut für den Wissenschaftlichen Film (Institute for Scientific Film), Göttingen
IWH Institut für Wirtschaftsforschung Halle (Halle Institute for Economic Research)
IWM Fraunhofer-Institut für Werkstoffmechanik (Fraunhofer Institute for Mechanics of Materials), Freiburg
IWS Fraunhofer-Institut für Werkstoff- und Strahltechnik (Fraunhofer Institute for Material and Beam Technology), Dresden
IWTZ Internationales Wissenschafts- und Technologiezentrum (International Science and Technology Centre), Moscow
IWU Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik (Fraunhofer Institute for Machine Tools and Forming Technology), Chemnitz
IZFP Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Fraunhofer Institute for Non-Destructive Testing), Saarbrücken
IZM Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (Fraunhofer Institute for Reliability and Microintegration), Berlin
IZW Institut für Zoo- und Wildtierforschung (Institute for Zoo Biology and Wildlife Research), Berlin

JESSI	Joint European Submicron Silicon Initiative
JET	Joint European Torus, Culham (UK)
JRC	Joint Research Centre
KfW	Kreditanstalt für Wiederaufbau, Frankfurt/Main
KHI Florenz	Kunsthistorisches Institut Florenz (German Institute of Art History in Florence)
KIS	Kiepenheuer-Institut für Sonnenphysik, Freiburg
KoWi	Koordinierungsstelle EU der Wissenschaftsorganisationen, Brussels
KTB	Kontinentales Tiefbohrprogramm (German Continental Deep Drilling Programme)
LASER	Light Amplification by Stimulated Emission of Radiation
LBF	Fraunhofer-Institut für Betriebsfestigkeit (Fraunhofer Institute for Structural Durability), Darmstadt
LCD	Liquid crystal display
LEP	Large Electron-Positron Storage Ring
LEONARDO	Action programme for the implementation of a European Community vocational training policy
LHC	Large Hadron Collider
LWR	Light water reactor
MAB	Man and the Biosphere (Programme of UNESCO)
MBI	Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy), Berlin
MDC	Stiftung Max-Delbrück-Centrum für Molekulare Medizin (Max Delbrück Centre for Molecular Medicine), Berlin
MEDEA	Microelectronics Development for European Applications
MeDoc	Multimedia and electronic documents
MERMAID	Marine monitoring system
MINT	Multimedia communications with integrated networks and terminals
MIU	Medizinisches Institut für Umwelthygiene (Medical Institute of Environmental Hygiene), Heinrich-Heine-Universität Düsseldorf
MOMS	Modular optoelectronic multispectral scanner
MPG	Max-Planck-Gesellschaft zur Förderung der Wissenschaften e.V. (Max Planck Society for the Advancement of Science), Munich
MPI	Max Planck Institute
MSL-1	Material Science Laboratory
MZFR	Mehrzweckforschungsreaktor (Multi-purpose research reactor)
NAS	National Academy of Sciences, Washington D.C.
NASA	National Aeronautics and Space Administration (US)
NATO	North Atlantic Treaty Organisation, Brussels
NEA	Nuclear Energy Agency, Paris (OECD)
NEAFC	North East Atlantics Fisheries Committee
NKBF/NKFT	Nebenbestimmungen für Zuwendungen auf Kostenbasis des BMBF an Unternehmen der gewerblichen Wirtschaft für Forschungs- und Entwicklungsvorhaben (Auxiliary Terms and Conditions for Funds Provided by the Federal Ministry of Education and Research to Commercial Companies for Research and Development Projects on Cost Basis)
NLR	Nationaal Lucht- en Ruimtevaart-Laboratorium, Amsterdam
NRC	National Research Centre
ODP	Ocean Drilling Programme
OECD	Organisation for Economic Co-operation and Development, Paris
OI Beirut	Orient-Institut Beirut der Deutschen Morgenländischen Gesellschaft e.V. (Orient Institute Beirut of the German Oriental Society)
PDI	Paul-Drude-Institut für Festkörperelektronik, Berlin
PEI	Paul-Ehrlich-Institut – Bundesamt für Sera und Impfstoffe (Paul Ehrlich Institute – Federal Agency for Sera and Vaccines), Langen
PFO	Personalförderung Ost (R&D personnel funding in the new Länder)
PGI	General Information Programme (UNESCO)
PIK	Potsdam-Institut für Klimafolgenforschung (Potsdam Institute for Climate Impact Research)
PPGG7	Pilot programme for protecting the rain forests in Brazil
PROMETHEUS	Traffic guidance system (EUREKA)
PST	Fraunhofer Patentstelle für die Deutsche Forschung (Fraunhofer Patent Centre for German Research), Munich
PT	Projektträger (project management agency)
PTA	Personal Trip Assistant (smart card)
PTB	Physikalisch-Technische Bundesanstalt (Federal Institute of Physics and Metrology), Braunschweig
R&D	Research and Development
R&T	Research and Technology
RGZM	Römisch-Germanisches Zentralmuseum (Forschungsinstitut für Vor- und Frühgeschichte, Mainz)
RKI	Robert-Koch-Institut – Bundesinstitut für Infektionskrankheiten und nicht übertragbare Krankheiten (Robert Koch Institute – Federal Institute for Infectious and Non-communicable Diseases), Berlin
RKW	Rationalisierungs- und Innovationszentrum der Deutschen Wirtschaft e.V. (Rationalisation and Innovation Centre of German Industry), Eschborn
ROSAT	Röntgensatellit
RV	Research vessel
RWI	Rheinisch-Westfälisches Institut für Wirtschaftsforschung (Rhine-Westphalia Institute for Economic Research), Essen
SCAR	Scientific Committee on Antarctic Research, Cambridge (UK)
SCIAMACHY	Atmospheric research instrument
SHIFT	Studies on Human Impact on Forests and Floodplains in the Tropics, Brazil
SIMM	STN-Internet-Multimedia
SME	Small and medium-sized enterprises
SNA	System of National Accounts
SNR	Schneller natriumgekühlter Reaktor (sodium-cooled fast breeder reactor)
SOHO	Solar and Heliospheric Observatory
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOCRATES	European Community action programme for co-operation in the field of education
SRTM	Shuttle Radar Topographic Mapper
STA	Science and Technology Agency (Japan)
STN-Hosts	Scientific and Technical Information Network
STIFT	Stiftung für Technologie und Innovationsförderung Thüringen

STN	Scientific and Technical Network, Columbus/Ohio (USA)
SV	Stifterverband für die Deutsche Wissenschaft, Essen
SWP	Stiftung Wissenschaft und Politik, Berlin
TA	Technology Assessment
TAC	Technical Advisory Committee
tbg	Technologiebeteiligungsgesellschaft der Deutschen Ausgleichsbank
TEG	Fraunhofer Technologie-Entwicklungsgruppe (Fraunhofer Technology Development Group), Stuttgart
TEMPUS	Electromagnetic containerless processing facility (spacelab experiment)
THTR	Thorium high temperature reactor
TIB	Technische Informationsbibliothek, Hannover
TIB QUICK 2000	Technische Informationsbibliothek für Technik und Naturwissenschaften (electronic specialised information library for engineering and natural sciences), Hanover University
TOU	Technologieorientierte Unternehmensgründungen (new technology-based companies)
TRANSRAPID	Magnetic levitation train
TRUMP	Transport und Umsatzprozesse in der Pommerschen Bucht (transport and exchange processes in the Pommersche Bucht)
TTZ	Technologiespezifische und branchenorientierte Transferzentren (industry-specific or technology-specific transfer centres)
TÜBITAK	Scientific and Technical Research Council of Turkey
UBA	Umweltbundesamt (Federal Environmental Agency), Berlin
UFZ	UFZ-Umweltforschungszentrum Leipzig-Halle GmbH (UFZ Centre for Environmental Research Leipzig-Halle), Leipzig
UMPLIS	Informations- und Dokumentationssystem Umwelt (Environmental Information and Documentation System)
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation, Paris
UNILAC	Universal Linear Accelerator, Darmstadt
UNISIST	United Nations Scientific Information System (UNESCO)
UNITAR	United Nations Institute for Training and Research, New York
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UV	Ultraviolet rays
VEGAS	Versuchseinrichtung zur Grundwasser- und Altlasten-sanierung (research facility for groundwater and contaminated soil rehabilitation), Stuttgart University
VERBMOBIL	Project developing a mobile system for the translation of spontaneous speech
VIK	Vereinigtes Institut für Kernforschung (Joint Institute for Nuclear Research), Dubna (Russia)
VLT	Very Large Telescope
WAK	Wiederaufbereitungsanlage Karlsruhe (Karlsruhe Reprocessing Plant)
WCRP	World Climate Research Programme
WGL	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz (Gottfried Wilhelm Leibniz Science Association)
WHF	Follow-up to HSP III
WHO	World Health Organisation, Geneva
WIAS	Weierstraß-Institut für Angewandte Analysis und Stochastik (Weierstraß Institute for Applied Analysis and Stochastics), Berlin
WIK	Wissenschaftliches Institut für Kommunikations-dienste GmbH, Bad Honnef
WIP	Wissenschaftler-Integrations-Programm (Scientist Integration Programme)
WIS	Wehrwissenschaftliches Institut für Schutztech-nologien – ABC-Schutz (Bundeswehr Research Institute for Protective Technologies and NBC Protection), Münster
WIWEB	Wehrwissenschaftliches Institut für Werk-, Explosiv- und Betriebsstoffe (Bundeswehr Research Institute for Materials, Explosives and Petroleum, Oils and Lubricants), Erding
WKI	Fraunhofer-Institut für Holzforschung “Wilhelm-Klauditz-Institut” (Fraunhofer Institute for Wood Research), Braunschweig
WMO	World Meteorological Organisation, Geneva
WOCE	World Ocean Circulation Experiment
WSV	Wasser- und Schifffahrtsverwaltung (Waterways and Shipping Administration)
WTZ	Wissenschaftlich-technische Zusammenarbeit (scientific and technical co-operation)
WZB	Wissenschaftszentrum Berlin für Sozialforschung (Social Science Research Centre Berlin)
ZADI	Zentralstelle für Agrardokumentation und -information (German Centre for Documentation and Information in Agriculture), Bonn
ZALF	Zentrum für Agrarlandschafts- und Landnutzungs-forschung (Centre for Agricultural Landscape and Land Use Research), Müncheberg
ZBL	Deutsche Zentralbibliothek für Landbauwissen-schaften (Central Agricultural Library of Germany), Bonn
ZBM	Deutsche Zentralbibliothek für Medizin (German National Library of Medicine), Cologne
ZBW	Deutsche Zentralbibliothek für Wirtschaftswissen-schaften (German National Library for Economics), Kiel
ZFMK	Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn
ZFO	Zuwachsförderung Ost (funding for additional R&D personnel in East Germany)
ZMT	Zentrum für marine Tropenökologie (Centre for Tropical Marine Ecology), Bremen University
ZPID	Zentralstelle für Psychologische Information und Dokumentation (Institute for Psychology Information), Trier University
ZUMA	Zentrum für Umfragen, Methoden und Analysen (Centre for Survey Research and Methodology), Mannheim

Charts

Research for Shaping the Future

Part I

Part II

Part III

Part IV

Tables