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-Scientific-technical foundation for a national waste prevention programme -

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**Substantive implementation of Article
29 of Directive 2008/98/EC
-scientific-technical foundation for a
national waste prevention programme -**

by

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Abstract

Based on the European Waste Framework Directive and the German Recycling Management Act of 01.06.2012 the objectives for a national waste prevention programme were defined. As main objective, according to art. 1 WFD, the "prevention or reduction of the disadvantageous impacts of waste generation and management on the human health and the environment" is recommended.

Indicators for a quantitative and qualitative monitoring are derived for both, the individual measures as well as for a waste prevention programme.

The almost 300 measures on waste prevention by the public authorities from the collection of examples of the previous project are initially evaluated and consolidated.

Along the life-cycle stages raw material extraction, product design, logistics, trade, purchase, utilisation and waste disposal, they are systematically classified.

The waste prevention potential and the ecological impacts of selected individual measures are evaluated for orientation.

The essential effects are gained through prevention of environmental pollution in the "prevented" production expenditures, e.g. through the intensified use and prolonged life span of products. Part of this is as well the promotion of a second hand market in order to reuse goods. Economic and social impacts are described selectively.

Based on the evaluation, suitable waste prevention measures are suggested for the national waste prevention programme.

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List of Abbreviations

BMVEL	Federal Ministry for Nutrition, Agriculture and Consumer Protection
BMWi	Federal Ministry for Economics and Technology
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
B2B	Business-to-business
BAM	Bundesanstalt für Materialforschung und -prüfung / Federal Institute for Materials Research and Testing
BAuA	Bundesanstalt für Arbeitsschutz und Arbeitsmedizin/ Federal Institute for Occupational Safety and Health
BBP	Benzyl Butyl Phthalat
BfC	Bundesstelle für Chemikalien / Federal Department for Chemicals
BfR	Bundesinstitut fuer Risikobewertung / Federal Institute for Risk Assessment
BImSchG	Bundesimmissionsschutzgesetz/Federal Pollution Control Act
BSchAmt	Beschaffungsamt / Procurement Office
BSR	Berlin City Cleaning Service
BVT	Best Available Techniques (kommt nur in den Quellen vor)
CRD	cumulative raw material demand
CRT screen	Cathode Ray Tube screen
CMR	carcinogenic, mutagen, toxic for reproduction
DBP	Dibutyl Phthalat
DEHP	(Bis(2-Ethylhexyl)) Phthalat
CED	Cumulative Energy Demand
Demea	German material efficiency agency
DIBP	Diisobutyl Phthalat
DVWK	(before 2004) Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall / German Association for Water, Wastewater and Waste
EAR	waste electrical and electronic register
ECHA	European Chemicals Agency
EFA	efficiency agency (North Rhine-Westphalia)
EffNet	efficiency network Rhineland-Palatinate
Eionet	European Environment Information and Observation Network
ElektroG	German Electrical Equipment Act
EMAS	Eco-Management and Audit Scheme

EPA	Environmental Protection Agency
Fsc	Forest Stewardship Council
GWP	Global Warming Potential
IED	Industrial Plants Emission Directive
IVM	Institute for Environmental Studies
KrWG	Kreislaufwirtschaftsgesetz / German Act for Recycling Management
KrW-/AbfG	German Act for Promoting Closed Substance Cycle and Waste Management
LAGA	Working Group on Waste Management of the Federal States (Länder) and the Federation (Bund)
LAI	Working Group on Immission Control of the Federal States (Länder) and the Federation (Bund)
LAWA	Working Group on Water Management of the Federal States (Länder) and the Federation (Bund)
LEH	Food Retail
MARESS	Projekt „Materialeffizienz und Ressourcenschonung“ (Material efficiency and resource conservation)
MEErP	Methodology for the Ecodesign of Energy-related Products
MIT	material input tax
MOAH	mineral oil aromatic hydrocarbons
MOSH	mineral oil saturated hydrocarbons
MVwV	sample administration regulations
NaCl	sodium chloride
PAH	polycyclic aromatic hydrocarbon
PBT	persistent, bio accumulative and toxic properties
PET	Polyethylenterephthalat
ProgRess	German Resource Efficiency Programme
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RKR	resource cost accounting
RoHS	Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment
SME	small and medium enterprises
SimaPro	Software Tool for calculation of „life-cycle assessment“
SRU	Sachverständigenrat für Umweltfragen / German Advisory Council on the Environment
SVHC	substances of very high concern

TMR	Total Material Requirement
UBA	Umweltbundesamt / German Federal Environment Agency
UIP	Environment Innovation Programme
UMS	Umwelt-Monitoring Systeme / Environmental Monitoring
VDP	Verband Deutscher Papierfabriken / Association of German Paper Factories)
VOC	volatile organic compound[s]
WEEE	Waste Electrical and Electronic Equipment
WFD	Waste Framework Directive
WPP	Waste Prevention Programme
ZIM	Zentrales Innovationsprogramm Mittelstand / Central Innovation Programme for SMEs

1 Introduction

The EU Waste Framework Directive (WFD) 2008/98/EC calls upon the Member States to step up efforts to prevent and recycle waste in accordance with the new 5-tier waste management hierarchy. Art. 29 WFD obliges the Member States to establish waste prevention programmes. In Germany, the amended Recycling Management Act (Art 33, Para 1, Sentence 1) stipulates that the "Federation" is to establish by 2013 a waste prevention programme which, in accordance with Art 33 Para 3 of the Act,

- establishes waste prevention objectives,
- sets out waste prevention measures and assesses the usefulness of the measures listed in Annex 4 or other appropriate waste prevention measures,
- establishes further waste prevention measures as required, and
- determines appropriate, specific quantitative or qualitative benchmarks for waste prevention measures adopted, by which to monitor and assess the progress achieved.

As a basis for the German national Waste Prevention Programme, a precursor project, the UBA research project "Development of scientific and technical foundations for a national waste prevention programme" (FKZ 3709 32 341 1) carried out by the Öko-Institut and the Wuppertal Institute, compiled and demonstrated numerous waste prevention measures of the public sector in Germany and abroad.

The aim of the present research project aims to build on the precursor project by establishing fundamentals for a waste prevention programme involving the participation of the *Länder* (Federal states) of the Federal Republic of Germany and the affected public. To this end, the goals of the waste prevention programme are discussed and indicators by which to monitor such goals are formulated. Representative measures established by the precursor project (Dehoust et al. 2010) are consolidated and are placed in relation to the life-cycle stages of products. Proceeding from these examples of measures, the measures coming into question for the programme are selected, characterised and assessed.

2 Objectives/Targets

2.1 Objectives of waste reduction after WFD¹

2.1.1 Principal objectives

According to Art. 29 and Recital 40 of the WFD the Member States are obliged to devise waste prevention programmes (cf. Art 33 German Waste Management Act). When elaborating waste prevention programmes they are meant to concentrate “on the key environmental impacts and take into account the whole life-cycle of materials and products. Such measures should pursue the objective of breaking the link between economic growth and the environmental impacts associated with the generation of waste”.

Waste prevention measures in the waste prevention programme are to be orientated towards the requirements of Recital 6 and Article 1 of WFD where measures are defined to "protect the environment and human health, by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving the efficiency of such use".

2.1.2 Secondary objectives

Numerous secondary objectives relating to waste prevention that support alignment of the principal objectives are formulated in the WFD.

2.1.2.1 Substantiation of the secondary objectives with regard to waste reduction

Art 3 Para 12 WFD defines ‘prevention’ as "measures taken before a substance, material or product has become waste", which reduce:

- a) the quantity of waste, including the reuse of products or the extension of the life span of products,
- b) the adverse impacts of the generated waste on the environment and human health, or
- c) the content of harmful substances in materials and products.”

The following qualitative and quantitative goals in support of attainment of the principal objectives can therefore be formulated:

1. Reduction of the quantity of waste
2. Reduction of the adverse impacts of wastes
3. Reduction of the content of harmful substances in products and wastes

To support the sub-objective of “reducing waste quantities” the measures of “prolonging the lifespan of a product” and “promoting reuse” have been identified.

¹ To the greater part the study was carried out before the Recycling Management Act of 24.02. 2012 (BGBl. I S. 212)) was adopted. Therefore this study refers in essence on the amended Waste Framework Directive (D 2008/98/EC) which was implemented in form of the Waste Management Act. Since 1. June 2012 the Waste Management Act is the general legal basis in Germany.

These secondary objectives do not represent an end in themselves; rather it is assumed that their implementation will support the main objective under normal conditions, i.e. to reduce the adverse impacts of waste generation and management on human health and on the environment. They are subject to the proviso that they provide the best results as regards environment protection as far as the overall impact of waste generation and management is concerned, given that life cycle regards are taken into account (cf. article 4 no. 2 of WFD). Thus in certain cases these secondary objectives can be disregarded, if the prevention alternatives provide worse results on a global level and with regard to life-cycle thinking from the perspective of protecting the environment.

2.1.2.2 Purpose and objectives of a waste prevention programme

A sub-objective of waste prevention remains the increase in efficiency and quality of production and the decrease of environmental impacts linked to the generation of waste.

Beside, this sub-objective introduces a relativisation of the target of decreasing the waste quantity and environmental impacts related to waste generation, which do not necessarily have to be achieved absolutely, but rather should be put into relation with economic growth.

As no specific environmental impacts are mentioned, article 13 is used as a point of reference to make the decision of which environmental impacts should in fact be analysed. Hence this project's task is to identify the most important environmental impacts of waste generation and management that are to be reduced through waste prevention. Article 13 of WFD serves as a guideline:

“Member States shall take the necessary measures to ensure that waste management is carried out without endangering human health, without harming the environment and, in particular:

- a) without risk to water, air, soil, plants or animals;
- b) without causing a nuisance through noise or odours; and
- c) without adversely affecting the countryside or places of special interest.”

2.2 Partitioning into target levels along the supply chain

According to Article 29 Para. 3 of WFD, part of the waste prevention programme should be the evaluation of existing prevention measures as well as an evaluation of their usefulness. In the context of this study, the evaluation occurs along the entire supply chain. The assignment of objectives, targets, means and measures to the individual life-cycle steps, allows the investigation of which measures support each other, in which fields measures are possibly missing, and how, overall, the most effective interaction can be reached (chain approach).

Therefore target levels are defined along the supply chain of products to allow the structuring of measures, means, and targets. The whole life-cycle is considered, from the supply of raw materials up to the treatment of waste. Hereby the fields of production and products are to be differentiated. In the transition zone the factor of distribution must also be considered.

The main objective of the programme is to reduce impacts of waste on the environment and on humans along the entire supply chain (target level I). Ways to achieve this are in particular the reduction of waste quantities and pollutant levels in waste and products (that are destined to become waste in time). These aspects are covered in particular by target level II.

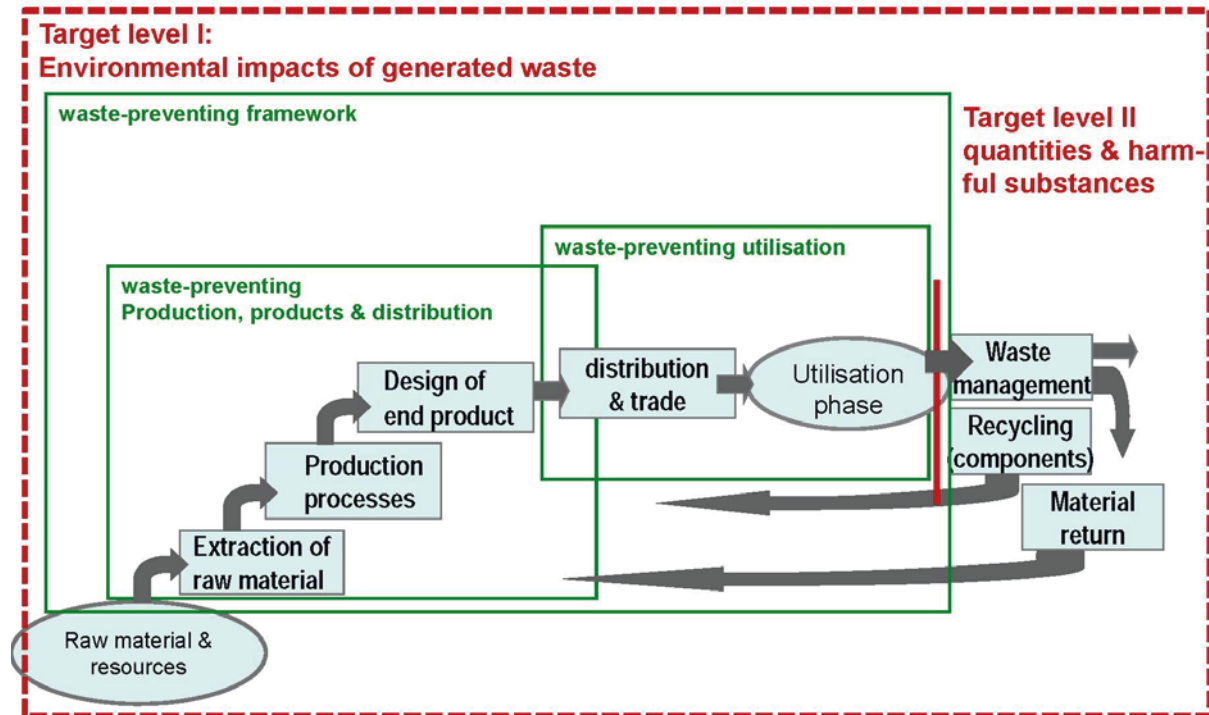


Figure 2-1: Target levels and measure areas along life-cycle stages of products (for improved clarity, waste generation does not figure within the production chain!)

In order to achieve these objectives, measures should be addressed along the whole life-cycle.

Points of leverage for waste prevention can be differentiated after the structure of the exemplary measure classification in Annex IV of WFD:

- Measures that influence the framework conditions,
- Measures that take effect on the fields of production and distribution,
- Measures that influence the acquisition/procurement and use of products.

2.3 Targets

2.3.1 Targets according to WFD

The introduction of targets in order to meet the objectives of measures for waste prevention and management occurred already with the introduction of Decision No. 1600/2002/EC of the European Parliament and Council of the 22. July 2002 within the Sixth Community Environment Action programme (cf. Recital 2 of the WFD). Art. 29 Para.2 WFD defines the objective of decoupling economic growth from the environmental impacts associated with the generation of waste. According to Art.29 Para. 3 WFD the Member States are to devise

useful, specifically qualitative or quantitative indicators for adopted waste prevention measures, which permit the monitoring and evaluation of the improvements reached through the latter. The Member States are thus not obliged to formulate quantitative objectives.

2.3.2 Quantitative objectives

Quantitative targets are favourable on the level of a national waste prevention programme, above all due to the binding character of the programme and the improved communication of quantitative objectives to the public. Possible means are specifically quantified requirements for a reduction in waste intensities, which are described by relating waste quantities to economic performance (in the form of e.g. price-adjusted GDP), population size, number of employees, or similar such (cf. e.g. to Destatis 2007).

However, specific quantitative targets can be objectively deduced only in individual cases. Suitable indicators permitting the monitoring of compliance and being able to be allocated clearly to the individual waste prevention measures or to the entire programme are lacking. Therefore quantitative targets for waste prevention on the national level cannot be derived from the technical point of view. The use of such targets and their degree of fulfilment for an international comparison of the effectiveness of waste prevention programmes is thus not possible (cf. Article 37 Nr 4 WFD).

A precondition for this would be a detailed definition of factual prevention potentials on all levels of waste generation, deduced from the respective theoretical potentials and the exact status of the currently already implemented measures. Existing data does not permit the definition of entry requirements, i.e. of a starting position for the waste prevention programme in a sufficiently exact way.

Even an approximate completion of quantitative targets cannot causally be brought in relation to a waste prevention programme and its individual measures, due to the complex influences on the development of waste quantities. This is because a reduction in waste quantities and prevention successes are influenced not only by measures of the waste prevention programme but also by the following factors:

- Changes in the general economic conditions, and
- Measures that are performed independently from the waste prevention programme.

Therefore the scope of this study on the scientific preparation of a national waste prevention programme only defines qualitative targets. In the context of the political discussion about details on the configuration of the programme it must be decided whether specific objectives can be defined and whether, building on that, the definition of quantitative objectives should occur within the programme.

2.3.3 Qualitative targets for the waste prevention programme

The objectives for the waste prevention programme described in chapter 2.1 and 2.3 and the waste prevention measures named therein cannot in sum be reached by all measures, since the objectives can contradict, depending on the individual case. Therefore the applicability of objectives must be checked for each measure.

The sum of individual measures is supposed to make the waste prevention programme reach the requirements of the principal objectives.

Each individual measure must fulfil at least one of the targets. Normally the secondary objectives and the associated requirements will complement each other.

All measures must follow the targets whilst taking into account the principles of the WFD. Above all, the measures have to support and promote the achievement of the principal objectives.

Main objective

Art. 1 WFD: “To protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste”.

Targets that result from this statement and are relevant within the framework of this study are:

- reduction of the disadvantageous impacts of waste generation and management on human health and on the environment in relation to economic performance, number of employees, and population size;
- reduction of the adverse impacts of waste generation and management on human health and on the environment in general;
- improvement of the information available to the public and to the actors in industry, commerce, trade, and waste disposal companies, about the adverse impacts of waste generation and management on human health and on the environment;
- improvement of the information available to the public and to the stakeholders in industry, commerce, trade, and waste disposal companies, about measures to reduce the adverse impacts of waste generation and management on human health and on the environment;
- increasing the sensitisation of the population and stakeholders in industry, commerce, trade, and waste disposal companies to measures for the reduction of the disadvantageous impacts of waste generation and management on human health and on the environment.

Sub-objectives after Art.3 WFD:

1. “Reducing the quantity of waste”
2. “Reducing harmful impacts of waste”
3. “Reducing harmful substances in waste”

Objectives that be derived from the above in the context of this study:

- improvement of the information available to the population and to stakeholders in industry, commerce, trade, and waste disposal companies, about the necessity to reduce the quantity of waste;
- reduction of the quantity of waste in relation to the economic performance, the number of employees and population size;

- reduction of overall quantities of waste;
- increasing the lifespan of products;
- increasing the utilization intensity of products;
- reducing pollutant levels in materials, products and waste;
- reduction of emissions into the air, water, and soil that relate to the generation and management of waste;
- reduction of the impact on human health that results from the generation and management of waste;
- improving the information available to the population and to stakeholders in industry, commerce, trade, and waste disposal companies, about the necessity and measures for the reduction of waste quantities, pollutant levels in materials, products and waste, as well as of emissions to the air, water and soil in connection with the generation and management of waste;
- increasing the sensitisation of the population and stakeholders in industry, commerce, trade, and waste disposal companies about measures to reduce waste quantities, pollutant levels in materials, products and waste, as well as to reduce emissions to the air, water, and soil in connection to the generation and management of waste.

3 Indicators for waste prevention

3.1 Procedure

The “identification and/or development of appropriate indicators/benchmarks for the evaluation of the measures and to monitor the prevention successes”² involves the steps of an in-depth research and analysis, an analysis of data availability, and the determination of indicators. All steps occur in an iterative way in an interaction with the development of the dimensions of the objectives and of the measures of the waste prevention programme.

For this reason existing approaches in the European context are presented and their different procedures described, following a brief characterisation of methodological challenges in the development of indicators for waste prevention measures on the basis of results of phase 1 (compare Dehoust et al. 2010). This should enable compatibility between the method used in the German waste prevention programme and the European level. Subsequently the structure of the indicator system is deduced, based on the waste prevention objectives developed in the project.

3.2 Target dimensions of an indicator system for waste reduction

According to Article 29 Para.3 WFD, the Member States are to specify functional, specifically qualitative or quantitative standards for adopted waste prevention measures, which would allow the monitoring of improvements made via the national waste prevention programmes. The introduction of targets to aid the pursuit of fulfilling the measure objectives in waste management already occurs according to the Decision No. 1600/2002/EC of the European Parliament and Council of the 22. July 2002 on the Sixth Community Environment Action programme (cf. Recital 2 WFD). To reach the objective of a “high level of resource efficiency, targets for preparing for reuse and recycling of waste should be set” (Recital 41 and Article 11 Para. 2 WFD). According to Article 29 Para. 3 WFD it is left to the Member States to decide, whether they want to use qualitative or quantitative standards to monitor the achievement of objectives (cf. chapter Quantitative objectives).

Indicators can serve a second important function, besides monitoring certain measures: Given the vast number of identified measures the public authorities could implement to prevent waste, and as there are limited financial resources, but also limited organising capacities, a means of selection and prioritisations is necessary. Indicators for waste prevention allow the comparison of the efficiency of different measures and thus provide, via the consideration of different scenarios, a foundation for the compilation of a national waste prevention programme. In the context of environmental programmes, indicators offer the possibility to portray effects and changes in complex systems. They provide the foundation for the evaluation of existing measures through monitoring and planned projects by means of the analysis of scenarios. Further they allow the verification of whether set objectives have been met and facilitate the dialogue with politics and the public (in Annex IV, no.3 this indicator function is actually presented as an independent waste prevention measure). They provide the comparison between different regions or towns and

² Translated from the German original

can thus motivate stakeholders on the ground to invest more time; effort and responsibility into set objectives (cf. OECD 2002).

3.3 Methodological challenges

When developing indicator systems for waste prevention it must be taken into account that they can correspond to completely different objectives (cf. Bel 2010, p. 5):

- to verify the adherence to defined objectives
- to determine the efficiency of a specific individual measure
- to be able to compare individual measures amongst each other
- ...

Depending on the function, one can differentiate between a purely descriptive indicator, a performance-indicator (in relation to specifically set objectives), an efficiency-indicator (generally a specific environmental burden per unit waste or product) or an effectiveness-indicator (evaluating the effectiveness of individual instruments).

The inventory of waste prevention measures in phase 1 showed that a main characteristic is their heterogeneity: the measures encompass completely different instrument types (regulatory, economic initiatives, informing), they are initiated by completely different stakeholders having specific resources and possibilities of influence respectively (government agencies, companies and their associations, NGOs etc.), and that target different points in the life-cycle (design, production, use, reuse).

At the European level there is the additional problem of considerable differences in data collection for waste management statistics: “There is no common terminology for waste management observation between the different countries” (Bel 2010, p.7). An important problem in waste prevention is the desire to measure something that cannot be measured directly: “The problem is simply expressed – how do you measure something that isn’t there?” (Sharp et al. 2010). Statements on the success of a specific waste prevention measure thus always require assumptions on the quantity of waste that would have been generated without this measure. The existing approaches thus are subject to a set of systematic problems (cf. bifa 2004):

- Existing indicators are generally barely comparable. Whereas qualitative statements on the composition of waste can indicate a prevention of environmental pollution, e.g. through a demonstrated decrease in its hazardousness, the overall burden can nevertheless increase through an increase in waste quantities, which is also true vice versa.
- Indicators for waste prevention are always confronted with the problem that the effects of a measure commence with different time lags, because, on the one hand, different product groups have different lifespan, and on the other hand, even within individual product groups, devices can have varying durability (cf. Gößling-Reise-mann et al. 2009).
- Because waste prevention is often associated to complex consumption patterns, cultural changes also play a role that cannot be revealed by indicators that are purely

related to waste. This factor must be taken into account especially when making international comparisons of measures and of the possibility of their transferability.

3.4 Criteria for the development of indicators

Altogether, it must be kept in mind, that the use of indicators is an attempt to make an objective comparison of complex circumstances. Thereby however, it must be considered that already when indicators are created, a compromise is being made between different objectives, e.g. between detail and survey-ability, between complexity and communication or between different demands of the individual target groups of the indicator.

Because the use of indicator systems always also has a subjective component, it is even more important to use transparent quality standards when developing indicators. The German Advisory Council on the Environment has developed the following criteria for the quality of indicators, which are also relevant for the subject of waste prevention (SRU 2002):

- consistency - the indicator must be suited to the subject/aim of the measure, the method of the inquiry must be coherent;
- representability - the indicator should be able to mirror developments in the subject matter accurately;
- liability - the indicator must be configured so that important stakeholders can come to a consensus on its relevance in the long term;
- international comparability - the indicator should be made compatible with other systems abroad and thus also allow international benchmarks;
- measure prioritisation – the indicator must deliver information to political actors on where the greatest environmental relief can be achieved, given limited means.

Further requirements to indicators are amongst others things the criteria of the (operational) feasibility of indicators as well as their reliability (cf. ETC SCP 2010).

The guidelines of the European Commission allude to the particular problem of data availability in the field of waste prevention: Because waste management statistics fundamentally deal with the treatment and the fate of waste, they are often of limited value for the generation and prevention of waste. Thus further quality characteristics that are mentioned are (Arcadis 2010):

- availability of sufficiently robust data or information, in order to be able to deduce indicators;
- compatibility with indicator sets of the EU and other waste indicators³.

3.5 Indicator systems on the European level

Indicators and benchmarks for waste prevention are an internationally intensely discussed subject (cf. BIOS 2009, OECD 2000). A multitude of models have been developed on different levels, which differ considerably in their key focus, addressees and in their extent. In the

³

In order to coordinate waste prevention indicators on the EU-level, contacts of the contractors of the European Topic Center on Sustainable Consumption and Production as well as in the framework of the European Environment Information and Observation Network (Eionet) were i.a. used.

following section, four approaches are to be illustrated, that target mainly the national or at least regional level and that therefore, compared to a number of municipal indicator systems, present a higher level of abstraction. Furthermore, all of the four approaches refer explicitly to the development of national waste prevention programmes according to WFD.

3.5.1 Guidelines for waste prevention

The “Guidelines on Waste Prevention” (cf. Arcadis et al. 2011) developed as an assignment given out by the European Commission can be used as an important foundation for the development of national waste prevention programmes and for the indicator systems used within the latter. It fundamentally differentiates between so-called output and outcome indicators:

- The first category of output indicators comprises prevention indicators that measure the deployment of communication instruments (e.g. the number of flyers), in order to capture the existing degree of knowledge and interest in aspects of waste prevention in specific fields of industry and society. The conventional measuring method consists of either directly using questionnaires or indirectly by making use of existing statistical sources. The big advantage of this type of indicator is its close connection to the measure itself; the disadvantage is the often weak or missing reference to positive effects on waste prevention or the prevention of environmental impacts.
- The second category of result indicators encompasses indicators that measure impacts on the state of the environment and their development through time. This confers the big advantage of a direct investigation into the state of individual environmental media. However, their disadvantage is that the impacts of waste prevention measures cannot clearly be proven and that the state of the environment is influenced by a number of other factors.

Headline indicators are defined for each of these categories, which target the political process and the communication of prevention successes. A headline indicator in this sense is an indicator that does not target a specific political instrument or a specific waste stream, but rather suitable for a global political estimate. It can be used either on the level of political negotiations or as a communication instrument for sensitising the public (cf. Arcadis et al. 2010, p. 292):

Output-Headline-Indicator (headline indicators on performance): As a central approach of the output indicator the European Commission is to develop a questionnaire that should be integrated in the reporting obligations of Member States according to Art. 37 WFD. This (questionnaire) should, inter alia, include questions on the implementation of national waste prevention programmes as well as on objectives set within it.

Outcome-Headline-Indicator (headline indicators on effect): To evaluate the outcome of waste prevention measures, indicators should be used that take all phases of a product’s life-cycle into consideration all phases of a product’s life-cycle and that are not confined to the post-usage phase. Simultaneously these indicators are to reflect the increasingly global character of resource use and the thus resulting environmental impacts. For this reason the indicator (global) Total Material Requirement, TMR, is suggested in particular, that takes both into account, the direct material costs, as well as the indirect and hidden material flow,

i.e. the material costs in the upstream chains including non-reused extractions in the production process (cf. Arcadis et al. 2010).

It needs to be pointed out that these very abstract indicators will not be sufficient to illustrate the multitude of secondary objectives within waste prevention, but no further comment will be made on this subject.

3.5.2 Indicators for waste prevention

Since 2001 the OECD has been working on questions of waste prevention in the framework of an international working group. One of the defined objectives of this group was to develop indicators that permit the Member States to evaluate their contribution to waste prevention on the national level. The point of leverage for this undertaking was the so-called Pressure-State-Response-Model (PSR-model), which focuses on the drivers and causes (pressure), but also considers the impacts on different environmental media (state), as well as the implemented instruments (response).

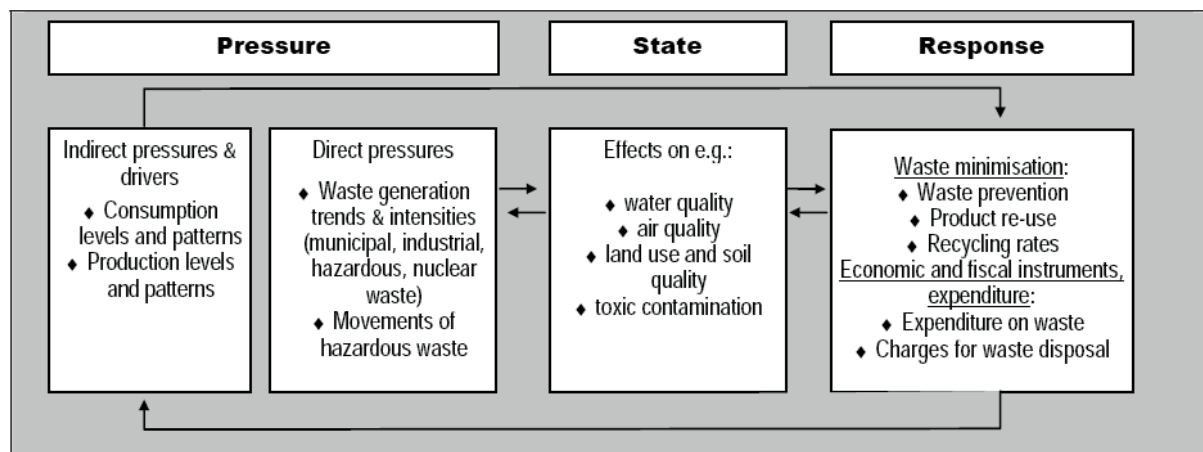


Figure 3-1: The PSR-Model for Waste (Source: OECD 2004)

In reference to the drivers, the analyses showed that population development and private consumption can be considered as deciding exogenous factors for the development of municipal waste (for industrial and construction/demolition waste economic growth is the relevant factor). Thus in order to develop efficient waste prevention measures, indicators that mirror the environmental pressures caused by the generation of waste are necessary. Furthermore, indicators that address the effectiveness of measures to prevent environmental pressures are crucial. Specifically, the OECD recommends pressure-indicators for the prevention of municipal waste (cf. OEC 2004, p.46):

- the pro capita waste generation, and
- the relation of waste generation to private consumption (according to national accounting).

With reference to measures for waste prevention the OECD performed a subdivision in short to medium-term indicators as well as long-term indicators. In case of the short-term indicators, the number of certified environmental management systems as well as recycling quotas for specific materials (e.g. for copper) were named. For long-term indicators, the

numbers of systems for expanded producer responsibility, as well as the share of households with waste charges dependent on waste generation were named. The response indicators, by contrast to the pressure and state indicators, focus above all on the intensity of waste prevention measures that are concretely carried out.

3.5.3 Overview of waste reduction indicators

Also commissioned by the European Commission, BIOS et al. (2009) have surveyed indicators already in use for waste prevention in the EU Member States. These focus on specific measures or waste streams, by contrast to the headline indicators. A questionnaire was used to inquire about currently used indicators for waste prevention in Member States. Thus the following indicators are currently being used in essence (cf. BIOS 2009)⁴:

- waste generation disaggregated into relevant main waste streams;
- household waste generation (kg per capita per year, total generation from households, etc.);
- share of households with self-composting;
- DMI (direct material input) for consumption and export for different materials (metals, minerals, etc.);
- avoided raw material extraction through prevention measures made by businesses and through measures performed by the public sector;
- share of reusable household packaging in relation to the overall packaging waste generated, i.a specifically for beverage packaging;
- share of consumer goods with eco-label;
- quantity of reuse and continued use of goods;
- quantity of advertising flyers in households;
- benchmark for businesses in relation to waste generated within a sector;
- questionnaires on environmental awareness in relation to waste prevention, specific surveys on the effect of waste prevention campaigns;
- quantity of disposed construction waste;
- quantity of disposed biological waste;

3.5.4 Waste prevention indicators in the Pre-Waste Project

In the context of the Interreg IVC Project Pre-Waste (Duration 2010-2012) one work-package consists of the task to develop a common concept for waste prevention indicators. For this sake a difference is made between indicators for resource input, for results, and for impacts:

⁴

From the point of view of the authors, not all of the listed indicators according to BIOS (2009) are suitable to describe waste prevention. For instance, self-composting is not classified as waste prevention but as waste recycling in the meaning of this study. Also indicators on the quantity of deposited construction rubble, and biodegradable waste do not show the successes of the waste prevention, but rather the successes of the overall waste management.

- The indicator “resources” includes all costs – of monetary, as well as of non-monetary nature, that are invested in a particular waste prevention measure. Included are e.g. working hours, equipment, communication tools etc. This reveals that often fundamental resources are not procured by the initiator of a measure, but by other involved stakeholders. The essence of this indicator is the deduction of statements on the intensity of performed waste prevention measures, which further also make possible an evaluation of the efficiency of said measures.
- The indicator “results” encapsulates the actually prevented waste quantities and -harmfulness in relation to specific prevention measures, but it also includes the participation in individual measures and their public perception. These indicators, however, require a very precise analysis of the status quo, by contrast to the first category (resources), so that changes can really be reflected.
- The indicator “impacts” refers to economic, ecological, as well as social impacts. For pragmatic reasons the analysis focuses on the cost side to evaluate the economic effects, on the labour market for social effects, and on greenhouse gas emissions for ecological effects (cf. Bel 2010, p. 39).

3.6 Conceptual basis for indicator development

3.6.1 Relation to the identified target levels

Given the multitude of methodological avenues, a consistent development of an indicator system must focus on targets, which are linked to the development of a national waste prevention programme.

The main objective concerns the reduction of environmental impacts and impacts on man through waste along the whole supply chain (target level 1). Achievement methods are in particular the reduction of waste quantities and pollutant levels in waste and products (that eventually turn into waste).

When developing waste prevention indicators the question of whether these should relate to the entire programme in the sense of a headline indicator and could cover entirely one of the named target levels, or whether they should be tuned more to the effects of individual clusters of measures or individual measures, arises. However, the experiences of empirical analyses (cf. Bel 2010, p.6) shows that neither the generation of waste or harmful substances (target level II) nor the use of natural resources are to be brought into a serious causative relation to a waste prevention programme. This is caused by the following aspects: besides measures of the waste prevention programme, changes in the prevailing economic circumstances influence waste generation and measures are performed independently of the waste prevention programme. This is clearly revealed in the decline of waste quantities in the years 2009 and 2010, which clearly was not due to waste prevention measures but to the worldwide economic crisis.

3.6.2 Orientation towards the entire life-cycle

An integral consideration of the process and the results of waste prevention measures are necessary, given the described difficulties of determining a clear causal relationship between the individual target levels of the waste prevention programme. As it is desirable for the

indicators to be differentiated in individual economic sectors and regions and that a dynamic evaluation of indicators over time occurs, the indicator system must also consider specific drivers of waste generation. This necessity arises especially from the objective requirement in Recital 40 of the WFD, according to which the measures should aim at “breaking the link between economic growth and the environmental impacts associated with the generation of waste”.

Operationalising the indicators

Existing approaches for the evaluation of waste prevention measures often aim solely at statements made on the basis of waste statistics on the waste generation per capita or household, cf. Table 3-1.

Table 3-1: Evaluations of waste prevention measures

Project	Duration and context	No. of participants	Impact kg household ⁻¹ week ⁻¹	Monitoring approaches	
				Self weighing	Collection round
Dorset (Dorset County Council <i>et al.</i> 2008 [WR0116])	A 3-year intervention campaign delivering a ‘package’ of measures to engage households, e.g. home composting, avoid junk mail and smart shopping. Used doorstep teams, community events and waste reduction packs to support delivery.	1 577	0.50		√
Armada (Changeworks 2008, SISTech 2008)	A 1-year intervention campaign delivering a ‘package’ of measures to engage households in home composting and in the home activities. Used doorstep teams, a toolkit, community events and workshops to support delivery.	1 150	0.98		√
Finland WPK (WastePrevKit 2007)	A 2-year intervention campaign supported by a toolkit for enterprises, schools and households. The campaign included seasonal events, banners, newsletters, newspaper articles and web pages.	14	0.53	√	
EcoTeams (GAP <i>et al.</i> 2008 [WR0114], GAP 2009)	A 5-month behaviour change project working with small groups of households (EcoTeams) who weighed their waste and undertook targeted action to reduce it.	3 602	0.62	√	
RoWAN (Wickens 2005)	A 13-month step by step waste prevention programme with a dedicated project worker. The project was supported by a local waste guide, fact sheets, feedback charts, community events and free equipment.	127	1.87	√	

Source: Sharp *et al.* 2010

In order to reach a complete picture of the success of waste prevention programmes, there are beyond this a set of additional survey methods, that amongst other things incorporate to what extent the individual measures support and motivate stakeholders in their efforts towards waste prevention (cf. Sharp *et al.* 2010):

- The use of representative pilot and control groups to investigate the success of a measure over a certain period of time within a predetermined group of people. This method was used successfully multiple times in England; however, it requires a lot of planning and involves high financial costs.
- Surveys on attitudes or waste prevention behaviour: such surveys can be an appropriate foundation for the evaluation of waste prevention measures; however, generally speaking it is nearly impossible to relate this to quantitative data.
- Recording personal waste generation through selected households: Keeping a “waste journal” based on a selected number of households weighing their own waste

provides an outstanding database that allows the evaluation of individual measures. However, this method is also expensive and at the same time influences the behaviour of households considerably, so that it should rather be considered as an instrument for waste prevention.

3.7 Indicator development

The following section examines specific waste prevention indicators that should be monitored, independently of specific individual measures, for a national waste prevention programme that implements Article 29 paragraph 3 WFD. A distinction is made between indicators of waste prevention success and indicators of the waste prevention process.

The purpose of the indicators is to provide indications, through their development over time, of the success of waste prevention measures and, where appropriate, to identify areas where there is a need for further action. It will generally not be possible to track the success of individual measures directly by means of the indicators. They are rather designed to permit a synoptic overview of the extent to which waste prevention is being implemented effectively as the supreme priority of the waste hierarchy. One constraint upon all possible waste prevention indicators is that prevention successes indicated by them need not necessarily be causally linked to waste prevention within the meaning of this programme, but can rather be due to general swings in the economy, for instance. The description follows a uniform pattern (reasoning, definition, data availability and notes). Operationalisation focuses on absolute per-capita quantities (in relation to population or employment figures). This approach makes it possible to take account of the effects of population trends, while also allowing comparisons at EU level. Table 3-2 gives an overview of the individual indicators.

Table 3-2: Waste prevention indicators

Indicators relating to waste prevention success	Indicators relating to waste prevention approaches
Generation of household waste	Costs as an incentive to reduce waste generation
Generation of food waste	Reduction in waste arising attributable to environmental management systems
Generation of construction waste	Relevance of waste prevention to consumers
Reuse of discarded electrical and electronic equipment	Reduction of waste arising attributable to low-waste procurement
Waste intensity in industrial sectors	
Development of resource productivity	
Generation of hazardous waste	
Generation of packaging waste	

The indicators listed in the left column of the table essentially refer to the output streams of key waste fractions. The right columns contain indicators guided by the response indicators of the OECD or the output perspective of Arcades et al. (2010) and relate more to the process

of waste prevention. The selection of indicators is based on the selection of effective waste prevention approaches, such as identified by, among others, the precursor study (cf. Dehoust et al. 2010). They also seek to capture the intensity of the incentives provided to prevent waste.

3.7.1 Indicators referring to successes of waste prevention

A) Indicator of waste generation in households

Explanation

The indicator reveals how the waste intensity of consumption develops and thereby enables conclusions on aggregated effects of a multitude of individual measures, especially in the fields of low-waste consumption, low-waste product design and reuse of products.

Definition

Generation of per capita household waste, as well as percentage changes compared to the previous year and to a yet to be determined starting year (e.g. 2013).

Data availability

The waste generation from households is recorded in a standardised manner.

Remarks

The comparison of data on the European level is rendered difficult due to the different delimitations between household and commercial waste.

B) Indicator of generation of food waste

Explanation

The food sector constitutes one of the three key sectors of sustainable consumption and production structures. Studies reveal that considerable quantities of produced food are never used but turn into waste. Thus there is a significant waste prevention potential that is increasingly coming into the focus of the general public.

Definition

The per capita generation of food waste in households, food service, catering and in trade, as well as percentage changes compared to the previous year and to a yet to be determined starting year (e.g. 2013).

Data availability

Food waste has so far not been recorded in waste statistics, and moreover, they are disposed of partly commercially, partly as component of residual waste, partly in municipal organic waste bins (generation of organic waste reported by German Federal Statistical Office (Destatis)). The recording of additional data is required.

Remarks

Both the content-related structure and the availability of data, the BMVEL-Project (BMVEL =Federal Ministry for Nutrition, Agriculture and Consumer Protection) of Stuttgart University, Prof. Kranert (Kranert et al.2012) can be used. This study determined waste prevention potentials in households (sorting analyses, but also a statistical determination of consumer behaviour), as well as in the catering and trade sector (e.g. through aligning purchasing and inventory quantities).

C) Indicator construction waste

Explanation

Construction waste is the most important waste stream in terms of quantities in Germany.

Definition

Per capita quantity of construction waste generated in the construction sector per year as well as percentage change compared to the previous year and to a yet to be determined starting year (e.g. 2013).

Data availability

Waste generation in the construction sector is reported regularly.

Remarks

In the framework of EIONET it is being discussed whether to calculate the quantity of construction waste in relation to new building space, on the basis of it being closely correlated to economic growth, or to demolition surface (area of demolition). In doing so, one must however take into account that there is generally a considerable time lag between construction and demolition, which could render the interpretation of such an indicator more difficult. Alternatively the quantity of reused structural components could be determined; however there is barely any statistical data available for this.

With this indicator it might be difficult in certain circumstances, to make a sensible differentiation between the successes of waste prevention and reuse of waste.

D) Indicator reuse of discarded electrical and electronic devices

Explanation

Electrical and electronic devices belong to the most important fields of qualitative waste prevention given the multiple hazardous substances they contain. Because many electronic devices are separated out well before the end of their technical useful life, their reuse is of particular significance.

Definition

The share of reused electronic devices in relation to the recorded quantity of electronic devices per device category as well as the change compared to the previous year and to a yet to be determined starting year (e.g. 2013).

Data availability

The quantity of separately collected electronic devices, the quantity that has entered the market, and the reused quantities are already being recorded and regularly being communicated to the European Commission⁵. The differentiation of devices that are fed into reuse from separate bulky waste collection is problematic. However, as these effectively generate the same effect, this statistical weak point can be tolerated from the technical perspective.

Remarks

The quantities collected through the structures of the waste electrical and electronic register (eae) and the German Federal Statistical Office constitute an essential share of the quantities that are generated. In addition a certain quantity of electronic waste is still disposed of as residual waste⁶. Further quantities of used and in part electronic devices are exported. According to Schilling, Sander (2010)⁷, the order of magnitude is approx. 150,000 t/a. The focus on reuse represents a content-related reference to 'Design for Repair'. In certain circumstances possible contradictions result for electronic devices whose energy consumption has been reduced through innovation.

E) Indicator waste intensity in industrial sectors

Explanation

Waste intensity puts waste generation of individual industrial sectors into relation to the respectively added value. The waste intensity in different sectors permits a direct reference to the different product-oriented waste prevention measures in Part B of Annex IV of the WFD. The relationship to economic data seems sensible here, because, by contrast to total GDP, effects through the continual structural change are avoided.

In the context of a research project assigned by the German Federal Environment Agency (UBA) (cf. Dehne et al. 2011) the generation of mixed commercial waste differentiated by economic sector were determined. Due to limited data availability for commercial waste a systematic comparison of economic sectors was only possible via the parameter of the "specific quantity generated per employee"⁸. The indicator "yearly specific waste quantity mt/employee" fluctuates greatly between different economic branches, between 0.04-0.1 mt in the sector "Energy and Water Supply" up to 0.66-0.97 mt in the sector "Glass Industry, Ceramics Manufacture, Processing of Stones and Earth". Due to the high share of employees in the service sector, the latter produces more than 50 % mass of total waste, despite the low specific waste quantity of 80 to 120 kg/employee. The reference to the number of employees

⁵ http://www.bmu.de/files/pdfs/allgemein/application/pdf/daten_elektrogeraete_2007_2008_bf.pdf

⁶ According to Janz/Bilitewski 2007 electronic devices made up 1 % of residual waste in Dresden in 2006; (after implementation of the obligation to separate as stated in the German Electrical Equipment Act (ElectroG)). Because the authors consider this value as exemplary for the majority of municipal residual waste in Germany, they extrapolated a value of approx. 138,000 t electronic devices in the residual waste, of which approx. 71,000 t can be catalogued according to ElectroG.

⁷ Stephanie Schilling, Knut Sander: Transboundary shipment of waste electrical and electronic equipment / electronic scrap – Optimization of material flows and control, UBA-Texte 11/2010, <http://www.umweltdaten.de/publikationen/fpdf-l/3933.pdf>

⁸ http://www.bmu.de/files/pdfs/allgemein/application/pdf/3709_33_314_gewerbeabfalle_bf.pdf

not only allows a comparison of the different sectors, but also can thereby serve as a foundation for the determination of structural change that respects resource conservation.

Definition

Generation of waste in individual industrial sectors in relation to value-added and the employee number in the respective branches, as well as (respectively) the change compared to the previous year and to a yet to be determined starting year (e.g. 2013).

Data availability

The sector specific waste destined for disposal can be determined easily via waste statistics, however, the generation of commercial waste that is reused can only be determined to a limited extent (to date).

Remarks

Building on the classification system of national accounts (WZ 2008) one can compare the main category like for example “A+B agriculture, forestry, and fisheries” and “C+D manufacturing and processing industry”, but also selected sub-categories that have been identified as particularly waste intensive and therefore as relevant for national waste prevention programme. The indicator could for example only refer to the sector WZ 2008 10, manufactures of food products, or more concretely to sector "10.1 Processing and preserving of meat and production of meat products"⁹. Here also, the classification of commercial waste is problematic, because this does not everywhere occur in a standardised way.

F) Development of raw material productivity

Explanation

Since all materials become waste or emissions at the end of their life-cycle, this indicator comprehensively reflects the efficiency of resource use and thus the source of all waste. Due to its relation to the GDP this indicator permits an estimation of the decoupling of economic growth from the demand for raw materials and can in certain circumstances be used as a rough proxy for potential environmental pollution, as the aim is defined in the WFD.

Definition

Gross domestic product (GDP) in relation to the domestic material consumption (DMC), or alternatively the raw material consumption (RMC) (see below), as well as the percentage change (without inflation effects) compared to the previous year and to a certain starting year, as yet to be determined (e.g. 2013).

Data availability

GDP, inflation, and DMC are recorded in a standardised manner.

⁹ <http://www.statistikportal.de/statistik-portal/klassiWZ08.pdf>

Remarks

Raw material productivity is the main indicator on the roadmap towards a resource-efficient Europe. As an indicator for the prevention of waste, however, it is weak due to the high level of aggregation: On the one hand making a reference between total material demand and actual environmental pollution is barely possible; on the other hand, resources that are used for the production of imported products are not accounted for. A possible alternative to this would be TMC (Total Material Consumption) that also considers material costs of imported products, and the not utilised extraction. However, data availability poses a major problem here.

A further alternative would be RMC (Raw Material Consumption), given its data availability, that equally accounts for material costs of imported products (excluding the not utilised extraction), cf. Bundesregierung 2012. For this purpose research projects in the framework of the Environmental Research Plan (Umweltforschungsplan) are currently underway.

Further problems result from the inclusion of GDP, which as a reference standard barely enables statements on the quality of economic growth or the wealth of society. Furthermore, both components of the indicator demonstrate considerable weaknesses in the transparency of their derivation.

G) Indicator hazardous waste

Explanation

The reduction of the generation and hazardousness of waste that presents a threat for human health and the environment is the essential approach of qualitative waste prevention.

Definition

Generation of hazardous waste, as defined in the European Waste List, per year as well as the percentage change compared to the previous year and to as yet to be determined starting year (e.g. 2013).

Data availability

Data are regularly recorded by Destatis.

Remarks

The course is fundamentally dependent on the legal framework, i.a. as regards the question of company-internal disposal of waste.

H) Packaging waste

Explanation

Packaging waste is still the in the focus of the general public: “Packaging is part of daily life”¹⁰. The reduction of the generation of packaging waste has been an explicit objective of the German Packaging Ordinance of 1991. Furthermore they cause a relevant share of the costs that are created through household waste.

Definition

Yearly per capita generation of packaging waste in relation to private consumer expenditure as well as the percentage change compared to the previous year and to an as yet to be determined starting year (e.g. 2013).

Data availability

Both the generation of packaging waste and consumer expenditure are regularly recorded.

Remarks

Packaging waste generation is determined in the form of “waste relevant quantities”. One year’s “waste-relevant quantity” is set equal to the quantity of packaging that enters the market, because the “lifespan” of packaging tends to be short.

The reuse quota for beverage packaging, which is regularly recorded, can be used in addition to this indicator.

3.7.2 Indicators referring to approaches of waste prevention

I) Costs as an incentive to reduce waste generation

Explanation

The disposal of waste produced poses considerable costs for the concerned industry, which in turn can become a considerable incentive for waste prevention. Apart from reflecting waste intensity in individual industrial sectors this indicator additionally informs on the cost reduction potential that could be achieved through waste prevention measures.

Definition

Running yearly costs of waste disposal in the manufacturing industry as well as percentage change compared to the previous year and an as yet to be determined starting year (e.g. 2013).

Data availability

Data are regularly recorded in the framework of integrated environmental and economic accounting.

¹⁰ http://www.bmu.de/abfallwirtschaft/abfallarten_abfallstroeme/verpackungsabfaelle/doc/41160.php

Remarks

However, this indicator only considers business with 50 or more employees.

J) Indicator reducing waste generation through environmental management systems

Explanation

Environmental management systems enable a business to determine cost reduction potentials within their enterprise. Especially with investments into waste prevention, which for example have the influence of saving material along the entire life-cycle (procurement, treatment, transport, waste generation, etc.), many companies lack reliable information about possible cost savings so that the statements on the profitability of such investments cannot be made with sufficient certainty. A perceived tension exists between material and cost efficiency that is thus often based on uncertainties, and resulting risks, that can be significantly decreased in businesses by the provision of corresponding figures¹¹.

Definition

The share of companies with environmental management schemes, as well as the development compared to the previous year and is as yet to be determined starting year (e.g. 2013).

Data availability

Data for this purpose is available e.g. from UMS (Umwelt-Monitoring Systeme/Environmental Monitoring) after EMAS (Eco-Management and Audit Scheme) or ISO 14000.

Remarks

In the framework of sustainability reports according to the guidelines of the Global Reporting Initiative, relevant data on waste prevention are also recorded (indicator EN2 “Percentage of materials used that are recycled input materials”; indicator EN22 “Total weight of waste by type and disposal method”¹²).

K) Indicator relevance of waste prevention for the consumer

Explanation

Raising consumer-awareness for the relevancy of waste prevention can be a determining precondition for all measures that are identified in the field of low-waste consumption.

Definition

Share of the population by whom waste prevention is considered to be a significant subject matter, as well as the development compared to the previous year and as yet to be determined starting year (e.g. 2013).

¹¹ <http://www.demea.de/dateien/fachartikel/2011-12-07-endbericht-materialeffizienz-in-der-produktion.pdf>, p. 18

¹² <https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl-Technical-Protocol.pdf>

Data availability

This indicator could be collected in the course of the survey on environmental awareness in Germany that is regularly performed on behalf of the German Federal Environment Agency (UBA).

3.7.3 Overview and prioritisation

The development of indicators for waste prevention must find a balance between the demand of many stakeholders, obtaining information on the success of individual measures as concrete as possible, and the additional effort that is possibly connected to recording and evaluating data.

Therefore it is necessary that the indicators are aligned to the Resource Efficiency Programme of the Federation. The latter has taken on a pioneering role in the context of indicator development through the setting of quantitative targets, and is also seeking the cooperation with European partners and institutions (this primarily affects the indicator on raw material productivity). Table 3-3 depicts a comprehensive overview of indicators with an estimation of data availability, as well as a concluding recommendation on the introduction of the indicator.

Table 3-3: Overview of indicators

Indicator	Data availability	Prioritisation
Generation of household waste	Data are available in principle	Useful indicator and unproblematic to track
Generation of food waste	Key items of data must be collected from scratch	Urgently required
Generation of construction waste	Data are available in principle	Useful indicator and unproblematic to track
Reuse of discarded electrical and electronic equipment	Data are available in principle, but the bulky waste collection quantities are problematic	Useful indicator
Waste intensity in industrial sectors	Key items of data must be collected from scratch	Useful indicator
Development of resource productivity	Key items of data must be collected from scratch, but this is already under way (e.g. ProgRes)	Urgently required
Generation of hazardous waste	Data are available in principle, but their development depends greatly upon the statutory setting	Useful indicator
Generation of packaging waste	Data are available in principle	Useful indicator and unproblematic to track
Costs as an incentive to reduce waste generation	Data are available in principle	Useful indicator and unproblematic to track
Reduction in waste generation attributable to environmental management systems (EMS)	Data are available in principle, but as yet only for specific EMSs	Useful indicator
Relevance of waste prevention to consumers	Key items of data must be collected from scratch	Urgently required

4 Clustering and consolidating measures

In the course of the preparatory work conducted prior to establishing a waste prevention programme for Germany, collected examples of waste prevention measures (cf. Dehoust et al. 2010) were grouped into clusters of measures and were further consolidated.

This clustering of examples of measures and the consolidation, based upon the clustering, of possible measures for a nationwide waste prevention programme has several purposes:

- Structuring and streamlining discussions with stakeholders,
- Ensuring relevance to discussions at EU level, which will presumably be structured mainly in line with Annex IV,
- Creating a systematic basis from which to derive suitable indicators of progress,
- Focussing the orientalise review upon the intended environmental impacts of the prevention measures.

The methodological procedure developed by the experts for this stage of the study is presented in this chapter, illustrated with examples and then applied to the fields A, B, and C of the measure clusters from Annex IV of WFD (cf. Figure 4-4).

4.1 Methodological Procedure

With the intention of providing a transparent and targeted methodology for the work stage, the step-wise approach outlined below was developed and trialled:

1. Structuring the points of leverage
2. (Review of the existing) assignment of measures
3. Clustering of measures
4. Consolidation of measures

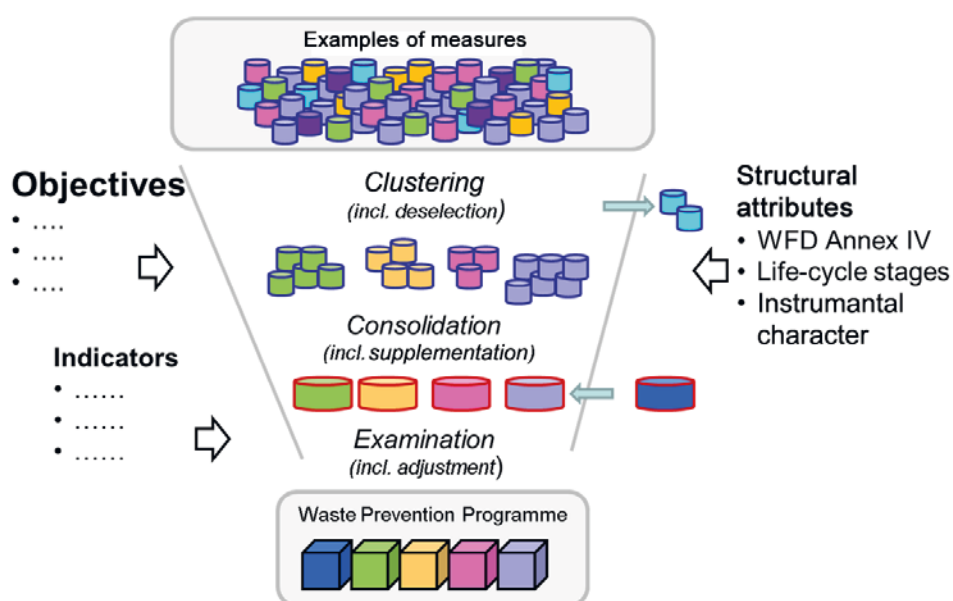


Figure 4-1: Schematic overview of the approach taken to cluster and consolidate measures

This approach takes the approximately 300 examples of measures collected in the precursor project as a point of leverage for consolidation and clustering. Further examples of measures are included as required.

Using the outcomes of clustering and consolidation, waste prevention measures are then proposed which are suited in principle to be included in a waste prevention programme.

4.1.1 Step 1: Structuring the points of leverage of measures along the measure areas of the WFD

Waste prevention measures can be organised and structured according to a multitude of attributes. Thus, when collecting and preparing exemplary waste prevention measures in the precursor project integration with several characterisation and sorting-criteria was undertaken.

An (additional) structuring along process stages of a prototypical life-cycle of a product is helpful. Amongst other things this enables:

- direct identification of interfaces with other policy and regulatory spheres,
- the integration of findings and actions from development and implementation activities that address waste prevention aspects in individual process stages but have not as yet been linked to waste prevention as an overarching issue¹³,
- debate with practitioners operating in the realm of market players.

A prototypical life-cycle that can demonstrate the basis for such structuring is depicted in the following figure (Figure 4-2).

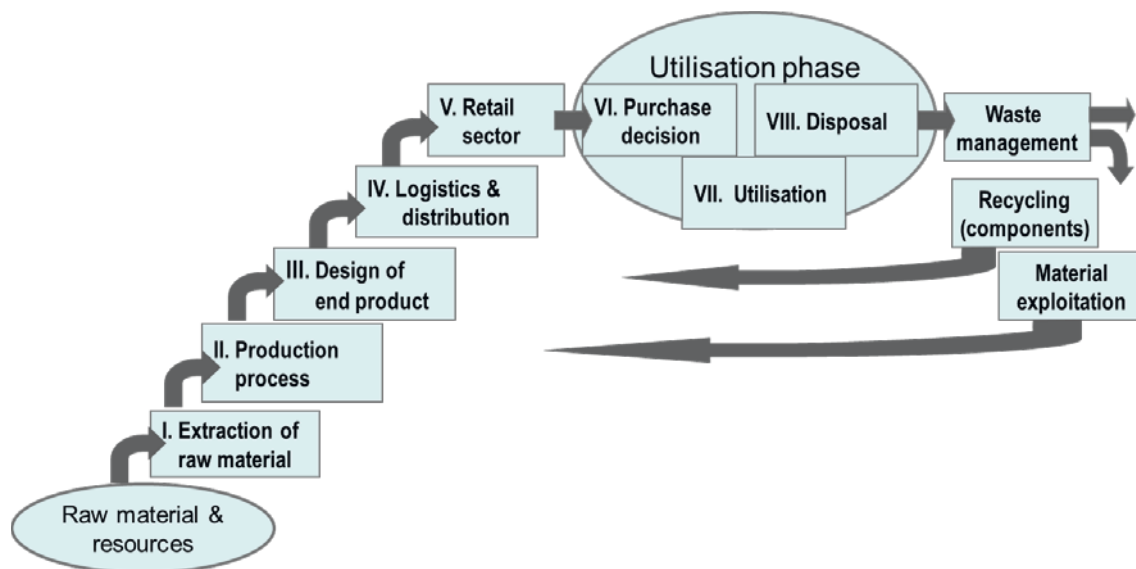


Figure 4-2: Prototypical organisation of the life-cycle stages

As shown in the following figures, the existing waste prevention measures can be assigned relatively well to these process stages of the life-cycle (points of leverage). In individual cases several possible assignments for measures may be possible, or individual stages, e.g. the

¹³

An example of this is provided by specific regulations governing substances in production processes which have up to now been discussed and analysed primarily in terms of direct exposure limitation, but not in terms of life-cycle and/or waste aspects.

utilisation phase, can possibly be differentiated further. However, such lack of precision is unavoidable when structuring at the present level of abstraction, and does not affect the result of the objective to assign measures to the life-cycle.

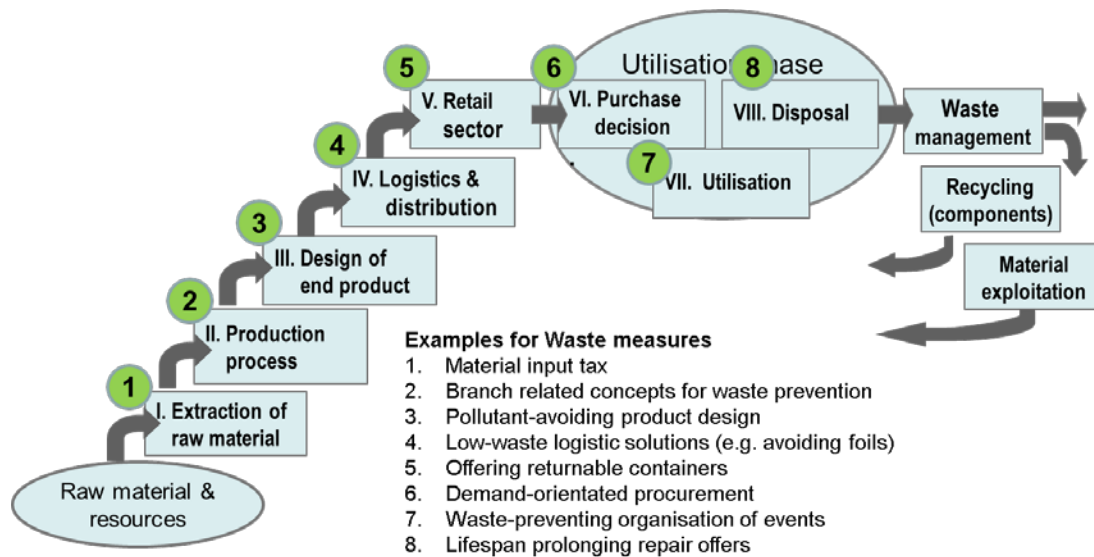


Figure 4-3: Assigning Waste Prevention Measures to the Life-cycle stages

The following Figure 4-4 depicts how the important assignment of the 16 exemplary measure fields of Annex IV WFD and the points of leverage in the life-cycle can occur on a comprehensive level¹⁴.

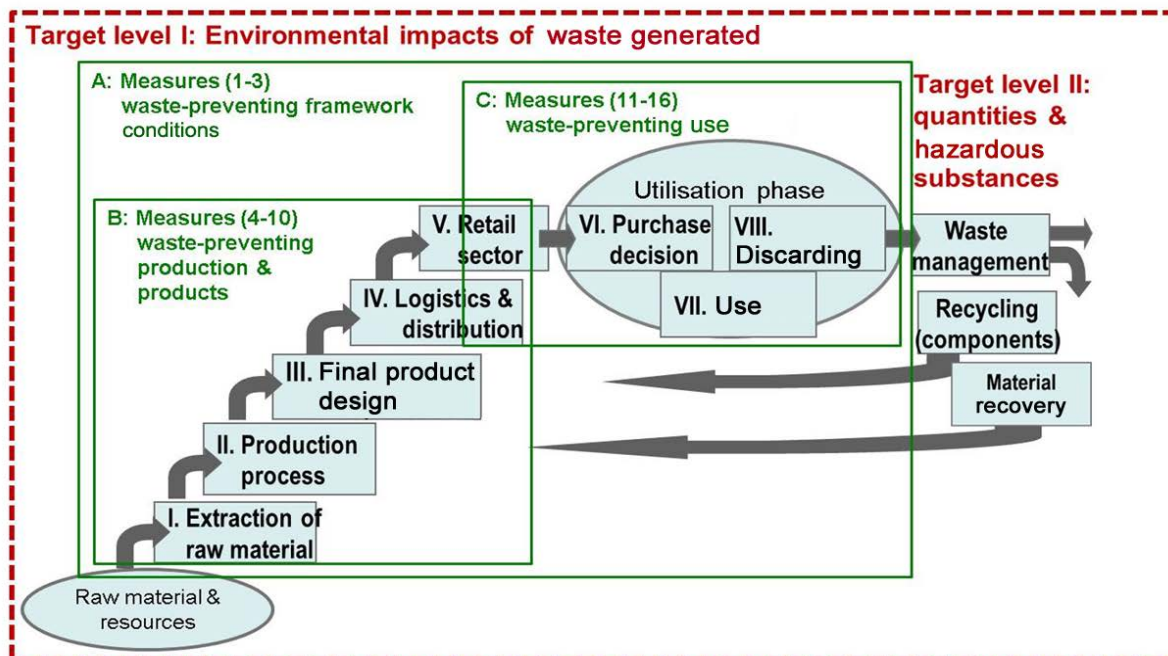


Figure 4-4: Assignment of the fields of measures set out in the Waste Framework Directive (Annex IV) to the points of leverage across the life cycle of products and the target levels of waste prevention

¹⁴

i. e. on the 3 main structuring levels of Annex IV of WFD (here described with A, B, and C).

The overview on this comprehensive level describes the accordance between both forms of structuring¹⁵.

4.1.2 Step 2: (Review of the existing) assignment of measures

The subsequent clustering will in the first instance occur from the perspective of the above outlined extended structuring according to life-cycle stages. As a foundation for this, the assignment of example measures to the measure fields of the WFD performed during the precursor project must be verified once again.

The assignment to the three overarching spheres of Annex IV WFD (“green boxes” in Figure 4-4) is relevant:

- A. general conditions
- B. design, production, and distribution phase
- C. consumption and use-phase

If displacements into other fields are sensible, corresponding notes are made.

While verifying the assignment of measures, measures that are not suitable for the next steps of the process can be filtered out.

Possible deselection criteria are:

1. The measure does not transcend current EU law.
2. The measure is not a waste prevention measure. E.g. this is the case when only optimisation is addressed within waste management.
3. The measure is insufficiently substantiated.
e.g. the various actor groups are not clearly denominated
4. The measure is not a measure of public sector

Especially as regards the deselection criteria 4, one must be critically verify, whether the missing reference of the example measure to the public sector cannot be sensibly compensated for through corresponding modifications/additions¹⁶.

¹⁵ Irritations can in certain cases result from the variable terminology. Whereas the experts consciously refer to the process stages in the life-cycle as “points of leverage” for waste prevention measures, the sub-headings of Annex IV WFD are *Measures, which can affect the ... (design-, production- and distribution phase)*. However, because in the context of overarching objectives of waste prevention it is also clear that in the WFD it is unquestionable that the intended (environmental) impacts do not occur in the individual life-cycle phases but occur or should occur on the level of the overarching objective levels, the experts see no contradiction here. The formulations of Annex IV are rather interpreted in the way that exemplary measures can have impacts on the points of leverage

¹⁶ Optimisation efforts within a production area or a product group can e.g. be initiated exclusively through economic stakeholders or they can e.g. become the focus of concentrated action between public administration/politics and economic stakeholders.

4.1.3 Step 3: Clustering the measures

Within the 3 overarching fields of measures A-C and the 16 examples of measures (1-16) subsumed under these fields taken from Annex IV of the Waste Framework Directive, the given examples of measures are further concentrated by combining similar measures.

Such a combination of examples of measures can be guided by their respective "character" in the sense of a regulatory "push-pull" approach. In this approach, measures are classed according to whether they set universally binding minimum requirements (usually through regulatory law), have a mediating/informing focus and/or promote (financially) and/or reward pilot projects or the implementation of good prevention practice.

Subsequently an assignment of points of leverage in the life-cycle is undertaken (cf. Figure 4-2 and Figure 4-3).

Table 4-1: Assignment between life-cycle stages and the measures of the WFD in field B.

Stages in the life-cycle	(exemplary) fields of Annex IV WFD
Stage I: Waste prevention in raw material extraction	Not specifically addressed, but partly addressed through low-waste production process design (e.g. no. 5 or no. 10)
Stage II: Waste prevention in production facilities	5. The provision of information on waste prevention techniques with a view to facilitating the implementation of best available techniques by industry. 6. Organise training of competent authorities as regards the insertion of waste prevention requirements in permits under this Directive and Directive 96/61/EC 7. The inclusion of measures to prevent waste production at installations not falling under Directive 96/61/EC. Where appropriate, such measures could include waste prevention assessments or plans. 8. The use of awareness campaigns or the provision of financial, decision making or other support to businesses. Such measures are likely to be particularly effective where they are aimed at, and adapted to, small and medium sized enterprises and work through established business networks. 10. The promotion of credible environmental management systems, including EMAS and ISO 14001.
Stage III: Waste preventing product design	4. The promotion of ecodesign (the systematic integration of environmental aspects into product design with the aim to improve the environmental performance of the product throughout its whole life cycle). 9. The use of voluntary agreements, consumer/producer panels or sectoral negotiations in order that the relevant businesses or industrial sectors set their own waste prevention plans or objectives or correct wasteful products or packaging
Stage IV: Waste-preventing logistics	Not specifically addressed, but partly addressed through measures for low-waste production process design (e.g. no.9 or no.10)
Stage V: Waste-preventing trade	14. Agreements with industry, such as the use of product panels such as those being carried out within the framework of Integrated Product Policies or with retailers on the availability of waste prevention information and products with a lower environmental impact

Table 4-1 shows exemplary for the field no. 1-4 of the annex VI, how such an assignment to the life-cycle stages can appear from the extraction of starting materials to the distribution of the final products.

It is obvious that the assignment on this level is not clear¹⁷ and not complete¹⁸ in all cases. This is particularly caused by the fact that the exemplary fields from annex IV WFD were not only structured according to life-cycle stages but also with regard to organisational principles, such as the differentiation into voluntary or regulatory measures. Furthermore the addition should be taken as a serious example.

4.1.4 Step 4: Consolidation

In step 4 a waste prevention measure is formulated for each of the, as presented earlier, example measure „clusters“ formed, and this is described through one or more example measures that could be part of a future waste prevention programme.

The waste prevention measure that represents a measure cluster, often does not correspond in a 1:1 manner to one of the example measures¹⁹, but has to be (newly) generated in the course of the consolidation. That newly formulated waste prevention measure creates a sort of “umbrella” over a row of example measures.

During this consolidation “missing” measures are to be added that have become apparent within the process of structuring and clustering, as far as this is sensibly possible.

Since the questions of stakeholders and target addressees are of central importance during the consultation of the waste prevention programme, its implementation and its updating, a clear reference to stakeholders (who initiates, who acts) is very important when formulating the consolidated measures.

The overview of example measures occurs in chapters 6 to 8 in addition to a written characterisation, which occurs appears in a uniform characterisation pattern, and whose components are described in Table 4-2.

4.2 Findings of applying the methodology

In the following section the findings of applying the methodology are presented.

While the main text documents presents, besides a few relevant results of the verification/clustering, mainly the waste prevention measures being in the result of the consolidation step, the documentation of the interim results of the individual examination and clustering steps can be found in the corresponding annex.

4.2.1 Findings for Field A: General framework conditions

In Field A, i.e. numbers 1-3, the examples of measures listed in Annex IV WFD address the framework conditions of waste generation.

¹⁷ A row of measures of WFD can be assigned to more than one life-cycle stage.

¹⁸ E.g. the measures mentioned in Annex IV for the area of low-waste distribution are not particularly specific.

¹⁹ This is prevented by the differences in the respective spatial references and other contexts.

Table 4-2: Uniform characterisation matrix for examples of waste prevention measures

No. and title of example	
Objectives	Link of the measure to the individual target levels and specific targets for action that are to be achieved by means of the measure.
Characterisation	Key framework conditions and cause-effect mechanisms.
Link to measures set out in study I	Reference to the representative measures defined by the precursor project.
Link to Annex IV WFD	Reference to how the measure matches the catalogue of Annex IV WFD.
Instrumental character	Character of the measure as a waste prevention instrument.
Initiators	Actors who initiate and implement the measure.
Addressees	The addressees targeted by the measure.
Waste prevention potential	Potential estimates made by the authors of this report. These are usually qualitative estimates of the waste quantities that could be affected by the measure on the one hand, and could be prevented on the other. Quantitative statements can only be made in isolated cases.
Environmental impacts	Characterisation of relevant environmental impacts initiated by waste prevention. The focus is placed on climate impact. The environmental impacts are assessed in a representative manner for a number of selected products.
Indicators	Specific benchmarks are stated for the individual measures by which the outcome of a measure can be monitored.
Social impacts	Significant positive or negative social impacts are discussed for the individual measures to the extent that they exceed the normal degree of goal attainment of waste prevention measures. That waste prevention can lead to employment losses due to saved production and waste management effort is trivial and is only mentioned in special cases.
Economic impacts	Significant positive or negative economic impacts are discussed for the individual measures to the extent that they exceed the normal degree of goal attainment of waste prevention measures. That waste prevention can lead to income losses due to saved production and waste management effort is trivial and is only mentioned in special cases.
Conclusion / recommendation	The conclusion assesses the measure as a component of a national waste prevention programme in the view of the authors of this study, and also states, where appropriate, relevant framework conditions or restrictions that must be taken into account when implementing the measure. A recommendation on whether the measure should be included in the programme or not is initially made for each measure without weighing the pros and cons between the measures.

In the view of the authors of this study, these are overarching measures that differ from the measures of Field B (4-10, Annex IV WFD) and C (11-16, Annex IV WFD) in that they do not (only) tackle individual points of leverage (Phases I to VIII in the scheme set out by the authors of this study), but are rather effective in a cross-cutting manner by addressing various points of leverage.

In the application of the developed methodology to the assignment/verification of the example measures conflated in the precursor project this fundamental knowledge led to the placing of some of the example measures into the specific fields B and C and to some few measures being withdrawn.

The remaining measures can clearly be clustered into the 6 fields presented hereafter, according to their fundamental character/mechanism of action.

A General framework conditions

- A 1 Development of waste prevention strategies and approaches
- A 2 Establishment of overarching actor cooperation
- A 3 Waste-preventing design of economic settings
- A 4 Research on waste-preventing technologies and utilisation schemes
- A 5 Supportive programmes and activities to implement waste-preventing strategies and technologies
- A 6 Development and application of indicator systems
- A 7 Concretisation of producer responsibility

Using the uniform characterisation patterns (cf. section Step 4: Consolidation), a detailed characterisation report of the consolidation of these 6 waste prevention measures follows below.

4.2.2 Findings for Field B: Design, production and distribution phase

During the assignment/verification (Step 1-2) of to date presented example measures (from the precursor project), references to the legal regulations in Germany that materially-speaking represented a 1:1 implementation of European law were deselected in particular (this i.a concerns amongst others the waste-related product regulations in the fields of end-of-life vehicles, electronic devices, batteries, but also POPs regulation and the chemicals legislation). For the area of statutory materials restrictions there is currently an ongoing investigation underway on the extent to which there are nevertheless material differences to the EU law, which thus could become a national measure.

During the conflation of previously clustered measures according to their features (Step 3a) it became apparent, as expected, that further duplicates exist and accordingly can be streamlined. These steps are presented in tables available in Annex B.

Furthermore it became clear during the assignment of example measure clusters to points of leverage in the life-cycle (Step 3b) that within the field of waste prevention in raw material extraction (Stage I in the life-cycle) there are to date no example measures. Against this background supplementary waste prevention measures were developed. Based on these actions the following approach was taken:

To begin with, the question of which approaches for action exist in this field was asked. A collection delivered the following points of leverage:

- use of secondary raw materials instead of primary raw materials;
- optimised raw material extraction aiming at an exploitation of ore that is as complete as possible, without however contributing to an increase of the environmental burden during raw material extraction;
- use of mine waste/overburden as a by-product, for example as building material, and should this not be possible, reshipment of the tailings/overburden as a by-product to refill the mines and quarries.

Furthermore, final products should of course also be designed in an ecodesign perspective in such a manner that resources are used which are associated with the lowest possible level of waste generation during resource extraction and processing (and environmental pressures in general).

The second question was: "How can measures of public-sector be formulated that tackle these points of leverage?" The following mechanisms or instruments come into question here:

1. Provision of specific advice,
2. Voluntary agreements or commitments,
3. Requirements under regulatory law,
4. Initiation or support of meaningful labels or marks.

A comparable situation also resulted within the field of the points of leverage logistics (IV) and trade (V). Here In this case there were also only very few example measures available, that moreover often had a comparable character or a similar objective direction.

In order to identify new/additional measures the possible options for action were analysed. Thereby it has become apparent that the focus of existing examples mostly was (only) on the prevention of packaging waste. But according to the knowledge of the experts, surplus quantities arising in the distribution of goods of several sectors (in particular food, print products, but also in the case of fashion textiles etc.), which result from logistical systems that are tailored to be as cost and time effective as possible, should also be taken into account. As a consequence as considerable quantities of highly refined products become to waste unused.

There are no simple, generally applicable solutions, especially as newer and stronger demand-oriented concepts in many cases prevent the surpluses and thus initiate greater transport efforts. Governmental agencies can here as well initiate and promote consulting, information, and labelling activities, which could lead to concrete optimisation regionally and specific to product groups. Corresponding waste prevention measures were included in the catalogue of measures, which are to be investigated for their continued suitability in the framework of a national waste prevention programme.

As a result of the clustering and consolidation, a number of 25 waste prevention measures (WPM) exist in the field of conception, production, and distribution phase (field B). These are presented along the corresponding points of leverage in the life-cycle below.

B I Waste prevention in resource extraction

- B I 1 Expansion of existing advisory structures to include the aspect of the production of or link to resources extracted in a manner generating minimum amounts of waste
- B I 2 Voluntary agreements with the primary industry
- B I 3 Initiation or support of meaningful marks or labels for primary materials

B II Waste prevention in manufacturing facilities

- B II 1 Universally binding restrictions at EU level on material inputs to production processes adopted

- B II 2 Adjustment to the state of waste prevention technology of sub-statutory rules and regulations governing installations requiring permits
- B II 3 Provision of support to advance the state of waste prevention technology in facilities
- B II 4 Enforcement of uniform implementation of waste prevention obligations, both in installations requiring permits and those not requiring permits
- B II 5 Institutions and structures to advise facility operators on waste-prevention options
- B II 6 Provision of support for intercompany cooperation on waste prevention
- B II 7 Strengthening of corporate ownership of waste prevention efforts by means of integration into corporate controlling systems

B III Waste-preventing production design

- B III 1 Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive
- B III 2 Information dissemination and awareness-raising for waste-preventing product design
- B III 3 Adoption of (sub-statutory) rules and regulations in support of waste-preventing or resource-conserving product design

B IV Waste-preventing logistics

- B IV 1 Agreements on voluntary measures to reduce "logistics waste"

B V Waste-preventing retail

- B V 1 Support for voluntary measures by the retail sector to prevent (packaging) waste
- B V 2 Provision of information and advice on the prevention of logistics waste
- B V 3 Support for low-waste, regional retail

A detailed characterisation of these waste prevention measures are shown below, using the uniform characterisation pattern (c.f. Section Step 4: Consolidation)

4.2.3 Findings for Field C: Waste-preventing use

During the conflation and verification of the example measures (Step 1) a set of new assignments to the main fields (A-C) of Annex IV WFD, as well as possible withdrawals based on duplications with existing EU regulation, resulted.

After implementing these initial sorting steps, the example measures from the precursor project could be clustered fairly clearly, corresponding to their fundamental features, and could be assigned to the three points of leverage for the utilisation phase of the life-cycle. These steps are presented in the tables of Annex B.

In this manner, 17 waste prevention measures could be derived for the three points of leverage in the sphere of the utilisation phase, which are to be verified for according to their suitability for the national waste prevention programme further on in the process.

The following list shows an overview of these 17 measures.

C VI Waste-preventing purchasing decisions and uses

- C VI 1 Taxes/levies on packaging's and waste-intensive consumer goods
- C VI 2 Greater prioritisation of waste prevention aspects in purchasing recommendations
- C VI 3 Consideration of waste prevention as a part of meaningful ecolabelling of products
- C VI 4 Green / waste-preventing procurement
- C VI 5 Promotion of waste-preventing product service systems
- C VI 6 Waste-preventing organisation of events in public spaces or public facilities

C VII General education measures and public participation in support of waste prevention

- C VII 1 Inclusion of waste prevention in training curricula for teachers and tutors
- C VII 2 Waste prevention in schools and universities
- C VII 3 Support for experiential communication approaches undertaken by the public sector
- C VII 4 Intensive public participation in waste prevention strategies

C VIII Waste-preventing discarding

- C VIII 1 Financial incentives and signals for waste prevention
- C VIII 2 Support for private and non-profit markets and exchanges for discarded products
- C VIII 3 Support for reprocessing structures
- C VIII 4 Support for strategies to prevent food waste
- C VIII 5 Information and awareness-raising of consumers to promote reuse
- C VIII 6 Support for research and development of measures to increase utilisation intensity
- C VIII 7 Institution of food wastes as a research priority

Again using the uniform characterisation pattern (cf. section Step 4: Consolidation) these waste prevention measures are described more detailed in the chapter “Characterisation and evaluation of waste prevention measures in the field A: general frame conditions”.

5 Assessment method for the estimation of environmental consequences

As a matter of principle, waste prevention measures always tackle the point at which waste may potentially be generated. They attempt to influence such arising with regard to their quantity (quantitative approach) and specific contaminant inventory (qualitative approach). The intended or achievable effects are therefore characterised in as great detail as possible for all examples of measures.

As is revealed in Figure 5-1, not all waste prevention measures, however, exclusively have the prevention of environmental pollution in mind that results from disposal (recovery / disposal). This is particularly the case in Phases I to III.

During resource extraction (Phase I) considerable surplus masses arise. The generation of these mass wastes can potentially be influenced, depending upon the selected resource deposit and/or the type of extraction and upgrading process. The characteristics of these masses within the waste management process do not present any major recovery potential; generally the masses arising must be disposed of without any particular benefit.

The production of goods (Phase II) is associated with the generation of production-specific wastes. The selection of particularly efficient engineering and strategic solutions can influence the types and quantities of these wastes. These may also be (mineral) mass wastes that are associated with comparatively small potential environmental benefit in their management. However, production processes also give rise to masses that can be returned directly to the production process or can be consigned as "co-product" to – usually high-grade – recovery.

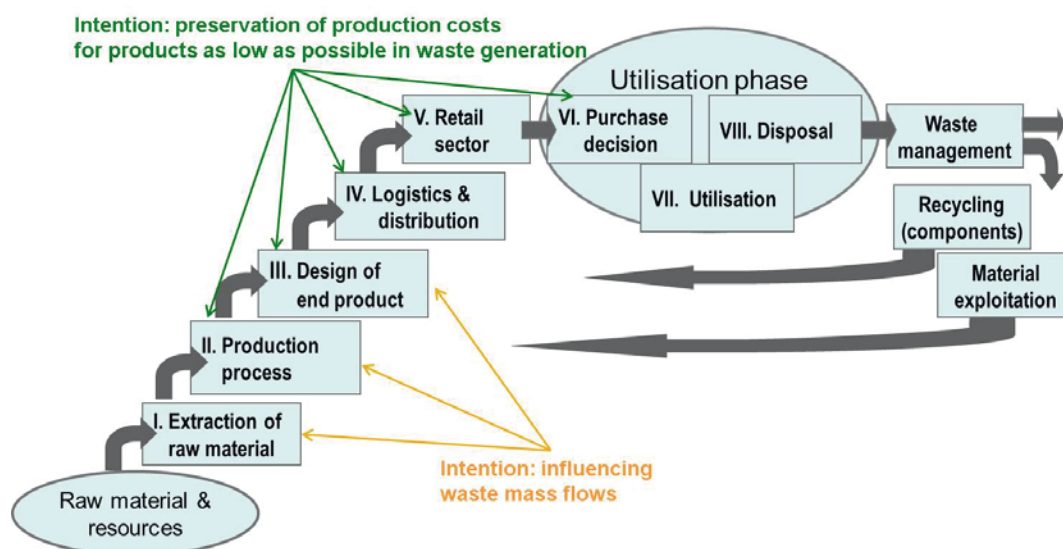


Figure 5-1: Different intentions associated with waste prevention measures

In Phase III, in which product design can be influenced, the above-mentioned waste generation can be influenced indirectly. Through product design, through a corresponding choice of resources or of procurement sources for semi-finished goods, and through the choice of corresponding production engineering solutions, arising of surplus masses in resource extraction and generation of production-specific wastes can be reduced.

There is also a type of waste prevention measure that can apply to the various phases with the exception of Phase I which, while also seeking to specifically tackle potential waste generation and to influence these, is concerned less with reducing or preventing the environmental pressures associated with the management (recovery / disposal) of the waste masses. The main aim of such measures is rather to prevent logistics wastes (packaging's, damage to vessels or cargoes during transport, surplus quantities) and above all to extend the use phase of products and thus to ensure that the high environmental pressures associated with the production of such products is commensurate to product use, i.e. is offset by correspondingly intensive and/or long periods of product use.

If waste prevention measures succeed in influencing waste generation in Phases IV, V and VI positively, this delivers the above-mentioned positive effects to a particularly strong degree. For instance, extending the use period prevents manufacturing inputs, and thus also the environmental pressures associated with production and the waste generation associated with production, especially in Phases I and II.

Furthermore, the wastes generation in Phases III to VI (partly also in II) tend to have characteristics within the waste management process that permit management / recovery that is high-grade and is associated with environmental benefit. On the other hand, with advancing phases of a product and increasing complexity, the effort required to extract recoverable materials can rise or recoverability at the level of materials (as opposed to the level of primary feedstocks) can be called into question fundamentally. Be this as it may, the credits from recovery do generally exceed the debits²⁰. To quantify the environmental effect of a waste prevention measure that tackles these stages, both the reduced production inputs and the lost waste material benefits need to be taken into account. For the present study, it was only possible to inventorise the lost waste material benefit in exceptional cases. The environmental benefit arising from the utilisation of wastes is fundamentally smaller than the environmental damage associated with the manufacture of a product that would then arise as waste. The environmental outcome of the waste prevention measure, however, is effectively the net sum that results from setting off the two effects.

A classic life-cycle assessment (LCA) study would provide such an inventory analysis; it was not possible to conduct such an assessment for the purposes of the present study. The following boundary conditions prevent an exact calculation and inventory analysis of environmental impacts:

- The potentially achievable quantitative outcomes of individual waste prevention measures cannot be characterised, or at best only in a very rough manner. It is not possible to conduct a (more precise) quantification.
- It was not possible to conduct an inventory analysis of the production inputs within the scope of the present study, particularly for complex and heterogeneous product streams. Data from product LCAs are only available in a few individual cases.
- It is generally the case that a greater number of different management options (i.e. recovery and disposal processes) are available for each of the individual waste fractions. A precise inventory analysis of waste management benefits lost due to

²⁰

As set out, in such cases the benefit delivered by prevention through reuse and other measures to extend lifespan or increase utilisation intensity is particularly large and is superior to recovery.

prevention would need to consider all of these aspects; this, too, was not possible within the scope of the present study.

Examples serve to explain the basic procedure and to exemplify the environmental outcomes that result from extending the lifespan and/or increasing the utilisation intensity of selected products. While the measures overall pursue the same or similar goals, it is not possible to determine precisely the contribution made by each individual measure to the (potential) outcome.

Furthermore, such rough assessments could not be carried out for all examples of measures. In some cases only qualitative statements could be made.

The quantitative inventory analysis generally applies the impact category "global warming impact and energy resource conservation" in conjunction with "cumulative material requirement". The assessment of the environmental impacts associated with a measure further examines to what extent other environmental effects need to be taken into account if the assessment findings suggest that these may run counter to a positive climate impact.

The environmental assessment of the individual waste prevention measures can thus only be orientative. Its purpose is to provide an indication, as far as possible, of the differences in environmental potential.

5.1 Waste prevention potential and environmental impacts of measures to extend product lifespan

A number of selected examples illustrate the positive outcomes that an extension of the utilisation period or lifespan and increase of the utilisation intensity of consumer goods can have. It is assumed in the assessments that this leads to correspondingly fewer new products being purchased and manufactured.

The following estimates thus provide indications of the waste prevention potential and environmental impacts of the following measures in particular:

- Principal objective: Extension of utilisation period or lifespan
Measures: A 3.1, B III 1.1&2, B III 2.1&2, B III 3.1&2, C VI 3, C VI 4, C VIII 2, C VIII 3, C VIII 6
- Principal objective: Increase of utilisation intensity
Measures: C VI 5

Ultimately all indirect measures also contribute indirectly to the success of the measures stated.

In addition to the effects presented with regard to climate change mitigation and energy resource conservation, the estimation of which provides a representative indication of the environmental effects associated with several products, the measures deliver for all products savings with regard to further environmental criteria and non-energy resource conservation. Estimates of cumulative resource requirement, in particular, provide an indication of the general level of resource conservation.

Savings of particularly critical resources, such as precious metals and rare earths, are also relevant. It was not possible within the scope of this study to conduct specific inventory

analyses for these aspects. A brief characterisation of linkages is provided and a number of representative estimates are performed in chapter 5.2.

5.1.1 Example: Washing machine

In 2008 approx. washing machines worth 1.35 billion were sold in Germany (ZVEI 2008). The stock of washing machines is worth approx. 38 million and the market is nearly saturated. The lifespan of washing machines in an average household is approx. eleven years (Rüdenauer et al. 2004). Prolonging a washing machine's lifespan by one year thus corresponds to savings of approx. 1/12 of newly manufactured washing machines. Assuming that an average washing machine costs 480 €, 2.8 million washing machines were sold in Germany in 2008 (Rüdenauer et al. 2005).

As is presented in Table 5-1, savings can be made for a relevant quantity of washing machines and the associated burden resulting from production, dependent on the achievable prolongations of lifespan. The data thereby refers to a large span of one or ten years on purpose. This reveals a range of possible savings between approx. 230,000 and 1.33 million machines. The actually achievable prolongation of lifespan lies within this range, depending on the consequence in the implementation of the measures. The credits from end-of-life recycling, which cannot be generated due to the prolongation of lifespan, and the related reduction in the yearly disposal of machines, have already been deduced from the presented examples.

Table 5-1: Ecological savings potentials through prolongation of lifespan of washing machines (Rüdenauer et al. 2005 and a few calculations IFEU)

	Unit	Cumulative Energy Demand (CED) (GJ)	GWP (t CO ₂ -eq)
Production per unit	1	3.51	0.31
End-of-life per unit	1	-0.79	-0.06
Production yearly	2,820,833*	9,895,483	885,742
End-of-life yearly	2,820,833*	-2,236,921	-155,146
Yearly production savings made with a prolongation of lifespan of one year **	231,216	811,105	72,602
Yearly end-of-life savings with a prolongation of lifespan of one year **	231,216	-183,354	-12,717
Net balance savings with a prolongation of lifespan of one year **	231,216	627,751	59,885
Yearly production savings made with a prolongation of lifespan of ten years***	1,330,582	4,667,680	417,803
Yearly end-of-life savings with a prolongation of lifespan of ten years***	1,330,582	-1,055,151	-73,182
Net balance savings with a prolongation of lifespan of ten years***	1,330,582	3,612,529	344,621

Remarks: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

* Calculation from the yearly sales turnover and the average price of a machine

** with a prolongation of lifespan from 11.2 to 12.2 years

*** with a prolongation of lifespan from 11.2 to 21.2 years

On the other hand a longer utilisation period will tend to come at the price of an increased need for repair and for the replacement of structural components. This can for example be control units, or new electrical motors. Disregarding the environmental impacts related to the disposal of exchanged components, the prolongation of lifespan comes at the expense of the ecological cost of manufacturing these replacement components.

The calculation in Table 5-2 are based on SimaPro-data for the control unit, in the way that they are presented in the EuP-study of Faberi et al. (2007), those for the electrical motors on the Ecoinvent-database (EI 2.2). Schäfer (2004) states the weight of an electric motor in a six year old and 67 kg heavy machine as 8.2 kg.

As evident in the comparison of the assessment results, the exchange of the electronic control is profitable already with a prolongation of the utilisation period by one year. The exchange of the electrical motor is linked to a larger effect.

Table 5-2: Costs that arise through prolongation of lifespan of washing machines by exchanging the electronic control or the electric motor

	Piece	Cumulative Energy Demand (CED) (GJ)	GWP (t CO ₂ -eq)
Production per unit electronic control	1	0.1	0.004
Yearly substitute of the electronic control	2,820,833*	279,263	11,960
Production per unit electric motor	1	0.43**	0.03
Yearly substitute of the electric motor	2,820,833*	1,202,617**	73,714
Remarks: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools. * Worst case assumption that the electronic control or the electric motor must be replaced in all old washing machines ** based on the upper calorific value			

But the prolongation of the utilisation phase is also to a large extent associated to waste management in all production steps, as is clear from the estimations of the cumulated raw material demand (CRD). Thus the manufacturing of a washing machine (76 kg weight) is associated with a cumulated raw material demand (CRD) of approx. 660 kg, as is revealed in the following table (Table 5-3). The corresponding materials of a washing machine are assigned to similar materials, for which the specific cumulated raw material demand (CRD) is available from Griegrich et al. (2012). The composition can then be calculated with the specific cumulated raw material demand (CRD)s. As is expected, steel is dominant, followed by electronics. Although the latter only has a low mass, but is bonded to other metals that have a high specific raw material cost.

Waste prevention potential

The annual savings of approx. 230,000 machines, when prolonging the lifespan for one year, imply that overall a saved mass of approx. 17,600 t/a washing machines can be achieved, which corresponds to savings in total raw material consumption of approx. 153,000 t/a.

Table 5-3: Composition of a washing machine of median price and average design from Rüdenauer et al. (2005) and the link to the cumulated raw material demand (CRD) of similar materials from IFEU-environmental profiles (Griegrich et al. 2012).

Material	Mass (g)	Depicted as	(CDR) (mg/g)	(CRD) (kg)
Acrylic-Butadiene-Styrene (ABS)	1,860	Styrene	2,207	4.1
Aluminium	4,120	Aluminium	10,412	42.9
Bronze	20	62 % Copper, 38 % Zinc	62 %*128,085 + 38 %*13,554	1.7
Cable	300	LDPE	1,686	38.7
Carborane 40 %	11,500	40 % Borate	40 %*2,885	13.3
Gray board	2,350	Newspaper printing	1,234	2.9
Concrete	18,680	Cement	1,468	27.4
Copper	750	Copper	128,085	95.7
Cotton with a phenolic binder	380	Cotton tissue	12,683	4.8
Electronic components	540	Laptop	271,130	146
Ethylene-Propylene-Copolymer	2,940	LDPE	1,686	5.0
Glass	1,690	Flat glass	1,629	2.7
Cast iron	1,920	Iron	4,126	7.9
Polyacrylic (PA)	60	LDPE	1,686	0.1
Polymethyl methacrylate	56	LDPE	1,686	0.1
Polyoxymethylene (POM)	46	LDPE	1,686	0.1
Polypropylene (PP)	1,060	LDPE	1,686	1.8
Steel	26,470	Steel	10,023	265
Other	1,190		1,188	1.4
Sum	75,930			662

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

With a prolongation of 10 years of the individual lifespan, 1,33 million washing machines could be economised, resulting to a mass of approx. 100,000 t/a and a cumulated raw material demand (CRD) of 880,000 t/a.

Environmental impact

With these marginal conditions a prolongation of the lifespan of washing machines by

- one year can lead to savings of approx. 630 TJ primary energy and 60,000 t CO₂-eq,
- 10 years can lead to approx. 3.6 million TJ primary energy and approx. 345,000 t CO₂-eq

in manufacturing costs.

These savings can in certain cases be reduced through increased costs in manufacturing and maintenance or repair (cf. chapter in the point of leverage III: Waste preventing product design, and chapter Measure C VIII 3: Support of preparation structures).

Particularly when prolonging the lifespan of devices already on the market today through measures such as increasing their reuse, however, the higher energy consumption during the utilisation phase, which overall leads to a reduction of possible savings, must be considered. Today already many actors in the field of second-hand articles take into consideration that only such devices, where the savings through a longer lifespan exceed the additional costs resulting from higher energy expenditure, should be reused. Moreover, within the context of refurbishing washing machines, there is the possibility of upgrading the machines. In the framework of measures to promote reuse these aspects should be taken into account and corresponding requirements specified (cf. chapter Measure C VIII 3: Support of preparation structures).

This is less relevant for measures that address the prolongation of lifespan through requirements to manufacturing or through conscious purchasing decision, because as they concern new machines that in future are supposed to last one year longer. It can be assumed that a conscious purchasing decision for waste-preventing washing machines also includes considering the energy efficiency of the machines and that the expected increases in efficiency for currently high-end devices will be less high. When implementing the measures it should be actively promoted that other environmental matters such as energy efficiency are considered.

5.1.2 Example: Passenger cars

3.8 million new passenger cars were registered in Germany²¹ in 2009. Assuming that the market is saturated and disregarding the export of vehicles for the sake of a conservative estimate, then the level of new registrations corresponds to an identical number of scrapings.

Table 5-4 illustrates both, the environmental impacts related to car production and the maximum possible savings achievable either through the prolongation of lifespan and/or increasing the utilisation intensity (e.g. CarSharing) - in this example by a reduction of 1/8 of new registrations.

The manufacturing of a car that weighs one ton corresponds to a cumulated raw material demand of 6.9 t (Griegrich et al. 2012). This is an indication for the fact that a large extent of surpluses destined for disposal are created in all steps of raw material extraction and processing up until the manufacture of a vehicle.

Waste prevention potential

The reduction of yearly produced vehicles by 1/8 of the currently permitted amount of new cars would entail a reduction of car masses of approx. 0.5 million t/a and thus a reduction of the cumulated raw material demand of around 3.3 million t/a.

²¹ <http://www.kfz.net/news/neuzulassungen/> ; accessed 15.02.2012

Table 5-4: Environmental impacts for the manufacturing of cars, as well as savings potentials through prolongation of lifespan

	Unit	CED (GJ)	GWP (t CO ₂ -eq)
Production per unit	1	84.9*	4.24
Yearly registration	3,810,000	323,469,000*	16,154,400
Production cost savings	476,250	40,433,625*	2,019,300
Charges through disposal	1	2.36	0.42
Credits for disposal	1	45.9	2.59
Disposal including credits	476,250	-20,735,925	-1,033,463
Net balance		19,697,700	985,837

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

* based on the upper calorific value

Environmental impacts

The environmental effect thus results in a reduction by 280 million GJ in primary energy costs and a climate contribution that is reduced by 16 million t CO₂-eq. But the disposal and the utilisation of the secondary materials are not incorporated here; their consideration would further reduce the burden. The end-of-life phase in the first place causes a burden from the dismantling and disposal. This burden is assessed using the data from Ecoinvent (2012). The conservative assumption is made that all materials of a car can be fed into secondary utilisation directly, and that the thus obtained secondary materials replace the corresponding primary material entirely. The composition of a car thereby determines the mass of secondary material that accrues. According to Schweimer et al. (1999), steel and iron represent the main share with 65.7 %, followed by 12.1 % plastics, 5 % rubber and 3.3 % light metal (above all aluminium alloys), approximated here to 80 % steel, 15 % LDPE-plastics and 5 % aluminium. The manufacturing of the corresponding primary materials according to Ecoinvent (2012) thus leads to the credits displayed in Table 5-4

Hence, a disposal including recycling of 0.5 million t/a, cars can roughly obtain a credit of 19 million GJ primary energy costs and 5.8 million t CO₂-eq, so that a net saving of nearly 270 million GJ primary energy and near to 9 million t CO₂-eq remains.

5.1.3 Example: Printer

In Germany approx. 5.8 million inkjet and around 21,000 laser printers were sold in the private sector in 2006. The stock in 2005 was at approx. 23 million inkjet printers and 0.7 million laser printers (InfoTrends cites Graulich 2007). The lifespan of printers fluctuates between four and six years (Graulich 2007, Stobbe 2007).

With the prolongation of the lifespan for a period of one year respectively, for the inkjet printers from four to five years and for laser printers from six to seven years, the sales figure, given the same printer density, is reduced by:

- 1.15 million inkjet printers and

- 3,000 laser printers

per year. Consequently the production and the associated environmental impacts change to a similar extent. This is a conservative estimation, as assuming that the market is probably not saturated, yet.

In printers, plastics followed by steel present the main mass fractions. Compared to the washing machine the share of copper and electronics of the overall mass is considerably higher. Given that the manufacture of 1 t of copper requires 128 t of raw material input, whereas for the same amount of plastic to be produced an average of only 2 t is required, the raw material input for electronics and copper dominates despite the low mass. Thus in total, raw material quantities, which are considerably higher than double the product's weight, are consumed.

Table 5-5: Environmental impacts for the manufacture of printers, as well as savings potentials through prolongation of lifespan

	Unit	CED (GJ)	GWP (t CO ₂ -eq)
Production per unit inkjet/ <i>laser</i>	1/ 1	1.44 / 4.63	0.07 / 0.24
End-of-life per unit inkjet/ <i>laser</i>	1/ 1	0.07 / 0.14	0.007 / 0.02
Yearly production of inkjet/ <i>laser</i>	5,759,000 / 21,000	8,799,752 / 104,433	460,720 / 5,481
Yearly end-of-life for inkjet/ <i>laser</i>	5,759,000 / 21,000	397,371 / 2,982	40,313 / 420
Yearly production savings through prolongation of lifespan by one year* inkjet/ <i>laser</i>	1,151,800 / 3,000	1,759,950 / 14,919	92,144 / 783
Yearly end-of-life savings through prolongation of lifespan by one year* inkjet/ <i>laser</i>	1,151,800 / 3,000	79,474 / 426	8,062 / 60
Net balance savings through prolongation of lifespan by one year inkjet/<i>laser</i>	1,151,800 / 3,000	1,839,424 / 15,345	100,206 / 843

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source and are thus the basis for the implemented calculation tools.

* with the prolongation of lifespan from four to five years in inkjet printers and from six to seven years in laser printers

In Table 5-6 the changed composition of an inkjet printer according to Stobbe (2007) is compiled. The electronic components pulled together in a simplified way. Similar materials are assigned to the corresponding materials, for which the specific cumulated raw material demand are available from Griegrich et al. (2012). The cumulated raw material demand is over-estimated in doing so. This is due to the all-inclusive figure of electronics with the laptop environmental profile. This illustrates that small masses of electronics and metals like copper and platinum dominate the cumulated raw material demand by their upstream chains.

Table 5-6: Composition of an inkjet printer from Stobbe (2007) and the link to the cumulated raw material demand (CRD) of similar materials from IFEU environmental profiles (Giegrich et al. 2012)

Material	Masses (g)	Presented as	(CRD) (g/g)	(CRD) (kg)
LDPE	97.1	LDPE	1.7	0.16
HDPE	40.8	LDPE	1.7	0.07
PP	76.2	LDPE	1.7	0.13
PS	768	Styrene	2.2	1.69
EPS	51	Styrene	2.2	0.11
HI-PS	2,335	Styrene	2.2	5.15
PVC	41.2	Styrene	2.2	0.09
SAN	2.7	Styrene	2.2	0.01
ABS	1,042	Styrene	2.2	2.30
PA	212	Styrene	2.2	0.47
PC	84.9	Styrene	2.2	0.19
PMMA	16.6	Styrene	2.2	0.04
Epoxy	5.9	Styrene	2.2	0.01
PUR	154	Styrene	2.2	0.34
Steel	1,890	Steel	10.0	19.0
Ferrite	38.1	Iron	4.1	0.16
Al	67.2	Aluminium	10.4	0.70
Cu	226	Copper	128	29.0
Au/Pd/Pt	0.2	Platinum S-Africa	190,000	38.0
Big caps & coils	90.5	Steel	10.0	0.91
Slots / ext. ports	28.2	Steel	10.0	0.28
Electronics	360	Laptop	271	97.6
Glass	650	Flat glass	1.6	1.06
Cardboard	901	Newspaper printing	1.2	1.11
Paper	161	Newspaper printing	1.2	0.20
Sum	9,355			199

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

The cumulated raw material demand for the colour laser printer available in the Ecoinvent-database (printer, laser, colour, ex works) which weighs 4.6 kg and has a packaging, mainly consisting from cardboard, with a weight of 1.6 kg, is approx. 79 kg (calculation by IFEU).

Waste prevention potential

Assuming that the before mentioned masses per printer correspond approximately to the respective average and that the cumulated raw material demand for inkjet printers, notwithstanding Table 5-6 correspond to that of the laser printers, then the annual reduction of each printer respectively can make mass savings of:

- approx. 11,000 t/a inkjet printers and a corresponding cumulative raw material demand of nearly 91,000 t/a, as well as
- approx. 14 t/a laser printers and a corresponding cumulative raw material demand of near to 237 t/a.

Environmental impacts

Using the figures for the environmental evaluation from Stobbe (2007), who evaluates as a basic scenario a single-function colour printer and a multifunction inkjet printer, then the prolongation of the lifespan of printers in the private sector by one year would be connected to an environmental relief of 1.8 million GJ and 100,000 t CO₂-eq per year in the case of inkjet printers, and in the case of laser printers to 15,000 GJ and 800 t CO₂-eq per year.

Expectantly measures for prolongation of the lifespan also cause environmental impacts, the savings values are narrowed down slightly. Reasons for this are for instance an increased production effort or an increased repair effort in combination with the therefore required substitute component provision. However, experience and estimations regularly show that the advantages of an increased lifespan outweigh the connected disadvantages by far!

5.1.4 Example: Laptop

In 2009 13 million computers were sold in Germany, of which 9 million were laptops (Prakash et al. 2010). The lifespan of computers and laptops is very variable and can last from three and a half to seven years. On average it is approx. five years for a laptop and six years for a desktop PC (Jönbrink 2007).

The manufacture of laptops is linked to high environmental impacts. The lifespan prolongation is thus an important tool from both a waste and an environmental perspective (Table 5-7). Thus the highest estimate (assuming a saturated market) is that for a prolongation of lifespan from five to seven years, newly produced laptops and thus the production costs could be reduced by 2/7.

A prolongation of lifespan in laptops and computers can be achieved above all through upgrading and modifications, as certain technological components easily become obsolete rapidly. One measure could be an upgrade by means of RAM-components in the working memory. Equally an exchange of the battery or the purchase of additional hard drives is conceivable. A defect CD-/DVD-drives can also be exchanged. Defect power supply units should also be replaced.

Table 5-7: Environmental impacts for the manufacture of laptops sold yearly in Germany as well as savings potentials through prolongation of lifespan

	Unit	CED (GJ)	GWP (t CO ₂ -eq)
Production per unit	1	1.27	0.08
End-of-life per unit	1	-0.02	-0.001
Yearly production	8,646,000	10,945,836	700,326
Yearly end-of-life	8,646,000	-172,920	-8,646
Yearly production savings made through a prolongation of lifespan by two years	2,470,286	3,127,382	200,093
Yearly end-of-life savings made through a prolongation of lifespan by two years	2,470,286	-49,406	-2,470
Yearly net balance of savings through a prolongation of lifespan by two years	2,470,286	3,077,976	197,623

The specific environmental impacts of some of these measures are illustrated in Table 5-8. The figures are based on those from the Ecoinvent-database (EI 2.2). The disposal of these components is not taken into account here. The extrapolation includes the assumption that the substitute components are respectively built into a number of laptops equal to the newly purchased devices, in order to achieve a corresponding prolongation of the lifespan.

Table 5-8: Environmental impacts for the manufacture of laptop replacement parts and an estimation of the maximum environmental impacts linked to this in the course of prolonging the lifespan of a laptop

	Unit	CED (GJ)	GWP (t CO ₂ -eq)
Production per lithium ion battery	1	0.02*	0.001
Production per battery yearly	8,646,000	177,961*	9,572
Production per HDD drive	1	0.06*	0.003
Production HDD yearly	8,646,000	527,296*	29,143
Production per CD drive	1	0.09*	0.005
Production CD yearly	8,646,000	808,905*	44,373
Production power supply	1	0.06*	0.004
Production power supply yearly	8,646,000	532,896*	32,659

* based on the upper calorific value

In the comparison of the assessment results it is revealed that it is also useful from an ecological perspective to modify existing laptops instead of replacing them with new hardware. This causes a considerable waste prevention potential with it in the steps of raw material extraction, processing and manufacturing of the computers. This becomes clear from the raw material input that weights 270 higher than the product.

In these appliances a lot of electronics is built in small mass. Thus when disposing of it, it is not only the product that is decisive, but also the surpluses, which accrue during production and that newly accrue again when newly producing hardware, which is to replace the old machine. This is valid at least as long as secondary materials from disposed laptops are remain unused during producing production of new laptops.

For instance, in order to manufacture 1 kg of gold, a raw material input of 740 t is necessary, for 1 kg platinum 67 t, for 1 kg rhodium from South Africa 485 t and for 1 kg iridium 120 t (Griegrich et al. 2012).

Waste prevention potential

Annual savings of approx. 2.5 million devices with a prolongation of lifespan of 2 years corresponds in total to mass savings in laptops of approx. 6,900 t/a, which in turn is equivalent to savings in total raw material consumption of around 1.9 million t/a.

Environmental impacts

Reducing the new production due to an increased product lifespan by two years, leads to a decrease in yearly primary energy costs for the manufacture of laptops of around 3 million GJ/a. The emissions that contribute to the greenhouse effect decrease by around 200,000 t CO₂-eq/a.

5.2 Excursus: Protecting “critical” resources

In electronic products a multitude of metals and rare and earths are contained. To be considered as particularly critical due to their scarcity are cobalt, gallium, germanium, indium, platinum group metals, rare earths, and tantalum (Buchert et al. 2012).

An economic use of these materials is required in particular due to the large future demand in key technologies. Some of the mentioned materials are indispensable for the manufacturing of wind turbines, and thus also for the move to alternative energy sources. Electrical mobility is impossible without these materials. Nearly all high-tech devices that have become indispensable in today’s society equally require these materials. A depletion of these reserves could thus jeopardize the societal progress.

Besides, the extraction of said materials is linked to a large raw material cost, because the desired product precursors are only present in low concentrations in the basic raw material. Table 5-9 lists the cumulated raw material demand for some of the mentioned materials. Material extraction from secondary materials is thus interesting from a waste management perspective due to the large surplus masses that accrue when extracting primary raw materials. The surplus masses increase with decreasing concentrations in basic raw materials, and thus also with increasing shortages and exploitation.

Raw material extraction is moreover linked to environmental impacts that are presented for a few materials in Table 5-9. Furthermore, upgrading of ore can be linked to environmental impacts. During the flotation of material from mines for the selective separation of the contained rare earths, so called flotation tailings are created, which are a mixture of chemicals, water and finely ground material, which equally containing heavy metals and radioactive materials. The tailings are fed into tailing ponds. E.g. a dam burst (as occurred in Hungary in October 2010) could have devastating consequences for the environment

(Schüler, Dietrich 2012). Such environmental catastrophes cannot be illustrated by LCAs. The stacking of surplus mass equally entails the threat of a concentrated leaching of heavy metals, salts, and radioactive substances in earths, groundwater and waters, for which LCA estimates are not possible, as there is a lack of fundamental data and/or an ecological evaluation method is missing. Because the masses that are to be moved increase with further shortages, environmental pollution increases through material extraction.

Table 5-9: cumulated raw material demand (CRD) for different metals and the environmental impact that is linked to their primary manufacture

Material	(CRD) (t/kg)	CED (GJ/kg)	GWP (kg/kg)
Cobalt	0.056	0.1	7.72
Tantalum	9.18	3.36	233
Silver	6.83	1.67	124
Gold	740	261	17,903
Indium	25.8	1.98	149
Palladium	51.4	169	10,277
Platinum	190	252	15,286
Gallium	1.67	2.7	186

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

Despite the problem discussed above, rare earths are up to date only recycled to less than 1 % (Buchert et al. 2012). The reuse of rare earths in electronic scrap can reduce the amount of moved raw material masses, air emissions, groundwater entry, and acidification and eutrophication. The reserves would be protected, and thus the environmental burden from necessarily remaining primary products would be reduced. Social progress would remain less threatened.

The most critical is the situation of metals, which require cumulated raw material demand (CRD) and have a short static range. The exploitation of problematic deposits with corresponding consequences for the environment is pre-programmed.

Table 5-10 illustrates the loss of critical materials in the recycling process of laptops. The material flows refer to the mass of critical materials, as they were built into laptops in Germany in 2010 (Buchert et al. 2012).

Evidently recycling of laptops with state of the art technology cannot prevent a large loss of critical material, which in turn corresponds to a large loss in cumulative raw material (see also Table 5-10). An option to improve recycling processes is a better capturing of the accrual of laptops followed by manual disassembling, so that sorting losses are reduced. Another option is a prolongation of a laptop's lifespan, so that less critical material is required in the first place. In the long term both options should be realised. Both options address a relevant waste prevention potential, especially with respect to the accrual of surplus masses in the course of material production.

Table 5-10: Loss of critical materials during the recycling process of laptops. Reference quantity: sold quantity of notebooks in Germany in 2010 (after cf. Buchert et al. 2012 and Giegrich et al. 2012).

Material	Losses	Source of Losses	Losses when recycling notebooks (kg)	CRD losses (1,000 t)
Precious metals	70 %	collection, pre-treatment		
Gold			515	381
Silver			2,174	14.9
Palladium			196	10.1
Platinum			19.9	3.78
Other metals	>99 %			
Tantalum		sorting, refining	11,944	110
Gallium		no technology	10.2	0.02
Indium		no technology	283	7.29
Rare earths	>99 %	sorting, refining		
Neodymium			2,100	

Remark: The listing of for the most part not rounded data is no indication for their accuracy. The data were adopted as such from the original source, and are thus the basis for the implemented calculation tools.

From an ecological perspective the prolongation of lifespan is more effective than recycling, because as the recovery of materials from scrap is linked to energy input and the materials thus are not available without an ecological footprint.

The extraction of secondary gold from a refinery (without sorting and collecting) is linked to an 852 kg CO₂-eq/kg greenhouse gas potential or 7,000 MJ/kg in primary energy costs. For secondary silver the figures are nearly 15 kg CO₂-eq/kg or 120 MJ/kg, for palladium kg 786 CO₂-eq/kg or 13,000 MJ/kg and for platinum 759 kg CO₂-eq/kg or 13,000 MJ/kg. The cost for the primary manufacture of precious metals thus outweighs those for the manufacture of secondary materials by far, so that complete recycling of precious metals is ecologically nearly as effective as a prolongation of lifespan of the corresponding products, and thus is to be recommended from both perspectives, waste management and ecological.

In order to classify the gold quantity contained in laptops compared to the overall gold trade flow in Germany, the 736 kg gold present in laptops sold in Germany (Buchert et al. 2012) can be compared to the imports of gold to Germany. The cumulated raw material demand connected to the gold present in laptops sold is approx. 540,000 t. Germany annually imports gold as a metal or built into finished goods with an cumulated raw material demand of 86 million t (calculated from Giegrich et al. 2012). The gold contained in laptops can thus only account for nearly to 1 % of German gold demand for the sum of the domestic and the German export market.

6 Characterisation and evaluation of the waste prevention measures in Field A: General framework conditions

In numbers 1-3 of Annex IV of WFD the waste prevention measures that target the framework conditions of waste generation are discussed. These are not to be assigned to the individual points of leverage of the life-cycle steps according to Figure 4-4²².

6.1 Overarching measures in points of leverage I to VIII

The measures in Field A can concern the whole life-cycle steps in the points of leverage I to VIII.

6.1.1 Measure A 1: Development of waste prevention strategies and approaches

Waste prevention strategies and concepts on a national waste prevention programme that are not subject to the direct obligations of the EU Waste Prevention Directive can be initiated for different causes and by actors in state trade on all levels.

In the past, municipalities above all engaged in such considerations. These were partly reflected in independent documents, programmes and concepts on waste prevention. In part, these reflections were triggered during large-scale events. Thus key areas for measures in waste prevention reflect the limited responsibility of the municipalities.

6.1.1.1 Example measure A 1.1: Development of waste prevention strategies and approaches by state bodies

Background

Reinforcement of waste prevention is to be reached through the development of measures that are adapted to the respective stakeholders, or specific occasions.

The municipality can develop waste prevention programmes at their level or can design separate programmes for waste prevention for individual occasions. In a multitude of municipalities either separate waste prevention programmes have been composed, or these are part of existing waste management concepts or programmes. Representations for all these approaches are the examples from study I:

- Waste prevention concept in Dresden (no. 218),
- Waste prevention concept in the Hassberg district (no. 291),
- Waste concept in Korbach with amendments to the statutes for the Hessentag Festival 1997 (no. 53).

The effort on the municipal level is usually limited due to their responsibilities:

- rigorous one-way ban for events in public space through corresponding clauses and sanction mechanisms (Korbach 1997),

²²

Therefore the denomination of the measures and example measures in this area occurs without reference to points of leverage.

- requirement to employ reusable cups made from plastic as well as ‘mobile dishwashers’ during events in public space through corresponding clauses and sanction mechanisms (Korbach 1997),
- recommendations towards using a shopping bag rather than a plastic bag (Haßberge 2009),
- recommendations on low-waste shopping (Haßberge 2009),
- recommendations on the reuse of household objects and second hand vehicles (Dresden 1999),
- repair guides (Dresden 1999),
- environmental education lessons (Dresden 1999),
- general waste consultation
- and similar measures.

On the level of the Federation and the States it is for instance conceivable to use the occasion of events of trans-regional significance, like the European Capital of Culture (e.g. the Ruhr area), or the national, respectively the state, garden show in the town XY, or the world championships in the sport Z, to newly consider the possibilities of waste prevention and partly define it through further approaches.

Objectives

In formulating overarching objectives, the designation of fundamentally desired effects and suitable measure packets, a framework is constructed, which is realised and substantiated during the subordinated and subsequent implementation.

Characterisation

Government bodies develop waste prevention strategies and (implementation) concepts on the different organisational levels (Federation, Federal States, municipalities ...). Below the national waste prevention programme, a framework for the respective levels or the respective occasions can be created, through the formulation of overarching objectives, the denomination of fundamentally desired effects and suitable measure packets; this framework is then substantiated and realised in subordinated and/or subsequent implementation.

Initiators and addressees

The initiator for the national level is the Federation. The Federal States can e.g. prompt a separate environmental programme for individual occasions, which also contain waste prevention measures – similar to what the German Football Federation did on the occasion of the World Cup 2006 (Stahl et al. 2006) and the Woman’s World Cup 2011 (Havers et al. 2011).

The municipalities can equally compile waste prevention measures, or prompt separate for individual occasions.

The addressees are on the one hand the implementation bodies of state trade and directly also the consumers.

Waste prevention potential

The development of waste prevention strategies and concepts, as well as the connected medium-term commitment by political decision makers on the municipal level represent a certain waste prevention potential. However, prevention effects could not be proven in practice on the municipal level through a demonstrable decrease in waste quantities. The sum of residual waste and recovered waste has partly increased on the municipal level in the past years, despite such efforts. Still, this observation does not exclude that the waste quantities of, e.g. a certain large-scale event in municipality XY have effectively decreased, notably compared to the previous year, as a result of greater attention to waste-preventing measures.

Environment impacts

The development of waste prevention strategies and concepts can to a certain extent also bring about a decrease effect, respectively burden, in other environmental fields. But the places of burden and relief can differ, so that occasional additional loads cannot be excluded.

Indicators

Indicators for the evaluation of waste prevention strategies and concepts are above all:

- their binding character,
- their degree of detail, and
- the degree to which they are oriented towards implementation.

Social impacts

The creation and implementation of waste prevention strategies and concepts usually have no direct Social impacts on larger parts of the population.

The creation of waste prevention strategies and concepts can contribute and promote a social and scientific debate on the topic of sustainable life-style and production ways.

Economic impacts

The creation and implementation of waste prevention strategies and concepts usually have no direct economic impact on larger parts of the population.

Conclusion

The development of waste prevention strategies and concepts complements activities that are superordinated, and reach further, through selective and location-related measures.

Remarks

The example measure is recommended for implementation.

Example measure A 1.1: Development of waste prevention strategies and approaches by state bodies	
Objectives	Through the formulation of overarching objectives, the designation of fundamentally desired effects and suitable measure packets, a framework is constructed, which is realised and substantiated during the subordinated and subsequent implementation.
Characterisation	Government (state) bodies develop waste prevention strategies and (implementation) concepts on the different organisational levels (Federation, Federal States, municipalities, ...). Through the formulation of overarching objectives, the denomination of fundamentally desired effects and suitable measure packets can provide a framework for the respective levels or the respective occasions, which is substantiated and realised in subordinated and/or subsequent implementation.
Reference to the measures in Study I	(207): "National Waste Management Plan" (Sweden) (218): Waste Prevention Concept in Dresden (291): Homepage on a Waste Prevention Concept in the district of Haßberg (53): Waste prevention concept with statutory amendments for the festival Hessentag 1997.
Link to Annex IV WFD	1. The use of planning measures, or other economic instruments promoting the efficient use of resources.
Instrumental character	Medium-term commitment of political decision-makers
Initiators	Federation/Federal States/municipalities
Addressees	Direct: control and implementation bodies of the state trade Indirect: consumers
Waste prevention potential	Waste-preventing effects can be identified in part.
Environmental impacts	Improvements are generally also to be expected with regards to other environmental effects and fields. However, fields of burden and reduction can be different, so that occasional additional loads cannot be excluded.
Indicators/Bench-marks	<ul style="list-style-type: none"> - binding character - degree of detail - degree to which they are oriented towards implementation
Social impacts	The creation and implementation of waste prevention strategies and concepts usually have no direct Social impacts on larger parts of the population. The building of waste prevention strategies and concepts can contribute and promote a social and scientific debate on the topic of sustainable life-style and production ways.
Economic impacts	The creation and implementation of waste prevention strategies and concepts usually have no direct economic impact on larger parts of the population.
Conclusion	The development of waste prevention strategies and concepts complements activities that are superordinated, and reach further, through selective and location-related measures.
Recommendation	The example measure is recommended for implementation.

6.1.2 Measure A 2: Establishment of overarching cooperation of stakeholders

Background

Waste prevention is influenced by a multitude of stakeholders: by customers through their desires, suppliers based on their range of articles, the manufacturing industry, administrative bodies and trade associations due to official requirements, as well as associations and chambers via their information policy.

Experiences with waste prevention projects reveal that potentials often cannot be exhausted, because the various stakeholders in the value chain are not sufficiently informed of each other's needs (Oeko-Institut 2011). Thus in order to optimally implement waste prevention concepts, it is recommended that a cooperation of the various stakeholders within a product's value chain is formed.

6.1.2.1 Example Measure A 2.1: Establishment of overarching cooperation of stakeholders throughout value chains

Background

The procedure in the coordination of cooperation among actors was suggested by the Oeko-Institut on the basis of the foodstuffs aliment value chain, within the framework of a study on waste prevention in Schleswig-Holstein (Oeko-Institut 2011). This procedure should in the future also be applied to other value chains. Examples for "best practice" from different countries and branches are to be found inter alia on the website of the European Commission (EU 2012).

A voluntary cooperation can have numerous advantages compared to rules and bans. Amongst others things, the resistance to their introduction as well as the surveillance efforts can be lower (Reisinger und Krammer 2007). In addition, the motivation not only to adhere to the rules but to also to be pro-active, increases (Reisinger and Krammer 2007). Actors in commercial enterprises (especially suppliers) consider the advantage of a joint procedure in actors' cooperation to be that the readiness of trading partners to offer corresponding solutions increases through the stronger demand for waste-preventing conceptual solutions.

Objectives

The objective of this measure is to find the causes for the generation of preventable waste in the entire value chain and to work out solution possibilities for their prevention, through actors' cooperation.

Characterisation

The public sector initiates and supports actors' cooperation along value chains. Control committees are to integrate existing networks in the public sector and in associations. Strategy circles unite stakeholders from participating businesses and form a platform for deciding on what the entire procedure per supply-chain should be. The concrete measures, e.g. "best-practice"-examples, specialist conferences or "idea-competitions" are then developed and implemented in expert working groups.

Initiators and addressees

This measure is initiated through actors of the public sector at the level of the Federation, of the Federal States, and the municipalities.

Addressees are all actors in the value chains of the different sectors.

Example measure A 2.1: Establishment of overarching cooperation of stakeholders throughout value chains	
Objectives	Causes for the generation of waste in the entire value chain are to be identified and possible solutions worked out for their prevention.
Characterisation	The public sector initiates and supports stakeholders' cooperation along value chains. Control committees are to integrate existing networks in the public sector and in associations. Strategy circles unite stakeholders from participating businesses and form a platform for deciding on what the entire procedure per supply-chain should be. The concrete measures, e.g. "best-practice" examples, specialist conferences or "idea competitions" are then developed and implemented in expert working groups.
Link to measures set out in Study I	(134): Government Commission on the subject of waste (Lower Saxony) (186): Zero Waste Strategy (USA)
Link to Annex IV WFD	Cannot clearly be assigned: 1. Deployment of planning measures 8. Awareness campaigns or support to businesses 9. The use of voluntary agreements, consumer/producer panels or industry-related negotiations
Instrumental character	Communication
Initiators	Federation/Federal States/municipalities
Addressees	All stakeholders involved in a value chain
Waste prevention potential and environmental impacts	Concrete statements are not possible due to the unspecific mode of action, and depend, i.a., on the selected branches.
Indicators	Number of initiated cooperation and the share of involved stakeholders.
Social impacts	No negative impacts. Collaboration and communication usually also last in the long term.
Economic impacts	Cost savings in waste disposal and primary materials.
Conclusion	This measure brings together different stakeholders of a value chain, and promotes the exchange of problems and experiences within waste prevention.
Recommendation	The example measure is recommended for implementation.

Waste prevention potential and environmental impacts

A statement on the waste prevention potential and the environmental impacts is not possible in advance due to the unspecific mode of action, since they depend on the i.a sector. Thus an initial estimation is only possible after the introduction of various collaborations and a first evaluation with reference to the respective branches.

Indicators

Over-arching indicators cannot be named for these measures. In principle, though, the number of initiated cooperation and the share of involved actors can be used as indicators.

Social impacts

Through joint meetings and symposia on waste prevention, the stakeholders come into close contact, which often lasts long after finishing work on waste prevention concepts.

Economic impacts

The decrease in waste generation leads to saved costs for the disposal of waste, as well as for the procurement of resources, in the participating companies and commercial enterprises. Furthermore, additional cost savings are made for primary material, through higher return and recycling quotas. This will at least compensate the required transaction costs and those for the implementation of concrete measures.

Conclusion

This measure unites the different stakeholders of a value chain and promotes the exchange of experiences and problems within waste prevention. It helps to develop optimal waste prevention measures and supports their execution and acceptance. In sectors having a potential for waste prevention, this measure contributes considerably to its exploitation.

Recommendation

The example measure is recommended for implementation.

6.1.3 Measure A 3: Waste-preventing design of economic settings

Background

The analysis of economic framework conditions for waste prevention measures is to investigate economic regulation instruments with respect to their waste-preventing effect. Especially in the analysis of taxes and subsidies with regards to their steering and incentive-giving effect, there are considerable waste prevention potentials, which can be exploited through the modification of existing regulations or through the introduction of new instruments.

For the estimation of concrete waste prevention potentials of taxes and subsidies it is important to consider that these fundamentally represent macro-economic instruments, which take effect on broader fields of the economy and society. They generally address waste prevention not directly.

Fundamental ecological effects of taxes and subsidies

An objective of taxes and subsidies as a macro-economic instrument is to set incentives for behavioural change of market participants. Ecological finance and tax reforms primarily target behavioural change, seeking a shift in relative prices through burdening, or relieving. Desired ecological effects of taxes target the internalisation of negative external effects or the strengthening of positive external effects through subsidies.

These can on the one hand aim on production factors, e.g. cheapening the factor of work in relation to the factor of capital, and thus they tend to bring about changes in the cost and thereby also in the production structure. On the other hand, taxes and subsidies can change the relative commodity prices and thereby cause substitution and other adaptation reactions within consumers.

Taxes and subsidies in the context of waste prevention

An efficient use of resources in the production process is strongly correlated to the relative cost structure of the production factors. Simultaneously the extraction and treatment of resources is particularly characterised by high external follow-up costs that can bring about negative ecological and social damages. But also in the consumption of goods and services incentives can be set through taxes and subsidies, in order to promote waste-preventing behaviour. The macroeconomic instruments that have been debated here, aim to effectively prevent surplus and waste quantities through a shift of relative and absolute prices.

It should be noted that the instruments of taxes and subsidies address principal objectives, as e.g. the improvement of resource efficiency is addressed, which at the same time implies the sub-objective “waste prevention”. These instruments extend far beyond “pure” waste prevention measures in their effect.

As concrete example measures for the characterisation and evaluation of these measures, the following are selected:

- the development of an implementation concept for an EU-wide product-resources-tax,
- the dismantling of environmentally harmful subsidies and incentive measures,
- Abolishing the reduced VAT on meat products.

6.1.3.1 Example measure A 3.1: Development of an implementation strategy for an EU-wide product resource tax

Background

Several versions for the taxation of resource use are being discussed, which differ in their details. The key word “material input tax” signifies the taxation of resource use. Because a large majority of resource use and raw material extraction occurs abroad, taxation at source is excluded for the majority of products, so that the taxes fall onto the materials of the products brought onto the market. This form of taxation of resource use is also discussed under the denomination of the product-resources-taxation (cf. e.g. UBA 2012 and Eckermann 2011). The final effects of resource taxes, that is to say the targeted cost rise for new production, are similar for the different versions.

The product-resources-tax represents a financial measure in line with market requirements, which is to lead to decreased material demand and intensity and higher resource productivity through financial incentives/sanctions; at the same time the latter is to contribute to the internalisation of external costs and resource use.

Direct and indirect waste prevention is to be addressed through the intentional steering effect of this tax, because resource intensive production methods and products become relatively expensive. With sufficiently high tax rates that perform a steering function, the

medium and long-term incentive for companies to develop resource-efficient products increases. As a consequence, waste can be prevented both, directly (e.g. overburden from mining) and indirectly (e.g. emissions in environmental media like water, air).

The assessment basis for the tax is the quantity of primary resources contained in products in conjunction with indicators for the environmental pollution caused by resource use (UBA 2012).

The distributors of products are the taxpayers. It is the resource use in production that is taxed. A transfer of burden onto the consumers is to be expected depending on the competitive environment, whereby, however, waste-preventing behaviour is equally promoted. In order not to discriminate the domestic industry negatively, and to reduce industrial migration in trade with other countries in which the resource tax does not apply, a supplementary WTO-compliant import duty of the same level on the resource use for the manufacture of products is to be introduced (cf. also Omann, Schwerd 2003, Fös 2011). Equally a tax exemption for products destined for the export into countries without a resource tax is necessary in order to maintain international competitiveness of the concerned domestic sectors, and not to discriminate them through this taxation.

Determining the level of taxation, taxpayers are to provide a breakdown of the comprised raw materials. These data are aligned with standard and average values of data from comparable products or figures from the literature to control them.

To determine the tax rate, binding parameters for environmental pollution, which are caused by these materials, are created²³. To simplify the implementation of this tax it should be verified whether the list of criteria can be reduced. For instance the so called “total material requirement” (TMR²⁴) could represent a practicable indicator, but also a combination with the indicator climate potential should be considered. Moreover, the binding parameters could be elaborated so that the more easily controllable data on the material composition of products can be used as a foundation for the communication of tax determination (cf. also UBA 2012).

As to the utilisation of the tax money, one should in the first instance verify whether the tax revenue can be implemented for the financing of specific measures and activities that promote waste prevention and resource preservation or for the targeted reduction of the cost of labour (part of the tax yield could be used to decrease the income tax, whereby the cost of labour would indirectly also be decreased and could in part achieve a compensation for the end-consumer for the price increase induced by the tax). A budget-neutral layout, whereby the entire tax revenue from the product-resources-tax is used to reduce taxes in other fields, should eventually lead to an easing of the burden on the consumers, who in total will be consuming more resource-efficient products.

The measure aims directly on decoupling of material flows from the GDP, which is a central aim of waste prevention measures. The tax is thereby potentially furnished with a double dividend. If sufficiently high tax rates can be imposed, then external costs can be

²³ Such parameters can be compiled analogously to the environmental profiles that are published by UBA, in which indicators and key figures for raw material consumption are presented (Giegrich et al. 2012).

²⁴ Or similar aggregating indicators like for example the cumulated raw material demand (CRD) according to Giegrich et al. (2012).

internalised on the one hand, which increases the price of resource-intensive products and acts as a shortage signal for the entrepreneurial calculation. On the other hand raw material costs thus become relatively expensive and increase the incentive for production-dependent efficiency improvements in the use of resources and energy. An incentive for the development of more resource-efficient products is created and/or the factor of labour becomes cheaper relatively speaking, which creates additional jobs (Omann, Schwerd 2003).

The product-resources-tax indirectly also supports other waste prevention measures. With the relative changes to burdens on resource use and to the benefit of the employment of labour, waste prevention measures are supported that target life-cycle prolongation or secondary use after repair (cf. e.g. chapter Example measure C VIII 3.1: Support of repair networks).

At the same time certain resource-intensive branches are burdened more than others; this leads to a partial structural change and corresponding adjustment costs. In the first place negative effects on employment are to be expected, that will in the medium and long term develop positively, because the factor of labour will become relatively cheaper and thus there will be greater demand for it (Omann, Schwerd 2003). This principle meets limits where demand cannot be replaced by other products.

Objectives

A product-resources-tax targets both at the same time: reduced environmental pollution, as well as impulses for the labour market. Intended effects result in particular with regards to the shifting of relative prices between (relatively more expensive) resource inputs and (relatively cheaper) labour inputs. The objective of achieving improved resource efficiency through the internalisation of external effects of resource use simultaneously promotes the prevention of waste.

At the same time the relative reduction of labour costs in relation to the use of resources is to create the potential for additional jobs in the fields of repair and services.

In the course of another detailed elaboration it has to be verified in the first instance, whether and which tax rates develop the desired steering effect. Beyond that it should be substantiated, which products should be affected by the taxation, and which exemptions should be in place. An EU-wide introduction of the taxation should be stimulated and supported.

Characterisation

The Federation supports the elaboration of concrete foundations for an EU-wide resource tax and is supporting its introduction in the EU. The taxes are levied on the resource use of products and the connected environmental effects. The foundation for calculation is the quantity of resources used and the connected environmental effects. The determination of the tax rate and the concrete framework conditions have yet to be developed. The distributors (including the importers) of the products are liable to this tax. Products that are exported into countries without resource taxes are not taxed.

Initiators and addressees

A European initiative is necessary for the introduction of such a tax, because the consideration of importers and their taxation could barely be synchronised with the principles of the single market. Since the EU (to date) not set any taxes on its own authority, an agreed upon taxation would have necessarily to be targeted in all, or at least in the majority of Member States. Initiators that make this possible are the responsible Federal Ministries (Federal Ministry for the Environment, the BMU, and the Federal Ministry of Finance, the BMF).

Addressees of this measure are all distributors, including importers of products that must be recorded in the framework of the MIT. Indirectly, this measure aims at producers in particular, at the resource-efficient products and production methods, as well as at the consumers, who are to favour less waste-intensive products and utilisation concepts.

Waste prevention potentials

Because a product-resources-tax of this layout has not yet been implemented anywhere in the world, the waste prevention potential is difficult to estimate.

For the estimation it can, however, be resorted to a study that predicts resulting effects from a material input tax, by means of an econometric simulation model. Even if the arrangement of a material-input-tax does not exactly correspond to the suggested version of a resources tax, one can assume similar impacts. Macroeconomic models on the basis of the PANTA RHEI²⁵ model show that a linearly increasing tax rate from 1 Euro in 2011 to 10 Euro in 2020 per ton TMR would lead to the total domestic resource consumption including “ecological backpacks” would decline by 5.5 %, especially in the fields of industry minerals and construction materials (cf. Dosch 2005).

The model shows that such a tax would above all trigger technical changes, i.e. the consumer level would stay largely constant, but the products would be manufactured in considerably less resource-intensive way (Dosch 2005). From a corresponding integration into further measures (cf. e.g. chapter Measure C VI 5: Promotion of waste-preventing product service systems) it is in addition to be assumed that products are more likely to be repaired and used intensively. This would lead to a considerable share of the waste prevention effects occurring abroad, because, assuming sufficiently high tax rates, the share of waste-intensively produced materials like metals would be reduced.

Environmental impacts

An assessment of the ecological effects achieved through waste prevention induced or supported by the introduction of a resource tax, is not possible due to the indirect effect of the measure in different product fields.

²⁵

PANTA RHEI is a macroeconomic model that was developed for the analysis of environmental-related economic questions, which divides the entire economy into 59 production areas, and is able to demonstrate their interactions. In addition it contains a deeply structured energy and air pollution model, which distinguishes the energy consumption and CO₂ emissions for 121 product areas and distinguishes households by means of 30 different energy sources.

Social and economic impacts

According to the modelling of the MIT example, the overall employment would remain largely the same despite taxation, however, the yearly GDP growth would be reduced by approx. 0.1 to 0.2 %. Individual sectors such as the construction material industry would however be strongly hit by such a tax. Within the sector one must also count on a shift of material-intensive “expensive” materials, to fewer raw material- intensive materials that are levied with a low tax rate (Dosch 2005).

Relatively high control and information costs occur additionally during the implementation, because the required raw material coefficients, i.e. the raw material quantities required for the manufacture of final goods and upstream products, are unknown or company secrets. This is true in particular for the recording and evaluation of foreign input streams, where a legally consistent recording of this kind of information would involve considerable costs (FöS 2011).

In order to off-set sector-specific burdens, the tax revenue could be used partly for adaptation and efficiency measures in these sectors, which could spark off additional waste-preventing innovation effects. In the new introduction of this tax though, political resistance from sectors that would be particularly hit by an internalisation of environmental costs, has to be expected as it is with all taxes, even in the presence of budget neutrality due to lowering the income tax.

The level of consumption increases through the decrease in income tax, which can lead to a partial compensation of the waste prevention effects.

Indicators

The resource tax has direct effects on the raw material consumption; raw material productivity and the generated waste quantities should also be influenced indirectly. Hence, the indicators of TMR or CRD (cf. Giegrich et al. 2012) lay at hand, which are used as a product specific measuring basis for the MIT. The effects of a resource tax should be reflected in indicators that put raw material productivity in relation to GDP development.

Conclusion

The product-resources-tax can induce an improvement of resource productivity and enable an absolute decoupling from economic growth (Dosch 2005), depending on the product, raw material, market conditions, as well as technical necessities, as long as sufficiently high tax rates are enforceable. Due to the extremely highly aggregated indicator, TMR, used in the model, it is difficult to put figures to the reduction of environmental impacts, as well as to qualitative and above all quantitative waste prevention.

The internalisation of environmental costs can lead to a considerable burdening of material intensive production sectors, depending on the tax rate, where massive political resistance is to be expected. The rationale of such a tax should thus be built on the increase of macro-economic raw material production, besides its indirect contributions to waste prevention.

In the opinion of the experts, the product-resources-tax is seen to be a suitable instrument to promote the prevention of waste through fiscal measures in line with market requirements, if sufficiently high tax rates can successfully be enforced politically. Given the described

difficulties encountered when determining and levying the tax, as well as the legal obstructions, a concrete verification of the feasibility must still occur. For this purpose it would be useful to perform a detailed analysis of the tax's definition and calculation, as well as of its expected effects for concrete products, including expected environmental impacts.

In the context of the free movement of goods in Europe and of the resistance to be expected through the burdening of individual sectors that are in competition on the European and global level, the introduction of an MIT is only recommended on the European level, respectively with the participation of the majority of EU Member States.

Recommendation

The example measure is recommended for implementation with some reservations. It is necessary to verify the feasibility to find out, if establishing and levying the tax is possible against the described difficulties, and the legal barriers, and whether the majority of EU Member States can be persuaded to participate.

Example measure A 3.1: Development of an implementation strategy for an EU-wide product resource tax	
Objective	The product-resources-tax targets the decoupling of resource input and economic growth and is to promote a resource efficient use of resources. Simultaneously the relative decrease in the cost of labour with respect to resource use presents a potential for additional jobs in the fields of repair and services. In the framework of a continued detailed elaboration one first must verify whether and which tax rates develop the desired steering function. Furthermore, it must be specified which products are to be subject to the tax and which exceptions should exist. An EU-wide introduction of the tax should be stimulated and supported.
Characterisation	The Federation supports the elaboration of concrete foundations of an EU-wide resource tax and is supporting its introduction in the EU. The taxes are levied on the resource use of products and the connected environmental effects. The basis for calculation is the quantity of resources used and the connected environmental effects. The determination of the tax rate and the concrete framework conditions have yet to be developed. The distributors (including the importers) of the products are liable to this tax. Products that are exported into countries without resource taxes are not taxed.
Link to measures set out in Study I	228
Link to Annex IV WFD	11. Economic instruments....
Instrumental character	Determination of taxes
Initiators	Federation, EU Member States
Addressees	Distributors (including importers), the entire manufacturing industry, particularly resource intensive sectors, consumers.
Waste prevention potential	As a result of the increase in price of resource consumption compared to labour, waste is prevented both directly and indirectly. The example of modelling MIT showed a reduction of TMR by 5.5 % (at a tax rate of 10 €/t TMR); clear decoupling from GDP.

Example measure A 3.1: Development of an implementation strategy for an EU-wide product resource tax	
Environmental impacts	Due to lower resource consumption the environmental impacts from raw material extraction are reduced. An exact quantification of the environmental impacts is not possible.
Indicators	TMR, resource productivity, overall waste quantities
Social impacts	A model based on a tax of 10 Euros per ton TMR with the example of MIT, resulted in a constant number of employees. Individual sectors like the construction materials industry would be greatly affected by such a tax. The measure would certainly face great resistance in particularly resource intensive industrial sectors.
Economic impacts	Annual GDP growth is reduced by approx. 0.1-0.2 % according to model calculations on the MIT.
Conclusion	<p>The product-resources-tax can induce an improvement of resource productivity and an absolute decoupling from economic growth (Dosch 2005), depending on the product, raw material, market conditions, as well as technical necessities, if sufficiently high tax rates are enforceable. The impact on qualitative and above all quantitative waste prevention is difficult to forecast, the contribution to waste prevention would amongst other things depend on the level of the tax rate.</p> <p>A conclusive concept for the introduction of a resource-tax has yet to be elaborated. This includes in particular the determination of sensible tax-rates on the large number of resources that achieve the desired steering function and are feasible.</p> <p>In the context of the European free movement of goods and of the resistance that is to be expected through the burdening of individual sectors that are in competition on the European and global level, the introduction of an MIT is only recommended on the European level, or in the case of the participation of the majority of EU Member States.</p> <p>In the opinion of the experts, the product-resources-tax is seen to be a suitable instrument to promote the prevention of waste through fiscal measures in line with market requirements, if sufficiently high tax rates can successfully be enforced politically. Given the described difficulties encountered when determining and levying the tax, as well as the legal obstructions, a concrete verification of the feasibility must still occur. For this purpose it would be useful to perform a detailed analysis of the tax's definition and calculation, as well as of its expected effects for concrete products, including expected environmental impacts.</p>
Recommendation	The example measure is recommended for implementation with some reservations. It is necessary to verify the feasibility to find out, if establishing and levying the tax is possible against the described difficulties, and the legal barriers, and whether the majority of EU Member States can be persuaded to participate.

6.1.3.2 Example Measure A 3.2: Removal of environmentally harmful subsidies and public support schemes

Background

Subsidies are described as “unilateral support by public authorities of enterprises without reciprocity by market players”²⁶ (UBA 2010). Budget-relevant instruments on the expenses

²⁶

Translated from the German original

side encompass cash and price reductions, as well as guaranties, and securities etc. On the income side, tax concessions in particular are considered to be budget-relevant subsidies. The German Federal Environment Agency (UBA) additionally mentions regulations with subsidy features in the form of liability limitations and restrictions on competition (UBA 2010)²⁷. The insufficient internalisation of external costs is not considered a subsidy in this definition, because it represents a fundamental problem of economic and environmental policy (UBA 2010).

The existing subsidy and support sector is the result of a historical development, which to a large extent is determined by the expectations of the respective prevailing political situation. Thus its effects are complex. A multitude of economic, social and environmental policy objectives are linked to this.

The pursued objectives can often induce conflicts and contradictions through the multitude of different subsidy stocks and support aims. The German Federal Environment Agency (UBA) assumes a total of 48 billion EUR of environmentally harmful subsidies in 2008 in one of its studies (UBA, 2010).

The removal of environmentally harmful subsidies and support in the first place requires the knowledge of its ecological, economic and social effects. This measure seeks to stimulate the observation of the existing subsidy and support sector on all subsidiary levels and to ensure their effects are evaluated scientifically. A corresponding report is to be published every two years together with the Federation's subsidies report. In particular the medium and long-term effects are also to be taken into account. An important start was set through the publication "Environmentally Harmful Subsidies in Germany" published by the UBA. This basis is to be developed and the specific economic and social effects to be considered in detail, besides the ecological effects of the support and subsidy policies, in order to anticipate and integrate political resistance and blockades on time.

The attendant assessment is the condition for an understandable and open democratic process on the allocation of state resources. A transparent and scientific discourse in the field of support funds and subsidies helps to increase the acceptance of political decisions and to meet resistance and blockades by stakeholders in an appropriate way.

A federal level commission can make recommendations for the future allocation of subsidies and support funds, based on the report, which in particular take into account aspects of waste prevention. The knowledge of ecological, economic and social interrelations helps to recognise existing conflicts of interest, to form understandable priorities and thus to increase the acceptance for unpleasant or uncomfortable political decisions.

This measure thus also performs an important contribution to the removal of the double burdening of households, which on the one hand finance subsidies through tax revenues, and on the other must financially compensate for the harm created by externalities, the so-called 'defensive costs' (Leipert, 1989).

²⁷ Although this definition issued by UBA is very broad and includes tax relief, (UBA 2010), this study will describe tax relief in a separate chapter for the better explanation.

Objectives

The measure causes the correction of economic framework conditions through the removal of environmentally harmful subsidies and support funds. Ecologically unfavourable developments and false economic incentives for the waste of resources, in particular those with a high waste potential, are to be recognised and dismantled in subsidy policies.

Characterisation

The complex interrelations of ecological, social and economic dimension within subsidy and support funds policies are investigated and evaluated in a transparent manner. The study “Environmentally Harmful Subsidies in Germany” represents a model for this measure. Political decisions occur on this basis, whereby resistance and blockades by concerned stakeholders are met effectively.

Initiators/Addressees

The measure is assigned and coordinated by the Federation (e.g. the Ministry of Finance in collaboration the Ministry of the Environment). The scientific accompaniment occurs through the expert competent authority (amongst others the UBA) and by independent research institutes. With the support by respective EU and Country panels, which are responsible for the respective subsidies, the ecological effects, as well as the interest groups hit by a cut in subsidies, are recorded and documented.

Addressees are, depending on the beneficiaries of the subsidies, households or the private economy, as are consumers and manufacturers through the changes in relative and absolute prices.

Waste prevention potential

In order to estimate the waste prevention potential of the removal of environmentally harmful subsidies, one can take the energy tax exemption for the non-energetic use of fossil energy sources in the production of plastics, varnish, and fertilisers, as an example. In 2008 the overall volume of fossil energy source used in production was around 1000 petajoules (7 % of the total energy consumption). Depending on the benchmark of reference, the total volume of yearly subsidies, in the sense of foregone tax revenues, amounts to 1.6 billion (UBA 2010).

The ecological effect through the removal of subsidies is dependent on the level of the tax rate that is introduced. The removal of subsidies, given existing reference values (Heating Oil: 1.69 EUR/gigajoule, Natural Gas 1.55 EUR/gigajoule) (UBA, 2010), would lead to a low waste prevention potential. The influence on quantitative waste prevention is difficult to estimate for such an individual case, however, it is highly dependent on the level of the tax rate.

A substantial prevention potential results, if the effects from the removal of additional environmentally harmful subsidies are considered.

Environmental impacts

The abolishment of tax exemptions on fossil sources of energy would tax their use and thus create incentives for the substitution through renewable sources of energy, or for a more

efficient use. Connected to this is a reduction in pollution through CO₂. These impacts are too high degree depending on the tax rate that is to be introduced.

Social and economic impacts

A modification of the subsidy allocation according to ecological criteria is connected to manifold political resistance and blockades due to the complexity and heterogeneous and in part conflict-prone objectives. In the context of subsidies there is above all competition between environmental, social and economic policy objectives, and thus a political prioritisation is necessary. The traceability and transparency of political decisions are essential aspects for the acceptance within the population. It is desirable to allow participation and integration of involved interested parties in the political decision making process. This way one can achieve majorities for unpopular and contentious decisions.

Indicators

Waste generation and the generation of hazardous waste in concerned sectors are recommended as indicators.

Conclusion

The measure performs an important contribution for a more sustainable economy and society in the expert's view. This is especially so if the measure is implemented as part of an encompassing reform of state financial and investment policies.

The overall waste prevention potential of the measure is difficult to estimate, but the effects for other objectives and policy areas are considerable. The measure is to be recommended highly from an ecological and economic perspective (double imposition of state budgets), however, it is politically difficult to implement, due to differences in interests, implementation, and objectives.

Recommendation

The example measure is recommended for implementation with some reservations. Before deciding for the measure, it should be examined, which waste prevention potential could be addressed.

Independent of the addressable waste prevention potential, the measure is highly recommendable, and should, as the case may be, be pursued in other contexts.

Example measure A 3.2: Removal of environmentally harmful subsidies and public support schemes	
Objectives	The target is the removal and identification of environmentally harmful subsidies and support measures.
Characterisation	The complex interrelations of ecological, social and economic dimensions within subsidy and support funds policies are investigated and evaluated in a transparent manner. The study "Environmentally Harmful Subsidies in Germany" represents a model for this measure. Political decisions occur on this basis, whereby resistance and blockades by concerned stakeholders are met effectively.
Link to measures set out in Study I	-

Example measure A 3.2: Removal of environmentally harmful subsidies and public support schemes	
Link to Annex IV WFD	11. Economic instruments ...
Instrumental character	Economic framework conditions
Initiators	EU, the Ministry of Finance, BMU, UBA, environmental authorities of the Federal States.
Addressees	Consumers, producers, households and companies
Waste prevention potential	The example of tax exemption for the non-energetic use of fossil energy sources presents a rather low waste prevention potential.
Environmental impacts	The measure leads to quantitative and qualitative prevention of waste, and reduces CO ₂ -emissions.
Indicators	Waste generation and the generation of hazardous waste in concerned sectors.
Social and economic impacts	The modifications of the subsidies and support measures concerns different interest groups. In order to implement political decision against their will, a broad societal consensus is necessary, which can be created through a transparent and traceable basis for decision-making.
Conclusion	The measure performs an important contribution for a more sustainable economy and society in the expert's view. This is especially so if the measure is implemented as part of an encompassing reform of state financial and investment policies. The overall waste prevention potential of this measure is difficult to estimate, but the effects for other objective and political areas are considerable.
Recommendation	The example measure is recommended for implementation with some reservations. Before deciding for the measure, it should be examined, which waste prevention potential could be addressed? Independent of the addressable waste prevention potential, the measure is highly recommendable, and should, as the case may be, be pursued in other contexts.

6.1.3.3 Example measure A 3.3: Abolishment of reduced value-added-tax (VAT) on meat products

Background

There are many social, environmental and economic policy aspects linked to the food sector. Around 75 % of all products that fall under a reduced VAT belong to the food sector (MARESS AP3 2010). The reduced VAT on foodstuffs is justified historically above all by socio-political motives.

The German food prices are considered to be relatively low by comparison to neighbouring European countries, and the quality of products is relatively poor. The discussion on the causes for this is strongly polarised (German Bundestag, 2010). It moves between positions of the food retail (LEH), which states a distinctive price sensitivity of German consumers, who prefer inexpensive products, even if they are of lower quality and are sourced from industrial agricultural production or large-scale livestock farming. Producer associations and consumer protection groups regard the missing transparency on products for consumers and the dominant position that food retail has in contrast to that of the food producers, as

the most important causes. Thereby the cost pressure is shifted above all onto the food producers and their employees, with corresponding social and ecological consequences.

According to the calculation of the consumer association of North Rhine-Westphalia the meat consumption in Germany in 2010 was on average 60.7 kg per head.

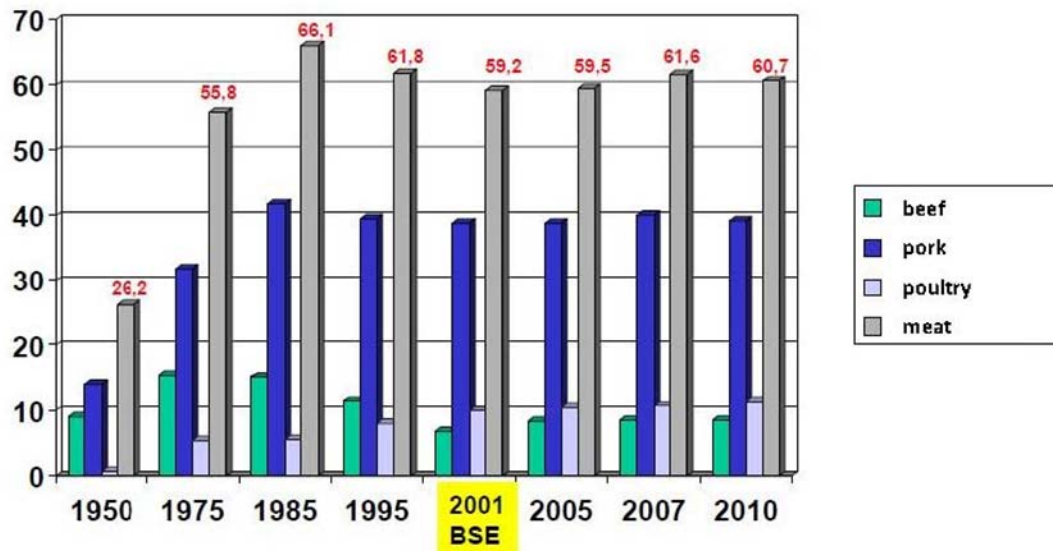


Figure 6-1: Meat consumption in Germany in kg per capita (Source: Consumer Association North Rhine-Westphalia 2012)

The proportion of the edible quantity is around 2/3 of the total of slaughtered meat (Deutscher Fleischerverband 2012). The consideration of bones, tendons, fat and other quantities resulting from slaughter that are regarded as non-edible, which are processed further in industry, results in the total yearly meat consumption.

With regards to climate effects, agriculture emitted 133 million tons of CO₂ equivalents, which is nearly as much greenhouse gas as is emitted through road traffic, 71 % of which are emitted from animal husbandry (MARESS AP3 2010).

The ecological and social consequences of milk and meat production further exceed this. Besides the directly emitted greenhouse gases, there are further environmental impacts to be observed in the consumption of water and land-use. If the reference framework takes into account the upstream chains, in particular feed, then further burdens result as a consequence of mono-cultures of food production. Fertilisers, pesticides and herbicides induce further resource consumption (e.g. fossil energy sources in the primary industry for fertilisers).

Because feed for the European livestock production is for the biggest part imported, the European meat demand induces utilisation competition related to agricultural surfaces of the global south, especially in soy-exporting countries, such as Brazil and Argentina. Within this “virtual surface import” (WWF, 2012) the local and European capacity to pay are in competition with one another for the utilisation of agricultural land as a source for vegetable-borne foodstuffs. If this is used for livestock feed, the export is usually in form of soy that is fed to European livestock, which then results in the transformation into animal

protein. In the process of transforming vegetable-borne food into meat up to a sevenfold of calories go lost (Fös 2012).

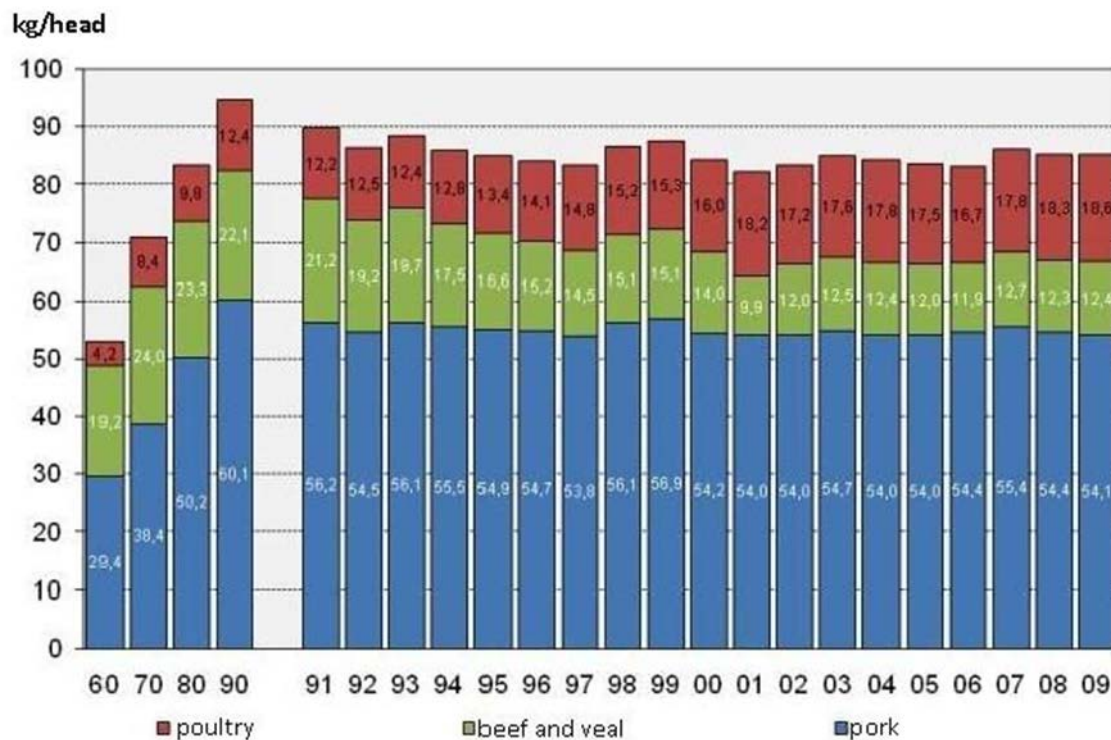


Figure 6-2: Meat consumption in Germany per capita per year (Source: BMELV 2012)

Objectives

The measure works in that the prices for conventional meat products increase in absolute terms and thus quantity in demand decreases and thereby also the proportion of thrown-away milk and meat products. This is achieved through levying the regular VAT on meat production.

Characterisation

Different studies show the particular ecological relevance of incentive effects through the reduction of VAT in the food sector for the generation of waste (MARESS AP3 2010, Fös 2012).

The waste prevention measure removes the socio-politically justified reduction of VAT on meat products and thereby generates a price and quantity reaction, which is justified and desired from the perspective of environmental policy.

There is the danger that based on the market conditions in the food sector, the VAT increase cannot be sufficiently shifted onto consumers by trade, particularly by discounters, and instead increases the cost pressure for agricultural producers and contributes to the acceleration of a structural change (DIW 2011). Thus in certain cases appropriate accompanying economic-political and competition law measures are to be instated, in order for the desired price and quantity reaction to occur.

Initiators/Addressees

The responsibility for VAT lies in the Federal Ministry for Finance. An EU-wide harmonisation through the European Commission would be desirable; nevertheless the measure can also occur solely on the national level.

Addressees of the measure would in part be consumers, in so far as the companies can shift the increased VAT on them. But manufacturers and producers are also hit by the cost pressure of the given market structure.

Waste prevention potential

Calculations made by IVM (2008) showed that a cancellation of the reduced VAT for meat products would lead to a reduction of meat consumption between 2 to 7 %. Assuming a reduction of 5 % in the sector of meat, and takes into account the extremely high shares of non-consumed food, then a rough estimate of the WP potential of a yearly 100,000 t results for the final consumer alone, without considering the waste in the production process.

The waste prevention potential through price changes in the food sector depends strongly on the assumed elasticity of demand²⁸. The data fluctuates a lot especially for foodstuffs, above all depending on the available income:

The lower the income, the less a household can evade to other goods when prices increase for basic foodstuffs (e.g. bread and milk), and thus the demand for these goods increases (Giffen-Paradox). It must be considered that the assumed elasticity of demand is very different in the food sector. Particularly with basic foodstuffs, a price change leads to only little change in demand. The elasticity of demand here is rather rigid. This is not applicable for the consumption of meat, since empirical studies have shown elastic demands here (Mankiw 1998). Thus for meat consumption one can assume a decrease in demand, when prices increase and a substitution through other foodstuffs with lower environmental impact. In practice as illustrated in Table 6-1 concerning all possible alternative food, like noodles, rice, potatoes etc., all environmental categories including the relevant indicator “abiotic resource consumption” particularly important for the waste prevention potential, is situated significantly below those of meat.

Environmental impacts

From an ecological perspective this measure leads to a reduction in waste generation in the food sector as well as to a marked reduction of greenhouse gas emissions. The increased consumption of meat has in the meantime led to 88kg per capita and year being consumed, which is a clear driver for greenhouse gas emissions (EU-wide approx. 20 million t CO₂eq per year, IVM 2008), and moreover is linked to high health policy follow-on costs. At the same time this measure leads to a reduction of the burden of soils and groundwater: through a restriction of incentives for overproduction one can expect a reduced discharge of pollutants in form of pesticides, etc., as well as qualitative contributions to waste prevention.

²⁸

Percentage change in the demand in relation to the percentage change in price

Table 6-1: Environmental impacts of different product categories under the main category food

Absolute Environmental Impact per Category ²⁹					
Product Category	GWP	Eut	AbR	HT	ÖT
Meat & meat products	5.6E+11	6.2E+09	5.9E+10	9.2E+09	3.6E+10
Dairy products	2.1E+11	2.5E+09	2.7E+10	3.9E+09	1.7E+10
Fruit & vegetables	9.2E+10	5.4E+08	1.4E+10	2.0E+09	1.1E+10
Table oil & frying fat	5.7E+10	4.6E+08	7.0E+09	1.0E+09	5.5E+09
Beverages (non-alcoholic & alcoholic)	7.3E+10	4.6E+08	1.2E+10	2.0E+09	6.4E+09
Bakery products	8.1E+10	1.9E+09	1.2E+10	1.8E+09	7.6E+09
Coffee, tea, & cocoa	3.0E+10	2.2E+08	4.6E+09	7.1E+08	2.8E+09
Grains & pasta	2.7E+10	7.7E+08	4.2E+09	5.7E+08	2.1E+09
Fish & fish products	4.5E+10	1.7E+08	7.6E+09	7.1E+08	2.0E+09
Jam & sweet products	3.9E+10	5.6E+08	6.1E+09	9.5E+08	5.9E+09
Others (processed foods - cereal, potato chips, etc.)	7.0E+10	1.1E+09	1.0E+10	1.6E+09	6.6E+09

Source: BIOS 2010

Social impacts

The measure's objective is linked to a degressive allocation effect, which would burden especially those with lower incomes more. Thus accompanying, compensating measures in the field of social policy are to be performed, in order to increase the acceptance of the measure. These could be financed by the revenue through the increased VAT intake.

Economic impacts

In order for the increase in VAT on meat products to be shifted to consumer prices, additional measures are necessary due to the competition intensity in food retail. Thus economic policy and cartel law measures must be scrutinised in order to find a way to prevent a shift of the increase in costs, arising from the removal of the reduced VAT, onto the producers. The resulting strengthened structural change will hit small agricultural producers to a higher degree than large concerns.

Indicators

A possible indicator for the measure can be the development of the consumption of meat, and as soon as reliable data is available, the per capita generation of waste of edible foodstuffs can be used in addition.

²⁹

GWP = Global Warming Potential 100 (kg CO₂eq / a); Eut = eutrophication (kg PO₄eq / a); AbR = abiotic resource consumption (kg antimonyeq/a); HT = human toxicity (kg 1,4-diclorobenzeneq/a); ÖT = eco toxicity (kg 1,4-diclorobenzeneq/a)

Conclusion

From an ecological perspective the reduction of meat consumption would represent a relevant contribution to waste prevention. Considering the entire product life-cycle there are huge resource efficiency potentials to be realised, particularly in conventional cultivation. Closely connected with this is the increased price of meat products, which might require corresponding compensation measures, in order to dampen the consequences for low income citizens.

This measure would in addition to the waste-preventing effect, contribute in a relevant way to climate protection and ensure healthier eating habits.

Thus from an ecological and health policy perspective this measure is to be recommended, but might be difficult to implement due to the expected resistance of concerned interest groups, and the additional measures that are to be implemented.

The waste prevention potential on the basis of the data available today can be calculated with roughly 100,000 t per year for the field of the consumers only³⁰. However, additional environmental relief effects are not possible to calculate facing the uncertainties about changes in the consumer's behaviour.

Recommendation

The example measure is recommended for the implementation with some reservations, which is not only justified for the potential contribution to waste prevention, but in particular by the positive effect on climate protection and healthy nutrition. To estimate further effects regarding waste prevention, the measure should be analysed more detailed, also in view of the expected political resistance.

Example measure A 3.3: Abolishment of reduced value-added-tax (VAT) on meat products	
Objectives	Change of price structuring and change of the consumption level or structure of meat products, in order to prevent waste qualitatively and quantitatively.
Characterisation	The regular VAT is levied on meat products. Accompanying measures in the field of economic policy and cartel law must be performed, in order for the desired shift of the tax onto consumer prices to occur.
Link to measures set out in Study I	-
Link to Annex IV WFD	11. Economic instruments
Instrumental character	Financial
Initiators	Federal Ministry for Finance
Addressees	Consumers, producers in the agricultural sector

³⁰

The estimation is very rough. More detailed data on this is supposed to be determined by the currently advertised UFO project of the UBA. Possibly higher waste quantities from the increased consumption of vegetarian products could reduce the overall potential. Equally, a significantly higher WP potential, due to the prevention effects in the upstream chains of the meat production, cannot be excluded

Example measure A 3.3: Abolishment of reduced value-added-tax (VAT) on meat products	
Waste prevention potential	With a reduction of meat consumption by 5 % a prevention of 100.000 t/a of food waste is achieved, alone for the final consumer.
Environmental impacts	The measure contributes considerably to climate and soil protection. As a result of reduced contamination in form of pesticides etc. one can expect a contribution to qualitative waste prevention. Negative ecological (rebound) effects are not to be expected.
Indicators	The development of the consumption of meat, and the per capita generation of edible food waste.
Social and economic impacts	Depending on the possibilities of shifting the tax, an increased burden is to be expected for consumers, especially for lower income classes, or correspondingly for the manufacturers and producers. Economic impacts cannot clearly be forecasted: A decrease in the level of consumption and/or substitution effects is conceivable.
Conclusion	The abolition of reduced VAT rates is a relevant contribution to waste prevention and to climate protection. Flanking measures that ensure the tax shift to consumer prices are necessary. This renders the political implementation more difficult. The exact waste prevention potential and ecological effects are difficult to estimate. Further examinations on the detailed effects are necessary.
Recommendation	The example measure is recommended for the implementation with some reservations, which is not only justified for the potential contribution to waste prevention, but in particular by the positive effect on climate protection and healthy nutrition. To estimate further effects regarding waste prevention, the measure should be analysed more detailed, also in view of the expected political resistance.

6.1.4 Measure A 4: Research on waste-preventing technologies and utilisation schemes

In Germany and Austria various programmes have supported demonstration projects in a large-scale manner, which for the first time show how progressive procedures for the prevention or diminution of environmental pollution can be realised. These consist both of measures that prevent or diminish the accrual of waste, and of measures through which the harmfulness of generated waste is decreased.

This promotes the further development of the state of the art and best practice examples of waste prevention are developed in a targeted way. Support measures have evolved in such a way that mainly integrated environmental protection measures are being supported. Sustainable technologies and innovations that combine waste prevention, energy efficiency and resource conservation, as well as a consistent emphasis on a product's benefits, are considered to be fund worthy. Furthermore, the main focus has shifted to SMEs.

Few research projects were funded in the field of waste-preventing utilisation concepts. The subject of the present investigation is not that of individual production technologies of a single company. Rather, the utilisation structures of certain products, and possibilities for influencing these, are of interest here.

6.1.4.1 Example Measure A 4.1: Support for demonstration projects on waste-preventing technologies and utilisation schemes

Background

In the framework of demonstration projects on the diminution of environmental pollution through waste prevention (= resource conservation), further support programmes should be made available.

State resources for research funding can be targeted at further research and development of low-waste and/or waste-preventing technologies, but also at product design, forms of use, and framework conditions. Moreover, the consideration of aspects of waste prevention could be a necessary prerequisite for receiving research funding for general technology development projects.

This measure follows on from measures and programmes already realised. Since 1999 in the course of the programme of the German Federal Ministry for the Environment's (BMU) for the promotion of investments with a demonstration feature for diminishing environmental pollution (Environment Innovation Programme (UIP)) projects were and will be financially supported in Germany, which have, or create key components to prevent waste (see also chapter B II 3: Supporting the further development of the current state of waste prevention technology in plants). Furthermore the Federal Ministry for Education and Research (BMBF) has supported innovation within industry i.e. with substantial effects on waste prevention, through different support programmes (BMBF 2004). Since the year 2000 demonstration projects on waste prevention are being supported in Austria, in the framework of the "Fabrik der Zukunft" ("factory of the future") programme of the Austrian Federal Ministry for Transport, Innovation and Technology (Fabrik der Zukunft 2012).

Examples for demonstration projects supported in Germany are amongst others (BMU 2012):

- the construction of a plant for the galvanization of plastics with amongst other things the prevention of highly poisonous chromium (VI)-containing waste;
- the erection of a production plant for the environmentally-friendly production of concrete elements with i.a. the prevention of 4,000 Mg/a of waste;
- the construction of a new type of forging press with i.e. prevention of oil sludge as waste;
- the modification of an electroplating company to a new staining process with i.e. the prevention of old corrosive agents as waste of approx. 50-75 %;
- the erection of a plant for a large-scale technical production of lithium-polymer batteries with i.e. the prevention of solvents, softeners, and foil as waste;
- the introduction of a new type of powder coating procedure for temperature sensitive wood-based materials and plastics with i.e. prevention of approx. 90 % paint sludge as waste.

Examples for demonstration projects supported in Austria are inter alia (Fabrik der Zukunft 2012):

- Development of low-emission cleaning processes for work piece surfaces with particular consideration of production processes of the automobile supply industry (without detailed information on the extent of prevented waste);
- Development of a powder coating plant for wood-based materials, with which wood-based materials (mainly medium-density fibreboards (MDF)) can for the first time be coated with powder coating with high hardness degrees and of the best quality in an industrial procedure (without detailed information on the extent of waste prevention).

A selection of benchmark data from the evaluation of the Environmental Innovation Programme (UIP) of the German Federal Ministry for the Environment (BMU), added to statistical data from Austria, shed light onto the fundamental aspects of these promotion programmes (see Table 6-2).

Table 6-2: Selected benchmark data from promoted programmes with waste prevention as a target

	Environment Innovation Programme (Inland) UIP	Fabrik der Zukunft (Austria)
Evaluation through or information from	(PROGNOS 2010) for the time span 1999 – 2008	(Fabrik der Zukunft 2012) for the time span 2000 – 2008 in five cycles
Programme since	1979	2000
supported projects/projects overall	111 (in the time span 1999 – 2008), of which 45 with a focus on waste	203
Supported projects	7 – 15 per year	20 – 81 per cycle
Total funding volume	Approx. 90 million €- of which 25 million € come from the Federation's Budget according to UBA – the share with a focus on waste is unknown.	Approx. 23 million € overall
Remarks	The yearly available resources have decreased by 50 % according to PROGNOS 2010 (p.13).	The total funding quote amounts to 38 %
	For >50 % of the projects the funding amounted to < 500 thousand €.	The funding encompasses very different projects, i.a. those with a focus on transfer from precursor projects (see measure A 5) and other themes such as promoting "Ecofashion" or "Ecodesign Learning Game", which are allocated with the WFD under other measures.
	The number of investment grants has increased in particular for SMEs (PROGNOS 2010, p.14).	
	15 projects with a focus on water, waste water and waste were promoted.	
	The trend is toward promotion shifting to integrated procedures with a focus on energy matters.	
	In over 80 % of funded projects the vote was completed or surpassed before funding had been granted.	
	In 35 out of 52 investigated projects a reduction in environmental pollution in the field of waste was achieved.	
Multiplication effects	Emulation effects often occurred or are to be expected. Imitation and power of persuasion are rendered difficult in the case of high investment costs and a high degree of complexity.	174 final reports are available for download on the internet. 23 brochures and guidelines were developed.
	High-profile measures exist but have still have potential to be built up (PROGNOS 2010, p.33). The importance of public relations work for impulses and emulation is increasing.	

Building on the insights from the evaluation, individual deficits of the UIP study were removed as of 2010 according to the German Federal Ministry for the Environment (UBA). Substantial evaluation results on this subject are not yet available.

In the course of the BMBF (German Federal Ministry for Education and Research) research project “New Utilisation Strategies” a total of 10 projects were promoted between 2001 and 2004, whose aim it was to increase the exchange of supply and demand in the framework of regional networks, to thus be better able to estimate market potentials for waste-preventing products and services – i.a. in the product groups of computers, furniture and bicycles. In Austria, i.a. a project for the strategic development for the dissemination of waste-preventing product services in the electric and electronics sector was executed (KOPACEK 2003).

Objectives

Objectives of this measure, as well as of the thereby promoted research projects on waste-preventing technologies and utilisation concepts, are the further development of the environmental law regulatory system and the state-of-the-art, as well as the promotion of measures with a high demonstrative effect, accompanied by multiplier effects on a voluntary basis. Thus best practice examples for waste prevention are created in a targeted way.

The multiplier effect of such concrete research projects is to be increased through an increased high-profile publication of the results.

Characterisation

In the framework of research programmes, demonstration projects for the diminution of environmental pollution through waste prevention (including resource conservation) are to receive increased support. This way existing measures and programmes can be taken up and continued or further developed.

Initiators and addressees

The Federation is the initiator, who launches funding programmes and makes resources available for this. The Federal States Federal can also act as initiators with specific support programmes. The Federation can furthermore set up favourable interest rate finance and promotion programmes with specific focuses via the programmes and focal points of the KfW Bankengruppe (Bank of Reconstruction Credit – KfW banking-group). Most recently this occurred in the course of the recently expired Recovery Plan, or with programmes for energy efficient construction or rehabilitation (KfW 2011).

Addressees in terms of technology development are research establishments that deal with processes and procedures of industrial technology. Addressees are also industrial enterprises and SMEs, which want to optimise and renew production processes.

Addressees in the context of utilisation concepts can be research establishments and interest groups, which deal with the sustainable development of life-style and consumption patterns. Indirect addressees are the companies and citizens, whose future behaviour patterns are to be altered.

Waste prevention potential

Quantitative information on the overall prevented waste cannot be derived from the existing evaluations of the individually executed funding programmes.

The details given on waste prevention in individual examples on the one hand describe percentage values of 50 % and more. On the other hand waste-preventing effects in terms of particularly dangerous waste are specified.

Integration or the computing of a mean value, of exemplary percentage information for the waste prevention in the context of demonstration projects is neither admissible nor possible, due to scientific-methodological reasons within the very different examples. The supported companies are very different and their procedures for the characterisation of effects, i.a. in relation to waste prevention in the funding programmes, are not uniform. However, the estimation that demonstration projects in general can achieve impacts or a waste prevention potential of explicitly more than 10-20 %, can be made.

No quantitative information on the overall prevented waste can be made based on the previous evaluations in the field of research on waste-preventing utilisation concepts.

Environmental impacts

The focus and target of support programmes in the field of demonstration projects for the reduction of environmental pollution through waste prevention has changed in the past few years, away from the enforcement of downstream purification technologies to integrated environmental protection measures. In doing so, demonstration projects often achieve greater improvements in both waste prevention and energy efficiency and resource conservation. As a “by-product” of research funding with the focus “waste prevention”, one would thus expect relevant improvements in relation to other environmental effects and fields.

Support programmes in the field of waste-preventing utilisation concepts have as an objective the long-term change of consumption patterns and the behaviour of companies and individuals. The environmental impact in relation to waste prevention is achieved indirectly through a decrease of used devices and products, in combination with savings in manufacturing costs within industry here.

Indicators

As an indicator for the funding programmes focussing technology development the quantity of prevented waste in individual demonstration projects is suitable, if the type of waste remains unchanged. If the type of waste does change, then qualitative evaluations are necessary that take into account the hazardousness of prevented waste compared to potentially newly generated waste, the consumption of secondary raw materials and the energy demand in comparison.

As an indicator for funding programmes in the field of waste-preventing utilisation concepts, alternatively the quantity of prevented products in individual is suitable.

A benchmark for funding programmes in general can be the funding resources that are implemented in the field of waste prevention. A further useful benchmark is the quantity of demonstration projects in the field of waste prevention.

Social impacts

Funding in the field of demonstration projects to reduce environmental pollution through the support of waste prevention, which is directed at small and medium size enterprises, would in general suit the German economy in its medium-sized structure of industry and commerce. Funding programmes with demonstration projects in the field of technology generally have no direct social impact on larger parts of the population. They mostly accompany improvements of working conditions for employees of affected companies.

Funding programmes in the field of waste-preventing utilisation concepts can contribute to and stimulate the social and scientific discourse on the subject of sustainable consumption. They can also identify possibilities that enable the access or easier use of products for the socially disadvantaged.

Funding programmes can realise knock-on-effects in a less controversial manner than taxes or incentive levies.

Economic impacts

Beside the “classical large-scale industry”, funding programmes in the field of demonstration projects to reduce environmental pollution through waste prevention have intensified the support of small and medium-sized enterprise. An intensification of funding programmes with a focus on waste prevention as a key element of integrated environmental protection measures in general suit the German economy in its medium-sized structure of industry and commerce. The promotion of technology development in SMEs takes the limited economic potential of these structures into account. At the same time an intensification of funding programmes with a focus on waste prevention would be an important contribution to the new innovation topic “resource conservation”.

Funding programmes in the field of waste-preventing utilisation concepts could contribute to the social-scientific discourse on the topic of sustainable consumptions and promote these. This way the long-term economic impact of implementing a change in utilisation behaviour can be detected at an early stage.

Conclusion

Funding programmes in the field of technology development, where demonstration projects for the reduction of environmental pollution through waste prevention on a commercial scale are promoted, and which show for the first time how progressive procedures for the prevention of waste can be realised, cause sustainable impulses in production processes and in competition. They have realised irrelevant potentials for waste prevention and for a large part achieved and partially surpassed the targeted environmental relief. Their results are multiple within the respective sector and in part transferable beyond individual sectors.

A funding programme in the field of waste-preventing utilisation concepts could considerably promote the social-scientific discourse on the subject of sustainable consumption.

Recommendation

The example measure is recommended for implementation.

Example measure A 4.1: Support for demonstration projects on waste-preventing technologies and utilisation schemes	
Objectives	Objectives of research projects on waste-preventing technologies and utilisation concepts are the further development of the regulatory system of environmental law and of the state-of-the-art, as well as the support of measures with a high demonstrative effect, accompanied by multiplier effects on a voluntary basis. Thereby best practice examples for waste prevention are created in a targeted way.
Characterisation	In the framework of research programmes, demonstration projects for the diminution of environmental pollution through waste prevention (including resource conservation) are to receive additional support. This way existing measures and programmes can be taken up and continued or further developed.
Link to measures set out in Study I	(197): BMBF Research Project on Novel Utilisation Strategies (240): BMU-Programme on the promotion of investments with a demonstration character for the diminution of environmental pollution (257): Funding program „Fabrik der Zukunft“ (Austria)
Link to Annex IV WFD	2. The promotion of research and development
Instrumental character	Provision of financial support
Initiators	Federation, Federal States, the KfW Bankengruppe
Addresses	Directly in technology development: research institutions, industry and SME. Directly in utilisation concepts: research institutions and interest groups.
Waste prevention potential	The details given on waste prevention in individual examples of technology development describe on the one hand percentage values of 50 % and more. On the other hand waste-preventing effects in terms of particularly dangerous waste are specified to a significant extent. The estimate that demonstration projects in general can achieve an impact or a waste prevention potential of explicitly more than 10-20 %, seems to be acceptable. On waste-preventing utilisation concepts no quantitative data can be derived.
Environmental impacts	Public funding for research programmes can aim on further research of low-waste and/or waste-preventing technologies but also for corresponding product design, utilisation forms, and framework conditions. Furthermore the consideration of aspects on waste prevention can be used as necessary preconditions for obtaining funding in comprehensive technology development projects.
Indicators	Share of waste-preventing funding resources deployed; number of supported research projects; prevention potential of concrete research projects in the field of technology development; Prevention potential for products of the concrete research project in the field of utilisation concepts.
Social impacts	Funding programmes with demonstration procedures in the field of technology usually have no direct social impact on larger parts of the population. Funding programmes in the field of waste-preventing utilisation concepts can contribute to and stimulate the social-scientific discourse on the subject of sustainable consumption.

Example measure A 4.1: Support for demonstration projects on waste-preventing technologies and utilisation schemes	
Economic impacts	Supporting technology development in SMEs does justice to the limited economic possibilities in these structures. At the same time, an intensification of funding programmes with a focus on waste prevention can make important contributions to the new innovation topic "resource conservation". Funding programmes in the field of waste-preventing utilisation concepts reveal long-term economic impacts of the implementation of altered utilisation behaviour transparently, and at an early stage.
Conclusion	Funding programmes in the field of technology development, where demonstration projects for waste prevention are implemented have realised important potentials, and achieved for a large part, and partially surpassed, the targeted environmental relief. Their results are multiple within the respective sector and in part transferable beyond individual sectors. A funding programme in the field of waste-preventing utilisation concepts could considerably stimulate the social-scientific discourse on the subject of sustainable consumption.
Recommendation	The example measure is recommended for implementation.

6.1.5 Measure A 5: Supportive programmes and activities to implement waste-preventing strategies and technologies

In Germany and Austria various programmes have supported demonstration projects in a large-scale manner, which for the first time show how progressive procedures for the prevention or diminution of environmental pollution can be realised. An essential finding of the evaluation of such projects is: *"The importance of public relations to generate impulses and emulation is increasing"*³¹(PROGNOS 2010). This example measure is intended to deal with the extensive to exhaustive expansion and implementation of the findings of measure A 4. 1: Promoting demonstration projects for waste prevention.

6.1.5.1 Example measure A 5.1: Supportive programmes and activities to implement waste-preventing strategies and technologies in product development and production process design

Background

A series of previous studies have shown that there is still a considerable potential to reduce the environmental impact of products during the product development process (MARESS AP1 2010). Due to the fact that many parameters may still be influenced at this stage, approaches towards waste prevention and to increasing resource efficiency should be considered and supported as early as possible in the product development process.

The most successful environmental improvements through waste prevention programmes in the industrial sector in the entire EU were achieved when the public sector performed a consistent role in goal setting and in giving timelines for improvements (DTU 2006, cited after Reisinger, Krammer 2007).

The Federal Ministry for Economics and Technology (BMWi) supports i.a. waste prevention measures (BMWi 2009) in its ERP - Environment and Energy Efficiency Programme, part A.

³¹ Translated from the German original

The programme itself is carried out by the KfW Mittelstandsbank. Most recently this was performed in the course of the recently expired Recovery Programmes, or through programmes for energy efficient construction and rehabilitation (KfW 2011) or by the recently issued KfW - Energy Efficiency Programme and KfW - Environment Programme.

The data-related restrictions of the measures supported by the KfW stand in the way of a far-reaching dissemination of findings from demonstration or precursor projects. A statistical evaluation of the KfW-financed projects with a focus on waste prevention results in a funded share of less than 1 % (see Table 6-3). This share corresponds to 20 of the total 44,472 funding, which are supported both through the ERP - Environment and Energy Efficiency Programme and the KfW - Environment and Energy Efficiency Programme. The share of projects in which waste prevention was achieved as a side-effect during a support programme cannot be given on this basis. Nevertheless there seems to be imperative to support waste prevention in connection with resource conservation broadly through incentives and impulses.

Table 6-3: Statistical Evaluation of the KfW - Environment and Energy Efficiency Programmes, and all Support Programmes with a Focus on the Environment (KfW Förderreport 2012)

	ERP- Environment and Energy Efficiency Programme	KfW- Environment and Energy Efficiency Programme	Funding Programmes in total (Totals encompass further programmes that present no projects on waste prevention)		
	Measures	Partial Amount Loan Commitment	Measures	Partial Amount Loan Commitment	Total KfW
	[Number]	[Mio. €]	[Number]	[Mio. €]	[Number]
Waste Prevention	16	10	4	14	20
Total	1,951	1,894	552	1,314	44,472
Share of Waste Prevention [%]	0.82 %	0.53 %	0.72 %	1.07 %	0.04 %

In its fundamentals there is another support programme for the benefit of SMEs, through the BMWi programme Zentrale Innovationsförderung Mittelstand (central innovation programme (ZIM)). *The ZIM received 13.899 applications up until 30.06.2010, of which 8.795 grants were allocated, funding of a total of 1.11 billion €* (FRAUNHOFER ISI 2010). In the comprehensive evaluation report from 2010 there is, however, no information on the share of support, which concern waste prevention or waste management measures. Since 2009 network projects are also promoted (ZIM-NEMO) – of which 20 have been included in the above evaluation. Data on the extent of waste prevention in those projects have unfortunately not been made available on the part of VDI/VDE-IT (Institute for Innovation and Technology), as no explicit request to that effect has been submitted.

In draft V. 3.0 on the German Resource Efficiency Programme (ProgRes 2011) the „waste prevention“-approach is missing. By contrast, „recycling and cascading use systems“ are mentioned as indicators and objectives for resilient decisions. Waste prevention however also makes an important contribution to an increase of material efficiency, as it was already in 2008 identified to be a central element of sustainable raw material industry (Bundesregierung 2008).

According to the funding data bank of the BMWi, there are currently three Federal States which offer funding programmes that include i.a. measures for waste prevention (BMWi Förderdatenbank 2012):

- in Bavaria, the Bavarian “Umweltkreditprogramm/Ökokredit (Ecological Credit Programme/ Eco-Credit); which according to the Bavarian State Ministry for the Environment did not provide funding for projects on waste prevention.
- In Rhineland-Palatinate, the support of waste management measures and of rehabilitation of contaminated sites; hereunder to date no measure on waste prevention has been funded.

Rhineland-Palatinate, like many other Federal States, supports an exchange with industry in general and the creation of networks for the implementation of “*company-specific potentials for increasing the integration of environment/ protection into production*”³² (see EFFNet and EFFCheck, (EFFNet 2012)). Measures for the diminution of waste are part of this. Moreover, Rhineland-Palatinate also refers to further education programmes.

plus:

- in Saxony-Anhalt, the support of waste management measures. The Ministry for Agriculture and the Environment of Saxony-Anhalt provides no information on supported projects.

Under the programme „Fabrik der Zukunft“ (“Factory of the Future“), running in Austria since 2000, also demonstration projects for the transfer of results from precursor projects supported by the Austrian Federation for Transport, Innovation and Technology have been funded, e.g.:

- the sustainable hospital. Transfer phase;
*“The results of the feasibility study and the precursor project on the “sustainable hospital” was spread with a diversified transfer strategy and target-group-specific impulses. The transfer was facilitated through a long and intense cooperation between the pilot hospital, the Viennese department of the municipality in charge of the healthcare institutions owned by the City, a hospital owner from Berlin, as well as an interdisciplinary team of researchers”*³³ (Fabrik der Zukunft, 2012).
- Transfer of results from the sub-programme „Fabrik der Zukunft“ into the target groups of internal energy officers and company energy consultants;
- PRO WISSEN (“pro knowledge“) – strategy and methods for a regional knowledge transfer – a process for the introduction of sustainable products and services in handicraft businesses.

Knowledge about waste-preventing utilisation concepts from research programmes like “Neue Nutzungsstrategien“ (New Utilisation Strategies) should be multiplied and

³² Translated from the German original

³³ Translated from the German original quotation

implemented in a broad-scale manner through transfer projects that are to be provided with additional funds.

The share and importance of waste prevention in existing support programmes like the KfW-Environment Programme, should be strongly increased and broadly advertised in the next few years. In case the existing programmes do not permit a broad-scale publication of supported and effective possibilities for waste prevention, either they should be modified to allow this or new programmes should be created, which warrant the required broad impact.

Objectives

The practical integration of the consideration of waste prevention and resource efficiency in product development and product design is to be supported in a multilevel procedure.

Funding programmes are to spread positive experiences and findings from funded demonstration projects (see Table 6-2) in all different production fields with the highest possible effect. Best practice examples of waste prevention during the product development are to be spread through support programmes on different levels and addressed at the management level of companies.

Funding programmes are to spread positive experiences and findings from funded demonstration projects on utilisation concepts in all different product segments with the highest possible effect.

The increased high-profile publication of results is to increase the multiplier effect of such research projects.

Characterisation

Support programmes are to provide additional support for the transfer of findings from demonstration projects on the diminution of environmental pollution through waste prevention with a view to reach maximum dissemination and implementation of findings.

This measure follows already implemented measures and programmes. Findings from the BMU-Programme on the promotion of investments with demonstration character for the reduction of environmental pollution (Environment Investment Programme) in Germany, as well as from different support programmes of the Federal Ministry for Education and Research (BMBF), are to be implemented in an increased and broad-scale manner.

Initiators and addressees

The initiator is the Federation creating support programmes and offering financial resources for this purpose. The Federal States can also act as initiators for funding programmes with specific focuses. The Federation can furthermore, through programmes and focuses of the KfW Bankengruppe, set up favourable interest rate finance, and initiate programmes with specific focuses.

Addressees regarding the transfer from demonstration projects within technology development are above all industrial enterprises and SMEs that want to optimise and renew their products and production processes.

Addressees regarding the transfer from demonstration projects on utilisation concepts are above all the commercial trade and interest groups that deal with sustainable development

of life-style and consumption habits. Indirect addressees are companies and citizens, whose future behaviour is to be changed.

Waste prevention potential

Existing evaluations of individual, implemented support programmes of the transfer from demonstration projects for technology development do not permit quantitative information on the prevented waste. According to Riesinger, Krammer (2007) measures that focus on the beginning of a life-cycle can have a particular effect on many waste streams and thus extensively contribute to waste prevention.

An integration or extrapolation of individual values from exemplary percentage data for waste prevention in the course of demonstration projects might neither be allowed nor possible for scientific and methodological reasons. The conditions are after all different in each enterprise and the potential for realisation i.a. in relation to waste prevention is not uniform. The estimation that the broad-scale implementation of findings from precursor projects in regards of target waste, however, usually can achieve an effect, respectively a waste prevention potential, of more than 10 % - 20 %.

The previous evaluations in the field of research on waste-preventing utilisation concepts do not permit the derivation of quantitative information on prevented waste.

Environmental impacts

Individual supported demonstration projects often have caused large improvements both in waste prevention and as regards energy efficiency and resource conservation. Even if the conditions are different in each enterprise and the potential for realisation i.a. as regards waste prevention is not uniform, one would thus expect relevant improvements also as regards environmental impacts and environmental sectors.

The same is to be expected for a broad-scale support for the implementation of findings from research projects on waste-preventing utilisation concepts. The environmental impact of waste prevention is achieved indirectly here, through a reduction of used devices and products, in combination with the saved manufacturing costs in industry.

Indicators/benchmarks

As far as the types of waste do not change, the quantity of prevented waste is an adequate indicator for promotion projects in the field of implementing waste-preventing concepts, and technologies with a focus on technology development. If the waste types change one should make qualitative evaluations from previous individual demonstration projects, which take into account the comparison of the hazardousness of prevented waste with the potentially newly generated waste.

Since the most successful environmental improvements in the industry sector were gained through EU-wide waste prevention programmes when the public authorities took a consistent part in setting targets, as well as the timing for the improvements (DTU 2006), milestones for both, time and content, should be named and controlled in advance. A target set could, for instance be a share of minimum 5 % of waste prevention in the KfW-programme output by the end of the year 2015, and minimum 10 % by the end of 2018.

Alternatively, suitable indicators for support programmes in the field of waste-preventing utilisation concepts are the quantities of prevented products.

The benchmark for support programmes in general could be the funding made available in the field of waste prevention.

Another useful benchmark is the number of measures supported in the field of waste-preventing concepts and technologies.

Social impacts

Funding programmes in the field of implementation of waste-preventing concepts, and technologies with a focus on technology development, and support of waste prevention at small and medium size enterprises, would in general suit the German economy in its medium-sized structure of industry and commerce. Funding programmes with demonstration projects in the field of technology generally do not have any direct impact on larger parts of the population. Most of the times they accompany an improvement of working conditions for those directly employed in the concerned business.

Support projects in the field of implementing waste prevention can contribute and stimulate the social-scientific discourse about the topic sustainable consumption. They may also create possibilities for the socially disadvantaged to access certain products more easily or at all.

Support programmes can have knock-on-effects that are less contentious than those of taxes and other steering levies.

Economic impact

An intensification of support programmes that focus on implementing waste-preventing technologies as a central element of integrated environmental protection measures are particularly suitable for the German economy and its numerous SMEs. The promotion of technology development in SMEs does justice to the limited economic possibilities in these structures. At the same time an intensification of support programmes with a focus on waste prevention would also be able to perform important contributions to the new innovation subject matter of „resource conservation“.

The further development of production processes, which take into account waste prevention and resource conservation, increases the development costs for manufacturers of the concerned products or product fields. The situation is compounded by international competition pressures and import products, partly originating from countries with considerably lower environmental standards. On the other hand, the know-how advantage increases the competitive ability in the long term. Additional economic costs in precursor projects should thus be at least extensively covered by the scope of the support.

Support programmes in the field of implementing waste-preventing utilisation concepts can contribute and stimulate the social-scientific discourse along the theme of sustainable consumption. Additional economic costs from precursor projects should therefore at least be compensated to a certain extent within the funding volume.

Conclusion

Support programmes in the field of implementing waste-preventing concepts and technologies with a focus on technology development are sensible, and necessary, follow-up measures, in order to achieve a broad-scale implementation of demonstration projects. To reach relevant potentials of waste prevention, and to transmit the desired environmental protection to most of the enterprises, they are indispensable. Existing funding in this field seems to be relatively rare.

A support programme in the field of implementing waste-preventing utilisation concepts could considerably stimulate the social-scientific discourse on the subject of sustainable consumption.

Recommendation

The example measure is recommended for implementation.

Example measure A 5.1: Supportive programmes and activities to implement waste-preventing strategies and technologies in product development and production process design	
Objectives	A broad-scale application/implementation of best practice measures of waste management is to be supported in a targeted manner through state support resources. The share of waste prevention, which to date in Germany only was 1 % for broad-scale funding programmes, is to be markedly increased.
Characterisation	Support programmes are to provide additional support for the transfer of findings from demonstration projects on the reduction of environmental pollution through waste prevention (including resource conservation). This measure is a follow-up to already implemented measures and programmes.
Link to measures set out in Study I	(117): Waste Prevention in Hospitals (Austria) (241): Promoting a Plant for the Electrochemical (Galvanic) Coating of Bulk Materials with Aluminium (251): Promotion for the Erection of a Plant for the Environmentally Friendly Manufacture of Low-Solvent Varnishes and Glazes. (252): Promotion Programme for Sand Processing in an Aluminium Sand Casting Foundry (257): Promotion Programme „Fabrik der Zukunft“ (Austria)
Link to Annex IV WFD	2. The promotion of research and development into the field of achieving cleaner and less wasteful products and technologies and the dissemination and use of the results of such research and development.
Type of measure/instrument	Provision of financial support
Initiators of the measures	Federation, Federal, KfW Bankengruppe
Addressees of the measure	Directly in technology development: industry and SME Directly in utilisation concepts: commercial trade and interest groups
Waste prevention potential	A permissible estimation seems to be that in general impacts of waste prevention potentials of considerably more than 10 % - 20 % can be achieved. No quantitative information can be given about waste-preventing utilisation concepts.
Environmental impacts	Relevant improvements are usually also to be expected with regards to other environmental impacts, and environmental sectors.

Example measure A 5.1: Supportive programmes and activities to implement waste-preventing strategies and technologies in product development and production process design	
Indicators/Measures	The estimation of prevented waste in the field of implementing technologies; the amount of available (funding) resources; the requirement level of funding programmes; the number of projects/enterprises using these resources.
Social impacts	Funding programmes in the field of implementing waste-preventing concepts, and technologies with focus on technology development, usually have not direct social impacts on larger parts of the population. Funding programmes in the field of implementing waste-preventing utilisation concepts can contribute and stimulate the social-scientific discourse about topics of sustainable consumption.
Economic impacts	An intensification of funding programmes with a focus on waste prevention as a key element of integrated environmental protection measures in general suit the German economy in its medium-sized structure of industry and commerce. At the same time, intensifying funding programmes with a focus on waste prevention would cause important contributions to the new innovation subject matter of „resource conservation“. Support programmes in the field of implementing waste-preventing utilisation concepts enable long-term economic impacts of an implementation of changed utilisation behaviour to become transparent and detectable at an early stage.
Conclusion	Support programmes in the field of implementing waste-preventing concepts, and technologies with a focus on technology development, are sensible and necessary follow-up measures, in order to achieve a broad-scale implementation of demonstration projects performed on a commercial scale, and which bring about considerable results. A support programme in the field of implementing waste-preventing utilisation concepts could considerably stimulate the social-scientific discourse on the subject of sustainable consumption.
Recommendation	This measure is recommended for implementation.

6.1.6 Measure A 6: Development and application of indicator systems

The development and application of indicator systems for the promotion of waste prevention is featured a number of times in the WFD. On the one hand, Article 29 No.3 WFD determines that Member States are to specify functional, specific and qualitative or quantitative benchmarks for adopted waste prevention measures, by means of which achieved progresses in national waste prevention programmes can be monitored and evaluated. On the other hand, indicators are presented as exemplary measures in Annex IV of the WFD: "3. The development of effective and meaningful indicators of the environmental pressures associated with the generation of waste aimed at contributing to the prevention of waste generation at all levels, from product comparisons at Community level through action by local authorities to national measures."

In the course of the indicator development for a national waste prevention programme it has already been described that indicators can follow very different objectives, e.g. (cf. Bel 2010, p.5):

- To verify the adherence to specific objectives;
- To determine the efficiency of a specific individual measure;

- To be able to compare measures with each other;
- ...

As part of any waste prevention programme, the focus should lie above all on indicators that would allow a benchmarking in the field of waste prevention. Such benchmarks enable the comparison between different regions or cities and can thus motivate local actors to invest more time; effort and responsibility in the set objectives (cf. OECD 2002). A benchmarking is to be installed according to two different levels as an example measure:

- Benchmarking on the level of public bodies responsible for waste management;
- Benchmarking at the sectoral level

6.1.6.1 Example Measure A 6.1: Benchmarking at the level of public-sector waste management bodies

Background

Groundwork for such a benchmarking system was developed at the European level by i.a. ACR+, who assume an average waste generation per capita and year of 600 kg and from there make a comparison of five fundamental waste fractions: bulky waste, packaging, biological waste, paper and residual waste. The respective best practices are determined amongst the members and the participation in the benchmark is voluntary (ACR+ 2009). A guideline called „Quantitative benchmarking for Municipal Waste Prevention“ has been developed by the association in order to guide the execution – based on the different best practices, the objective of achieving a prevention of 100 kg or 15 % was developed. Figure 6-3 shows the distribution of prevention potentials in the framework of the benchmark.

Because waste generation depends on a row of exogenous factors like the average income or the average household size, sensible classifications must be found that take into account such differences. A possible approach would be e.g. a differentiation by city/country, or by population density. Furthermore, another important factor to be taken into consideration is the amount of people that contribute to waste generation but are not recorded in the population statistics, e.g. commuters or tourists.

In order to enable a comparability of quantitative data it is necessary that there be a standardisation of statistic methods in different fields or at least a normalisation of the data. The various organisational forms of the public bodies responsible for waste management can also be considered in this context.

Objective

A benchmarking for the comparison between waste quantities of different municipalities aims at the identification of best practices or offers help in determining municipalities that have above average quantities of household waste and thus must act to change this. The fact that benchmarks are being published is moreover meant to cause an incentive within municipalities to improve their „own“ quantities.

Characterisation

In the future a uniform collection of the quantities, and other data on the composition, and use of the most important household waste will be initiated. These data are already recorded by public bodies responsible for waste management. In addition to the evaluation of data on

the level of the Federal States Federal States, the data concerning individual districts will in future be evaluated and published at the federal level, by conflating the data from the individual Federal States. The recorded data sets up to date will be complemented by specific data on reuse.

Actions for the 5 flows		Generation (kg/hab./y)	Potential waste reduction (kg/hab./y)*
1	BIO-WASTE	220	40
	• Green scaping	90	10
	• Smart gardening		
	• Act against food waste	30	10
	• Home, community & on-site composting	100	20
2	PACKAGING	150	25
	• Encouraging refillable/returnable bottles	35	12
	• Promoting tap water	6	2
	• Encouraging reusable bags	2	1
	• Fight against excess packaging	107	10
3	PAPER WASTE	100	15
	• Reducing unwanted & unaddressed mail	15	4
	• Encourage dematerialisation through ICT	75	9
	• Reducing kitchen, tissue and towel paper	10	2
4	BULKY WASTE	52	12
	• Promote clothes & other textiles waste prevention	15	4
	• Promote furniture waste prevention	20	4
	• Promote WEEE prevention	17	4
5	NAPPIES & OTHER WASTE	78	8
	• Swap to reusable nappies and incontinence pads	18	2
	• Other municipal waste prevention strategies	60	6
		600	100

Figure 6-3: Average Waste Generation and Prevention Potentials (Source: ACR+ 2009)

Initiators and addressees

Such benchmarking should occur on the national level and be initiated by the German Federal Ministry for the Environment (BMU) or The German Federal Environment Agency (UBA). The involvement of Federal States e.g. in the form of LAGA (Working Group on Waste Management) is necessary and sensible. The measure addresses the public bodies responsible for waste management, who already record corresponding data today, and the German Federal Statistical Offices that process these data. In order to perform benchmarking in the

sense of this waste prevention measure, data must be made available in a nationwide uniform format.

Waste prevention potential

The measure refers to the total generation of waste from households, as is already determined by the German Federal Department for Statistics on the level of the individual Federal States.

A concrete prevention potential cannot be derived.

Environmental impacts

The measure does not cause any direct ecological effects, but it provides framework conditions that enable the recognition of successful waste prevention measures and setting initiatives for waste prevention.

Example measure A 6.1: Benchmarking at the level of public-sector waste management bodies	
Objectives	A benchmarking for the comparison between waste quantities of different municipalities aims at the identification of best practices or offers help in determining municipalities that have above average quantities of household waste and thus must act to change this. The fact that benchmarks are being published is moreover meant to cause an incentive within municipalities to improve their „own“ quantities.
Characterisation	In the future a uniform investigation into the quantities and other data on the composition and use of the most important household waste will be initiated. These data are already recorded today by public authorities responsible for waste management. In future, beside the evaluation on the level of the individual Federal States, also nationwide precise regional data is to be evaluated and published. The data sets collected to date are going to be complemented with concrete data on reuse.
Link to measures set out in Study I	-
Link to Annex IV WFD	3. The development of effective and meaningful indicators
Instrumental character	Benchmarking
Initiators	Federation
Addressees	Public bodies responsible for waste management, Statistical Offices of the individual Federal States
Waste prevention potential	A concrete waste prevention potential cannot be derived.
Environmental impacts	The measure only indirectly develops ecological impacts. Quantification thereof is not possible.
Indicators	Number of public bodies responsible for waste management participating in the nation-wide uniform benchmarking.
Social impacts	There are no negative social impacts to be expected.
Economic impacts	The additional economic costs are minimal.
Conclusion	The example measure is useful on one hand, because it increases the information basis for waste prevention measures considerably, and on the other hand, because it increases the incentive for more intense efforts towards waste prevention. On the other hand, benchmarks are intended for by the Waste Prevention Directive in any case.
Recommendation	The example measure is recommended for implementation.

Indicators

The benchmarks developed in this measure can be used as long term indicators. In the short and mid-term the effectiveness of this measure must be measured by the active participation in the benchmarking process. The number of public bodies responsible for waste management participating in the nation-wide uniform benchmark is an adequate indicator.

Social and economic impacts

There are no negative social impacts to be expected. The additional economic burden for the public bodies responsible for waste management, and the departments of statistics on the federal level, are minimal, because the necessary data is already being determined. The costs for the yearly analysis and publication are relatively low.

Conclusion

The example measure is useful on one hand, because it increases the information basis for waste prevention measures considerably, and on the other hand, because it increases the incentive for more intense efforts towards waste prevention. On the other hand, benchmarks are intended for by the Waste Prevention Directive in any case.

Recommendation

The example measure is recommended for implementation.

6.1.6.2 Example Measure A 6.2: Benchmarking at the sectoral level

Background

A second benchmarking system should be installed on the sectoral level, which can either occur on a voluntary basis through associations, or a corresponding legal basis must be created. In industrial sectors that have been identified as particularly waste-intensive, the accruing waste is to be recorded on the level of individual enterprises. In order to enable comparison of these data, each sector is to sensibly relate its values of generated waste to the size of the enterprise (e.g. waste per euro turnover, waste per number of employees, waste per product quantity). The presentation of the data is however not meant to be company specific, but rather should be issued on the level of the industrial sectors.

More than in the case of households, aspects of qualitative waste prevention must thereby be taken into account (material composition, deployment of potentially harmful materials, etc.). Such a benchmark could also address specific materials for the sector that have been recognised as problematic during the end of life phase.

Objectives

Sectoral benchmarking targets the identification of best practices in production. Beyond that, it serves to identify enterprises with an above average waste intensive production that must be called up for action.

Characterisation

Accumulated waste quantities are to be recorded on the level of individual companies. This value is then set into relation with the company's size (turnover, number of employees) and/or product quantity.

SMEs should be given the option of exemption.

Initiators and addressees

The benchmarking system of BMU and UBA should also be initiated.

Addressees are however the individual companies. In order to develop the benchmarking indicators, the recording of data, etc., sector-specific associations are to be involved.

Waste prevention potential and environmental impact

Compare for this purpose to example measure A 6.1.

Indicators

The benchmarks developed in the measure can be used as long-term indicators. In the short and medium-term, the effectiveness of the measure must be measured by the active participation in the benchmarking process:

- Amount of sectors for which benchmarks are available
- Amount of companies that participate in the benchmarking process

Social impacts

Compare to example measure A 6.1.

Economic impacts

The additional costs for the recording of data can be considerable for smaller enterprises.

Conclusion

The example measure improves the information basis for waste prevention measures in the commerce and gives incentives for intense efforts towards waste prevention.

Recommendation

The example measure recommended for implementation.

Example measure A 6.2: Benchmarking at the sectoral level	
Objectives	Sectoral benchmarking targets the identification of best practices in production. Beyond that, it serves to identify enterprises with an above average waste intensive production that must be called up for action.
Characterisation	Accumulated waste quantities are to be recorded on the level of individual companies. These values are then set into relation with a company's size (turnover, number of employees) and/or product quantity.
Link to measures set out in Study I	-
Link to Annex IV WFD	3. The development of effective and meaningful indicators

Instrumental character	Benchmarking
Initiators	Federation
Addressees	Industry
Waste prevention potential	A concrete prevention potential cannot be derived.
Environmental impacts	The measure only indirectly develops ecological effects. Quantification thereof is not possible.
Indicators	Number of branches and companies that participate in the nation-wide uniform benchmarking.
Social impacts	There are no negative social impacts to be expected.
Economic impacts	The additional costs can be considerable for smaller enterprises.
Conclusion	The example measure improves the informational basis for waste prevention measures in enterprises and gives an incentive for intense efforts towards waste prevention.
Recommendation	The example measure is recommended for implementation.

6.1.7 Measure A 7: Concretisation of producer responsibility

Background

In the environmental policy discussion on products low in harmful substances, that are also resource efficient and reusable at a high quality, one currently often refers to the concept of product responsibility. Congruously, product responsibility was incorporated as an individual section in the revised German Waste Management Act (KrWG) of 24 February 2012.

The term „product responsibility“ is used in many different ways³⁴. The notion established on the level of the EU of „extended manufacturer responsibility“³⁵ and the related concept of a precautionary environmental protection strategy where already developed in 1990 by Thomas Lindhqvist (cf. Lindhqvist/Lidrgren 1990). „Extended manufacturer responsibility“ was then understood to be the following:

*“Extended manufacturer responsibility is an environmental protection strategy, which has the environmental objective to reduce the overall environmental impact of a product; this is achieved by making the manufacturer of a product responsible for its entire life-cycle, especially for its collection, recovery and disposal. The extended manufacturer responsibility is implemented through administrative, economic and informative instruments. The combination of these instruments determines the exact form that the extended manufacturer responsibility takes on”.*³⁶

As is to be taken from this statement, the concept of manufacturer responsibility was at first applied above all in the context of product-related waste management regulations. But in subsequent environmental policy discussions the possibility for assistance in improving the

³⁴ The term “product responsibility” is neither defined legally nor in explanatory statements under German law. Thus the term is only manifested in regulations in which “product responsibility” is referred to (cf. for example also Beyer/Kopytziok 2005 and Kopytziok 2005).

³⁵ Cf. in particular article 8 of the directive 2008/98/EC of the European parliament and council from 19 November 2008 on waste and for the revocation of certain directives

³⁶ translated from German original (cf. Lindhqvist/Lidrgren 1990)

environmental characteristics of products and systems throughout the entire life-cycle was developed. Davis (1994) thus e.g. saw the extended manufacturer responsibility as a newly developing generation of environmental policy, which focuses on product systems rather than on production facilities.

He also noted the following definition for „extended manufacturer responsibility“:

„Extended manufacturer responsibility is a concept, by which manufacturers and importers have a certain degree of responsibility for the environmental consequences of their products along their entire life-cycle; this includes upstream impacts, that inherently result from the choice of materials for a product, impacts of the production process performed by the manufacturer himself, and downstream impacts of the utilisation and disposal of products. Manufacturers assume their responsibility, when they design their products in a way that minimises environmental impacts throughout the life-cycle, and by taking on legal, physical or economic responsibility for the environmental impacts that cannot be prevented through product design“³⁷ (Davis 1994).

Lindhqvist also broadened his definition of „manufacturer responsibility“ in 2000 by stating that „extended manufacturer responsibility“ is a political principle for the improvement of environmental aspects throughout the entire life-cycle of products and thus resembles integrated product policy, as it is described in the green book of the European Commission in 2001 (Lindhqvist 2000). The published requirements linked to product responsibility however are largely limited to the return- and recovery- system of waste (OECD 2011).

Product responsibility thus presents itself as an abstract, fundamental regulatory concept in the first instance, vaguely comparable to the precautionary principle. However, product responsibility as described in § 23 of the KrWG (previously § 22 Waste Management Act) is a legally binding fundamental obligation for the addressed market players according to relevant legal commentaries (cf. e.g. Lersner et al. 2009).

Whereas § 23 Para. 1 KrWG i.a. contains a generic obligation for waste prevention (*„In order to fulfil product responsibility, products must be so designed, if at all possible, that waste production is reduced within their production and use ...“³⁸*), paragraph 2 no.1 specifies that product responsibility encompasses in particular the *“development, production and marketing of products that can be re-used, that are technically durable and that are suitable, after use, for proper and safe recovery and environmentally compatible disposal ...“³⁹*.

With longevity and reusability, central principles of waste-preventing product design are thus named. Without any further substantiating ordinances this cannot, however, be carried out as a binding legal obligation nor can it be sanctioned.

Thus § 23 KrWG (previously § 22 Waste Management Act) calls upon the economy to engage in voluntary self-obligation. This type of voluntary commitment currently prevails for construction waste⁴⁰ and graphic paper products⁴¹.

³⁷ translated from German original (Davis 1994)

³⁸ translated from German original

³⁹ translated from German original

⁴⁰ A Voluntary commitment of the Working Group for Building Industry Sponsors of Closed Cycle and Waste Management Policy (ARGE KWTB) was agreed upon with the Federal Environment Ministry in

This voluntary act must, however, be seen in the context of the authorisation mentioned in § 23 Para. 4, according to which the Federation is entitled to issue obligating ordinances on the implementation of product responsibility.

On the basis of this authorisation, ordinances were issued in the following product fields (legislation): end-of-life vehicles, batteries, packaging, electrical and electronic waste and waste oil. European guidelines⁴² also set regulations in these fields, to which the German legislative provisions must adhere.

Generic specifications of the requirements stated in § 23 KrWG in the form of ordinances after § 24 KrWG for other products groups that go beyond EU law have as yet not been issued. This is justified by i.a. the fact that interference in the freedom of trade is relatively strong and will be very difficult to push through nationally, if applied solely to the common European market⁴³.

With reference to the authorisation of § 23 Para. 4 KrWG, the objective for waste prevention no.3, to be found in the substantiations in § 24, is possible: *„The federal government is authorised to stipulate that 3) certain products are only allowed to be brought onto the market if they contribute to reductions in waste disposal, particularly through facilitating multiple use or recovery“*.⁴⁴

However, it is obvious that (also) in this formulation (in other specifications of the authorisation of § 24 this is more distinct) a link to a „considerable reduction in waste disposal“ is requested. The independence of the waste prevention objective is thus restricted, also as regards other environmental impacts (e.g. climate protection or resource conservation).

In the context of the present waste prevention measure the following discusses, as a first attempt, how the issuing of substantial ordinances for other product fields should be assessed, according to § 23 und § 24 KrWG.

A substantiation and complete investigation as performed for implementation measures will not occur at this stage. On the one hand equivalent implementation measures were analysed from a material perspective in the context of other waste-preventing measures (the results of which are referred to in the following); on the other hand, from a regulatory perspective, the experts consider an individual national effort with regards to the German Waste Management Act often to be less promising for success than alternative measures that are directly enshrined in EU law.

1996 to “reduce by half the quantity of construction waste that is still deposited but recoverable by 2005”.

⁴¹ The objective of the voluntary commitment declaration of the Working Group on Printing Papers for the Return and Recovery of Used Printing Paper (AGRAPA) of 26.09.1994 was to ensure a recovery quota of 60 % starting in the year 2000; the same is applicable to the update of the voluntary commitment, which ensures that the quota will permanently remain at a level of > 80 % (+/- 3 %).

⁴² Directive 2000/53/EC on End of Life Vehicles, The Waste Electrical and Electronic Equipment Directive 2002/96/EC (in connection with Directive 2002/95/EC on the restriction of the use of certain hazardous substances) and Directive 2006/66/EC on batteries and accumulators.

⁴³ According to a legal commentary from Lersner et al. (2009) in relation to § 23, which is identical in wording

⁴⁴ translated from the German original

Objectives

The implementation of the waste prevention measure prohibits placing certain products on the German market, if they do not fulfil corresponding minimum requirements on the absence of hazardous substances and/or for the potential utilisation intensity. Besides a reduction of waste disposal in quantitative (less disposal-necessitating products per unit of time, based on an increase of the utilisation intensity) and qualitative (the removal of hazardous substances in (used-)product streams) terms, the achievement of positive effects on the conservation of natural resources and a reduction in the exposure of hazardous substances throughout the entire life-cycle of products are targeted.

Characterisation

Through one or more ordinance(s) the Federation defined generic minimum requirements for product groups:

- i. In reference to the maximum allowable contents of problematic materials: cf. the exemplary example measure B II 1.1 Restricting problematic – i.a. recovery processes of disturbing – mineral oil components in coldset-printing inks (Chapter 7.2.1.1).
- ii. A product design that prolongs a the lifespan of a product or increases it utilisation intensity Cf. the exemplary example measure B III 1.1 Determination of waste-preventing design requirements for inkjet printers (chapter 7.3.1.1) and the example measure B III 1.2 Supporting the expansion of the EU Eco-Design Directive on further product groups with waste prevention potential (at the example of upholstered furniture) (chapter 7.3.1.2).

Initiators/addressees

Initiators of this measure are the federal level legislators, who push through a corresponding legislation initiative in accordance with participating circles and approval by the Bundesrat.

Addressees are the actors who bring the corresponding products onto the market. Product developers/product designers within these companies are required to develop and realise design alternatives.

Waste prevention potential

The waste prevention potential of a substantiated product responsibility is naturally dependent on the reach (number of captured products) and depth (level of formulated minimum requirements compared to the status-quo).

For the example measures taken as an example there are corresponding exploratory quantifications of the waste prevention potential available in this study⁴⁵.

Environmental impacts

As regards the environmental relief the same general remark with regards to reach and depth of the concrete regulation apply in principle, as for the waste prevention potential.

⁴⁵

Cf. for this purpose the statement on B II 1.1 as well as B III 1.1 and B III 1.2.

Furthermore, besides the environmental relief effects on the disposal phase, there is also environmental relief that results in the field of resource use and of production. These upstream chain oriented relief effects are in principle higher in complex, highly refined products per product unit than in simple, unrefined products.

Exploratory quantifications of environmental effects can be extracted from the sections on the exemplary measures of this study⁴⁶.

Moreover, the environmental effect of measures prolonging the lifespan is appropriate, as they are presented as examples for washing machines, cars and laptops in chapter 5.1.

Indicators

Development of waste generated of the regulated product groups (before and after the measure).

Social impacts

In the first instance the social impacts correspond to other generic legal requirements for product design. The removal of hazardous substances in particular in certain cases can have a risk reducing effect with respect to human health and the environment. Life-prolonging measures can decrease the specific utilisation costs.

For concrete estimations please refer to the exemplary examples in the corresponding paragraphs of this study⁴⁷. Furthermore, one must note that the higher design requirements for products that may be placed onto the German market may cause corresponding increases in manufacturing and consumer prices. The likelihood of bypass reactions (relocation of production, cross border shopping) with corresponding negative social impacts (e.g. job loss)⁴⁸ is considerably higher than in EU wide regulation (such as with material bans of the EU Chemical Legislation or the implementation ordinances in the implementation of EU Eco-Design Directive for example).

By contrast, with reference to hazardous substances one must note that these can cause environmental impacts outside of a country's borders, due to the regional proximity and the cross-border effect of most hazardous substances. Burdens and benefits of regulatory measures thus may spread unequally in space.

Economic impact

The Economic impacts equally depend on the concrete layout of waste-preventing ordinances on product design. As long as the specifications of the requirements are appropriate and proportionate, the Economic impacts should be moderate⁴⁹.

However, one must consider that the one-sided increase in design requirements for products on the German market increases the probability of corresponding evasion reactions

⁴⁶ Cf. for this purpose the statement on B II 1.1 as well as B III 1.1 and B III 1.2.

⁴⁷ Cf. for this purpose the statement on B II 1.1 as well as B III 1.1 and B III 1.2.

⁴⁸ However, it must be noted that the increased regulatory pressure could have innovation-promoting effects, which could generate competitive advantages in other regions and/or in time.

⁴⁹ Cf. for this purpose the statement on B II 1.1 as well as B III 1.1 and B III 1.2.

(production relocation, cross border shopping) with corresponding negative economic ramifications (e.g. job loss).

Conclusion

In principle, ordinances for the generic implementation of waste-preventing aspects of product responsibility represent an effective instrument, which can have a substantial impact if it is developed accordingly.

Relevant restrictions as regards the feasibility and positive waste prevention potentials result from the national approach of ordinances according to § 24 KrWG. Because, besides the already described frictions in the field of social and economic impacts that are to be expected, delays and uncertainties with respect to the final design and time-frame of regulations result, due to the necessity to notify the EU on national interventions in the free single market⁵⁰.

Recommendation

The experts recommend to substantiate the principles and obligations of product responsibility as a priority to direct EU wide regulation instruments or to make them generally binding. If important measures cannot be implemented in this way, then the individual national ordinances should be modified according to the Waste Management Act.

⁵⁰ Any form of substantial, regulatory requirement towards product design is likely to be considered such an intervention according to expert evaluation.

7 Characterisation and evaluation of the waste prevention measures in measure field B: conception, production, and distribution phase

In figures 4-10 of Annex IV WFD the waste prevention measures are considered that can have an effect on the design, production, and distribution phase. These consider points of leverage I to V in reference to the life-cycle stages as presented in Figure 4-4⁵¹.

7.1 Measures in point of leverage I: Waste prevention in resource extraction

The extraction and preparation of raw materials is fundamentally linked to a considerable accrual of waste. For some raw materials and raw material deposits a preparation procedure is used that causes considerable environmental damage. Through choosing the supply source in a targeted manner for each raw material one can influence the degree of environmental damage caused.

7.1.1 Measure B I 1: Expansion of existing advisory structures to include the aspect of the production of or link to resources extracted in a manner generating minimum amounts of waste

Analyses within the project “Material Efficiency and Resource Conservation”⁵² (MaRess) have revealed that the subject of less waste-intensive products or the procurement of low-waste extracted raw materials, has been of little significance for companies to date; and that it is not sufficiently actively pursued by intermediary actors, nor by the various associations (MARESS AP4 2010). Existing consultation structures have been identified as a crucial obstruction, which still have considerable potential with regards to waste prevention.

In this context the following two example measures are investigated in more depth:

- An increased consideration of waste prevention in efficiency consulting for companies
- Expanding existing internet-based consulting services to incorporate the aspect of low-waste extracted raw material.

7.1.1.1 Example Measure B I 1.1: Greater consideration of waste prevention aspects when providing efficiency advice to businesses

Background

As regards consulting on products low in raw materials, Görlach and Schmidt find that to date there has been no success in developing a branding strategy with a signalling character. Efficiency consultants that work at company level face the problem of having to fight considerable prejudices against the consultancy sector in general, especially from SMEs. However, lacking competence on the subject matter of resource efficiency is to be detected amongst consultants, especially in the field of implementation skills, which would lead to recognizable consulting successes. Consulting is currently still much focused on technology.

⁵¹ Therefore the denomination for the measures and example measures which refer to these points of leverage is B I to B V in this area

⁵² Translated from German original: „Materialeffizienz und Ressourcenschonung (MaRess)“

Objectives

This measure aims to ensure that waste prevention is given greater importance in efficiency consulting for companies; this in turn has the objective of better informing companies, especially SMEs, on the link between the use of raw materials and waste prevention and the related savings potentials.

In the first instance the training of consultants in this field is to be intensified, to then improve consulting in companies, based on a national concept with regional integration. In order to achieve voluntary participation by companies it is necessary to emphasise more clearly the benefits of such consulting.

Characterisation

The essence of this measure is an optimised efficiency consulting for companies on the subject of waste prevention. In order to realise in a more efficient manner the cost-reduction potentials at the corporate level through waste prevention and the manufacture of low-waste products, the approach of a more strongly integrated efficiency consulting for SMEs is to be developed, that follows the approach of existing programmes, i.a. the ‘Deutsche Materialeffizienzagentur (demea)’ (=German material efficiency agency)⁵³. The approach targets the training of the consultants in the first place, who are to be taught “bridge qualifications” besides management and engineering, which is to achieve stronger implementation skills in the individual companies.

Through a specialisation on the federal level in combination with regional consulting teams, for example “Efficiency-Angel” Networks, the efficiency of consulting is to be markedly increased (MARESS AP4 2010). The target for regional consulting is strong coordination, networking and cooperation with currently already existing consulting structures on the level of the individual Federal States and municipalities.

Initiators and addressees

Ideally the initiators of such a measure would be the German Federal Ministry for the Environment and the Federal Ministry for Economics, because this measure could not only contribute to waste prevention, but also to significant cost reductions in the manufacturing industry. The main approach could be in particular the development of guidelines for the financing of corresponding consulting networks. In doing so the existing, established consulting networks are to be included without fail, above all those of Demea (=German material efficiency agency).

Addressees of the measure would be sectors of industry in the manufacturing industry in particular. Focussing on particularly waste-intensive sectors could potentially be sensible.

Waste prevention potential

According to a current study by the Fraunhofer Institute for Systems and Innovation Research ISI based on 1484 surveyed companies within the manufacturing industry, companies themselves estimate that they could on average make savings of 7 % in their

⁵³

<http://www.demea.de/>

material consumption⁵⁴ given the state of the art (Schröter et al. 2011). Thus the savings potentials are lower than the estimated 15 % in the energy sector (Schröter et al. 2011), but the energy costs represent a much lower share of production costs, with 2 %.

The estimated waste prevention potential increases with the complexity of the produced goods: Especially for high-quality products like in the field of information and communication technology (ICT) with a multitude of individual components and highly complex supply structures, there are still considerable reduction potentials through material savings to be made. For instance, 15 % of the surveyed companies in the automobile sector- that is so important in Germany- estimate they could achieve potential savings of 10 % and more (Schröter et al. 2011).

Table 7-1 shows absolute saving potentials in different sectors, whereby the automotive industry could even save 15.7 billion Euros yearly with the support of current technology. The sum of savings potentials across all different sectors is 48 billion Euros per year. Taking account of the average return on sales across the sectors studied, and then the textile industry for example would have to increase its turnover by 270 % in order to achieve the same impact on profitability.

Table 7-1: Cost savings potentials by sector

Branchen	Umsatz (in Tsd. Euro, 2008) ^(a)	Material- kostenanteil (in Prozent) ^(a)	Durchschnittliches Einsparpotenzial (in Prozent) ^(b)	Kosteneinsparung bei x-Prozent Materialeinsparung (in Tsd. Euro, 2008) ⁽¹⁾
Fahrzeugbau	372.192.394	54,3%	7,7%	15.697.557
Maschinenbau	232.016.419	43,2%	7,0%	7.188.325
Elektroindustrie, incl. MMSRO ⁽²⁾	199.657.870	38,1%	7,1%	5.480.698
Ernährungsgewerbe	161.228.728	54,7%	5,2%	4.600.890
Chemische Industrie	179.524.810	35,4%	6,3%	4.030.207
Metallerzeugung und -bearbeitung	116.293.992	55,5%	5,9%	3.808.173
H.v. Metallerzeugnissen	104.248.653	41,0%	6,1%	2.645.873
H.v. Gummi- und Kunststoffwaren	69.599.064	41,5%	8,2%	2.376.718
Papiergewerbe	38.581.335	45,7%	4,3%	758.928
Glasgewerbe, Keramik	39.083.179	32,0%	5,5%	689.942
Textil-, Bekleidungs- und Ledergerwerb	22.581.232	41,6%	6,5%	613.259
Holzgewerbe	18.217.587	51,2%	5,0%	468.882
Verlag- und Druckgewerbe	17.951.767	36,7%	7,0%	461.521

Quellen: (a) Statistisches Bundesamt 2010a; (b) Erhebung *Modernisierung der Produktion* 2009, Fraunhofer ISI, eigene Berechnungen.

Anmerkungen: (1) Die Berechnungen basieren auf den Angaben zu Umsatz und Materialkostenanteil (Spalte 1 und 2, Statistisches Bundesamt 2010a) sowie den Daten zum Einsparpotenzial (Spalte 3, Fraunhofer ISI 2009); (2) MMSRO: Medizin-, Mess-, Steuer- und Regelungstechnik, Optik

Source: Schroeter et al. 2011

According to scientific investigations, 20 % of raw materials used in production could be saved by 2016, taking into account the technological progress in the individual sectors (BMU

⁵⁴ Except for energetic raw materials, savings in material consumption have a 1:1 effect on waste prevention.

2009). Assuming a material input of 1600 million t (cf. BMU 2011) in Germany (including imported products), this would imply raw material savings of more than 300 million t/a, that would have direct consequences for waste prevention.

Environmental impacts

The described savings in raw materials and the connected (production-) waste bring about considerable environmental preservation. Within the framework of an evaluation of efficiency consultation by demea it was i.a. revealed that the lightweight construction measures taken when building the glass roof of the Reichstag President Palace enabled savings of approx. 7 t steel and 330 m aluminium profile (cf. demea o.J. p.3). The reduction of the overall quantity of steel used in this individual construction project by 40 % alone thus leads to savings of more than 10 t CO₂ (cf. BMU 2011). In the example of a processing company in Baden-Württemberg, savings of approx. 20 % of detergents used could be made (cf. demea o.J., p. 11).

Indicators

The success of the measure can in the long term be documented by statistics on the decrease in material consumption and production waste. A sector-specific evaluation in time can increase the significance of such an indicator.

In the medium-term the successful implementation of aspects in waste prevention within efficiency consulting can be indexed by the number of specifically trained consultants.

Social impacts

There are no negative social impacts to be expected.

Economic impacts

Within the context of the MaResS-project, the overall economic effect of such consulting programmes was investigated by means of the macroeconomic model PANTHA RHEI, which is capable of illustrating the effects of changed resource consumption along the entire supply chain. It was assumed that all companies in the manufacturing industry were subjected to efficiency consulting within a time-frame of 20 years, and that the overall costs for such a broad consulting initiative would be approx. 105 million Euros for the consultation, in addition to, from experience, a doubling in necessary investments into the companies. However, this would also bring huge positive effects by 2030 through the reduction of material consumption in these companies.

Such a programme can bring about structural change towards a dematerialised economy: Whereas the individual raw material producing sectors like the processing of mineral oil or the sector of stones and earths would have to deal with marked economic slumps, mechanical engineering in particular would see a huge increase in turnover and jobs given the revival in demand and an improved position in international competition. At the same time total resource consumption in Germany would, despite a price-adjusted increase in GDP of 14.2 %, decrease by 9.2 % compared to reference scenarios (MARESS AP5 2010). Even though the real effects strongly depend on assumptions, e.g. on wage developments, the results clarify the economic potentials that could be realised through comprehensive efficiency consultation.

Table 7-2: Overall Economic impacts of the consulting instruments for resource efficiency

Deviation from the baseline	gross domestic products	national debt	labour force	final energy consumption	TMR
% absolute	+14.2 +374.7 billion €	-10.2 -226.0 billion €	+1.9 +696,100 pers.	+0.42 +33147TJ	-9.2 -506.4 million tons

Source: MARESS AP5 2010

Conclusion

A strengthened consideration of the subject matter of waste prevention in efficiency consulting of companies is particularly sensible from an economic point of view in the framework of a national waste prevention programme. An expansion of consulting services would go hand in hand with additional costs, which could however be markedly overcompensated for by savings made in companies.

Recommendation

The example measure is recommended for implementation.

Example Measure B I 1.1: Greater consideration of waste prevention aspects when providing efficiency advice to businesses	
Objectives	Waste prevention is to be given more importance in efficiency consultation of companies, in order to better inform companies on the links between raw material consumption and waste prevention and the connected potential savings.
Characterisation	Through strengthened integration of efficiency consulting, SMEs in particular are effectively informed of the possibilities of waste prevention through material efficiency. Better implementation skills within the individual companies are to be achieved through the combination of specialisation on the federal level and regional consulting teams.
Link to measures set out in Study I	(3) Deutsche Materialeffizienzagentur (demea) (=German Material Efficiency Agency) (135) Effizienz-Agentur NRW (=efficiency agency in North Rhine Westphalia)
Link to Annex IV WFD	5. The provision of information on waste prevention techniques
Type of measure/instrument	Information/Consulting
Initiator	German Federal Environment Agency, and German Federal Ministry for the Environment
Addressees	Efficiency agencies, consultants, companies within the primary industry and the manufacturing industry.
Waste prevention potential	Approx. 20 % of raw materials consumed in production could be saved by 2016, if one takes into account and implements the technological advances in the individual sectors. This would correspond to raw material savings of more than 300 million t/a, which would have a direct impact on waste prevention.
Environmental impacts	The described savings in raw materials and in the connected (production) waste bring about considerable environmental savings, which cannot, however, be quantified exactly.

Example Measure B I 1.1: Greater consideration of waste prevention aspects when providing efficiency advice to businesses	
Indicators	Long-term: The decrease in material consumption and of production waste with a sector-specific evaluation in time. Medium-term: Number of specifically trained consultants.
Social impacts	There are no negative social impacts to be expected.
Economic impacts	A comprehensive efficiency consulting for industry brings about high initial investment costs for the public sector for the consultation and necessary investments in the companies themselves. However, there are also positive effects through the decrease in material consumption in these companies, including a strengthening of the regional economy and positive effects on employment. Shifts between branches are to be expected.
Conclusion	A strengthened consideration of the subject matter of waste prevention in efficiency consulting of companies is particularly sensible from an economic point of view in the framework of a national waste prevention programme. An expansion of consulting services would go hand in hand with additional costs, which could however be markedly overcompensated for by savings made in companies.
Recommendation	The example measure is recommended for implementation.

7.1.1.2 Example Measure B I 1.2: Extension of existing web-based advisory services to include the aspect of the procurement of low-waste and low-contaminant resource extraction

Background

The efficient use of resources decreases the specific demand in raw materials and thus inevitably also the creation of surplus quantities (by-products, waste) or the use of problematic materials that are linked to raw material extraction.

Up to now it has barely been acknowledged that the supply source or the type of raw material influence the specific burden caused. There are in fact differences in how promising different deposits are, and thus a different specific generated quantity per product. Also when processing ore, different technical procedures are used, that can differ markedly in their use and handling of potentially problematic auxiliary and operating materials.

The quantitative impact of the extraction of metal ores or metals is illustrated well in the example of gold. The cumulated raw material demand (CRD) for gold is around 740.000 tonnes per tonne, which reveals the huge resource requirement and is an indication of the waste quantities that accrue during the process (Giegrich et al. 2012). These numbers quickly reveal that small fluctuations in the viability of raw material deposits or also the exploitation in different processing procedures have marked impacts on waste generation. The industrial extraction of gold using the amalgam process and the use of mercury, or using cyanide leaching, are traditional. The direct emissions of mercury in small-scale mining (15 % of worldwide gold production) have direct and marked environmental consequences. The environmental pollution potential of large-scale industrial cyanide leaching is revealed especially in the case of disturbances and maritime accidents. Cyanide leaching leads to huge quantities of cyanide sludge that are channelled into large retention basins in production sites. When dams break, hydrocyanic acid causes considerable environmental

damage, as was illustrated in the recent Baia Mare accident in Romania in a gold and silver mine. The contamination of the River Tisza leads to fish mortality, which spread into Hungary.

The strict alternative to this is the classical gold extraction in rivers (gold panning) from the sediment or in particular the recourse to gold from secondary sources, i.e. from the processing of gold-bearing products, whereas the current demand can by no means be covered using these two approaches.

In the batteries of a mobile phone from 2005 there are 0.034 g gold and 16 g copper. The overall weight of the mobile is 113 g (Sullivan 2006). In order to obtain the same amount of gold in the form of primary material, 25 kg material must be processed cumulated raw material demand (CRD)s, and for copper 2 kg are required (Giegrich et al. 2012).

This is also linked to environmental relief in other environmental aspects. According to the datasets of Ecoinvent (2012), the extraction of gold from primary sources comes with a twenty-fold higher climate impacts than that from secondary sources, both calculated from the refinery onwards. For copper, the specific contributions for the extraction of primary copper are about two times higher.

The positive effects resulting from the measure are generally realised outside of Germany, because only few raw material deposits are exploited or existent within Germany.

Industrial companies residing in Germany use raw materials or intermediate products to a large extent, which gives them market power and influence. The targeted direction of demand, marginal conditions for extraction and processing can be fundamentally influenced, even though the leeway for doing this in the case of certain metals may be limited by the high concentration of companies on the supply side.

For some biogenic materials like wood or agriculturally produced raw materials, certification systems have been established (e.g. Fsc for wood) or are in development. For many other raw materials this information is, however, not available yet.

Especially given the aspect of waste prevention the procurement of secondary raw materials is hugely important. The generation of tailings as well as waste quantities, that accrue when processing ore and in all steps that follow, can be prevented by resorting to secondary raw materials instead of primary ones, especially in the case of metals. Awareness raising for raw material procurement and thus for waste generation and environmental impacts, elsewhere and outside the concerned company is the fundamental task of this measure and targets SMEs in particular, which must resort to external consulting services.

Based on these considerations it seems sensible to expand consulting services in particular for SMEs with the aspect of low-waste procurement of raw materials and of all resulting intermediary products.

Objectives

The measure targets the prevention of waste quantities that accrue during raw material extraction and processing. Knowledge on the possibilities of reducing waste through the deployed raw materials is to be promoted in production companies and for manufacturers.

The improved knowledge on marginal conditions in raw material extraction and processing are important prerequisites for optimisation. They enable companies, which are committed to sustainable action, either out of self-interest or due to market requirements, to commit in the same way with regard to raw materials or products manufactured from these.

Characterisation

The measure draws on existing consulting structures in industry and handicraft, in the aim of informing and sensitising companies on the subject of starting or primary materials. Conventionally the focus of production-integrated environmental protection is the optimisation of the actual production processes towards emissions reduction (air and water), reduction of the specific waste generation (pollutant levels), as well as resource efficiency.

The efficient use of resources decreases specific raw material demand and thus the creation of surplus quantities (by-products, waste) or the deployment of problematic materials linked to raw material extraction.

Especially in terms of preventing waste quantities, the procurement of secondary raw materials is of huge significance. The generation of tailings and waste quantities, that result from ore processing and all the following steps, can be prevented if one resorts to secondary instead of primary raw materials, in particular in the case of secondary metals. Awareness raising for raw material procurement and thus for waste generation and environmental impacts, elsewhere and outside the concerned company is the fundamental task of this measure and targets SMEs in particular, which must resort to external consulting services.

The success of this measure is facilitated above all by its interaction with other measures, the certification of raw materials and intermediate products, as well as by the interest shown in the measure by individual companies. This will result if the recourse to certified raw materials is also rewarded by the market. The measure must thus be linked to a measure that involves labelling.

Initiators and addressees

The measure is initiated by the individual Federal States. Information on low-waste procurement of raw materials or on the products manufactured out of these is made available on internet portals, through exchanges with institutions like for example the chambers of industry and commerce as well as trade associations.

The measure targets companies from industry and commerce or the primary and manufacturing industries.

Targeted waste and products

The measure targets a reduction of waste quantities in mining, as well as in the processing of ore and thus generally locations and processes beyond the national borders. More specifically the targets are tailings and different types of product-specific waste.

Environmental impacts

The utilisation of secondary raw materials can, in contrast to the promotion of processing primary resources, be linked to higher energy costs. However, there are marked successes to be achieved from the perspective of waste prevention, which becomes clear from the low

concentration of metals in ores as well as from the generation of waste rock when promoting ores. Additionally, there is the often high environmental damage potential that is linked to ore processing.

The incentives on the demand side promote beneficial raw material extraction from a waste and environmental perspective.

Indicators

The success of the measure cannot be directly quantified. Furthermore, the intended successes in waste prevention are revealed worldwide.

A direct indicator for verifying the successful implementation of this measure is the extent to which such information on low-waste procurement of resources is made available on the existing internet portals. The success of the measure can also indirectly be measured by the share of secondary resources that enter production processes and products. The higher the demand for secondary resources and thus the higher the achievable price is, the more secondary material is extracted from the waste stream and made available to the market.

Example Measure B I 1.2: Extension of existing web-based advisory services to include the aspect of the procurement of low-waste and low-contaminant resource extraction	
Objectives	The measure targets the prevention of waste quantities that accrue during raw material extraction and processing.
Characterisation	Government agencies initiate/promote the increased consideration of aspects of waste-preventing procurement of raw materials and the manufacture of primary materials through information and consulting measures.
Link to measures set out in Study I	(139) Cleaner Production and Pollution Prevention (151): ECO+ Environmental Consultation
Link to Annex IV WFD	5. The provision of information on waste prevention techniques
Instrumental character	Information
Initiators	Ministries of Federation and Federal States
Addressees	Companies within the primary and manufacturing industries.
Waste prevention potential	Cannot be quantified, but presumably high.
Environmental impacts	Cannot be quantified, but presumably high.
Indicators	Number of correspondingly modified consulting measures, number of consultants in primary industry.
Social impacts	There are no negative consequences to be expected. An indirect contribution to the improvement of labour conditions in resource extraction.
Economic impacts	There are no negative consequences to be expected.
Conclusion	The prospect of high waste prevention potentials being exploited is good, given that the measure can draw up on existing consulting structures and is to be carried out in combination with further measures on waste prevention and resource conservation.
Recommendation	The example measure is recommended for implementation.

Social and economic impacts

The increased use of secondary raw materials supports industry and commerce in Germany and thus tends to have positive economic and social impacts. Through the targeted demand for sustainably extracted primary resources, one can in the mid and long term expect a contribution to the improvement of working conditions in raw material extraction.

Conclusion

The prospect of high waste prevention potentials being exploited is good, given that the measure can draw up on existing consulting structures and is to be carried out in combination with further measures on waste prevention and resource conservation.

Recommendation

The example measure is recommended for implementation.

7.1.2 Measure B I 2: Voluntary agreements with primary industry

The objective is a voluntary agreement on waste-preventing and resource efficient extraction/ production of primary materials. A voluntary agreement between government institutions and trade associations is generally made, when government and legal or sub-legal regulations exist on the corresponding subject. The approach of the intended measures is a voluntary agreement amongst the participating/concerned.

The primary industry in which primary raw materials are processed is of higher importance. Primary industry includes the following sectors:

- Processing metallic raw materials;
- oil refinery
- inorganic chemistry
- producing organic primary chemicals
- power plants

In processing plants for metallic raw materials (IFEU 2007), solid residues and dust accrue from the exhaust air purification, depending on initial concentration of the input material that needs to be disposed of. Action points for waste prevention cannot be identified, with the exception of imposing a condition whereby metal extraction must meet high environmental standards in the processing phase, especially with respect to emission standards. It should be made sure, however, that by-products are utilised.

In oil refinery plants (UBA Ö 2005), it is mainly various sludges of different origin that accrue for disposal besides heavy oil, bitumen and sulphur. If one assumes that the sludges of different origin, as well as residues from the purification of crude oil or from the purification of exhaust gas from the different combustion processes, are the actual waste quantities (and not by-products) of a refinery, then its generation depends above all on the crude oil quality processed in the plant, as well as on the design of purification processes. The latter are to be laid out in a way that no product mixtures accrue for disposal, but that materials and chemical compounds accrue for the most part, which can thus be reused as secondary materials (e.g. sulphur) in production processes.

Waste from inorganic-chemical processes is above all used catalysts, sludges and reaction chemicals like acids, bases and chlorine. The most important production branches (VCI 2010) are, derived from the production quantities, the manufacture of:

- Sulphuric acid,
- Sodium hydroxide and chlorine,
- Ammonia,
- Sodium carbonate, as well as
- Nitrogenous fertilisers and
- Titanium dioxide (colour pigment).

Waste from the manufacture and the formulation of basic organic chemicals are mainly sludges originating from the plant-based water purification as well as residues from reaction and distillation. Points of leverage for waste prevention are not identified.

Waste that occurs for disposal in power plants and combustion plants are the actual combustion residues (slags), as well as the solid residues from the flue-gas purification. The combustion residues result from the inert share of the combusted material, the flue-gas purification residues from the harmful substances contained in the combusted material, as well as the design of the flue-gas purification and its retention performance.

Against this background, the overview does not reveal any particularly relevant points of leverage for the prevention of waste quantities in primary industry. This does not exclude that there is a need for optimisation in the detail of certain processes. This is also true on the regional level, for instance for the construction industry, which could resort more to raw materials (see measure B I 3).

Given the problem described in measure B I, the focus of this measure should equally be on raw material procurement. An objective could be for the voluntary commitment of primary industry to prioritise the resort to secondary raw materials or to extraction sites of primary materials, in which extraction occurs in a comparably environmentally friendly and waste-preventing manner – especially when processing metallic raw materials

7.1.2.1 Example Measure B I 2.1: Voluntary agreement with the primary industry in the field of metallic re-source processing on the procurement of resources from comparatively environmentally sound and low-waste extraction sites or on the use of secondary resources

Background

A voluntary agreement of this type is to occur between the individual companies (potentially also trade associations), as well as government institutions on the federal level. It should have a clear agreement on objectives and make guidelines on the type and extent of regular reporting. The agreement aims to ensure the prioritised use of secondary raw materials, as well as the procurement of primary raw materials from comparably environmentally friendly or waste-preventing extraction sites.

The processing of old metals only generates low quantities of waste, but this is not the only environmental benefit. On the contrary, numerous ecological assessments and evaluations have revealed that the use of secondary material in production processes rather than the

resort to primary material usually is considerably more advantageous. The recourse to secondary raw materials is in general also interesting from an economic perspective. The latter is already comprehensively being approached for ferrous metals. The situation is different, however, for many other materials, in particular for non-ferrous metals. The separated collection and processing of scrap metals and their being made available as secondary raw materials is not always economically advantageous in contrast to the procurement of primary raw materials. Certain metals are more concentrated in electronic equipment than in primary raw material sources. Thus a mobile phone that weighs 113 g in total contains 16 g of copper and 0.034 g of gold (Sullivan 2006). In order to obtain the same amount of metal from primary raw materials one would have to exploit 25 kg of gold and 2 kg of copper (Giegrich et al. 2012). A voluntary agreement supports common practice in some fields and can give important impulses in other fields for increased reuse.

The recovery of secondary materials or the extraction of primary raw materials can be linked to different degrees of waste accrual and environmental pollution depending on the technical procedure. Voluntary agreements can play an important role in creating incentives for the raw material producers to do business in an environmentally friendly and waste-preventing manner. Similar agreements already exist, for example in the case of coltan (Coltan Fingerprint) and diamonds (Kimberley-Process), which respectively refer to particular regions of origin (BGR 2007)⁵⁵. A similar approach is conceivable for this measure, maybe not as concerns the exclusion of particular procedures and plants, but rather as regards explicitly stipulated preferences. The extraction and trade of iron ore in particular is concentrated among a few companies. This is, however, not the case to the same extent for all metals. Nevertheless, voluntary agreements can still be of benefit, even if the scope is in many cases restricted.

The voluntary agreement, which can include not only the manufacturers but also the 'distributors' (manufacture of intermediate products and e.g. consumer goods) of metal goods, aims at procurement of raw materials that is as waste-preventing as possible, and simultaneously takes into consideration further environmental as well as social aspects.

If increased demand causes incentives on the market, then this will have impacts on the side of supply. One can assume that, for example, more raw materials from secondary sources will be made available on the market, if there is a corresponding reward for the increased processing efforts.

Objective

The measure's aim is to prevent waste quantities that accrue during raw material extraction and processing.

Characterisation

Voluntary agreements between companies and associations from primary industry (here especially from the field of processing metallic raw materials) on the one hand, and governmental institutions on the other hand, determine concrete waste-preventing

⁵⁵ BGR, the Federal Institute for Geosciences and Natural Resources, certified commercial chains in the field of mineral raw materials, Hannover 2007

measures and efforts with respect to raw material extraction from comparably environmental friendly and waste-preventing extraction sites or as regards the use of secondary raw materials.

Initiators and addressees

The initiative for such a measure must be created by the federal level and aims at companies that process and further process metallic raw materials or the corresponding trade associations.

Targeted waste and products

The measure directly targets the prevention of waste masses that accrue for disposal at exploitation and extraction sites for metallic raw materials (primary and secondary raw materials)

Waste prevention potential

The waste prevention potential is large, but cannot be exactly quantified.

Environmental impacts

Extraction of metallic raw materials and their processing is linked to considerable environmental impacts, which go beyond that of the generation of waste, which cannot currently be exactly quantified. In any event of environmental burdens and waste prevention as discussed here cannot be counterproductive.

Indicators

Indicators for the evaluation of the measure's implementation can be the occurrence of voluntary agreements, as well as the results of monitoring reports.

Social and economic aspects

The increased use of secondary raw materials supports industry and commerce in Germany and thus is likely to have positive economic and social impacts.

The targeted procurement of secondary raw materials that stem from relatively-speaking environmentally-friendly and waste-preventing companies will improve the standards of raw material extraction. These standards do not only include environmental aspects, but also social ones, in particular as concerns job quality.

Conclusion

The measure can support substantial prevention of waste, as well as of the connected environmental burdens that can be considerable. The measure will mainly affect fields outside of Germany.

Recommendation

The example measure is recommended for implementation.

Example Measure B I 2.1: Voluntary agreement with the primary industry in the field of metallic re-source processing on the procurement of resources from comparatively environmentally sound and low-waste extraction sites or on the use of secondary resources	
Objective	The measure aims to prevent waste masses that are generated in raw material extraction and processing.
Characterisation	
Link to measures set out in Study I	..
Link to Annex IV WFD	9. The use of voluntary agreements
Instrumental character	Voluntary agreement
Initiators	The federal level.
Addressees	Companies that process metal ore
Waste prevention potential	There is only little available information on the extraction of metallic raw materials. This, in combination with the generally applicable formulation of the measure, renders a quantification of the waste prevention potential impossible.
Environmental impacts	High, but cannot be quantified exactly.
Indicators	The reduced material flows recorded in the monitoring reports.
Social impacts	No negative impacts to be expected.
Economic impacts	No negative impacts to be expected.
Conclusion	The measure can support substantial prevention of waste, as well as of the connected environmental burdens that can be considerable. The measure will mainly affect countries outside of Germany.
Recommendation	The example measure is recommended for implementation.

7.1.3 Measure B I 3: Initiation or support of meaningful marks or labels for primary materials

Governmental departments initiate and support the independent evaluation and labelling of primary materials that are manufactured in a waste-preventing manner. Regardless the existing challenges finding the right method, and despite the data situation which is often bad, there are numerous labels on the market, characterising and certifying certain facts, like for instance the environmentally-friendly manufacturing of products, but as well the raw material procurement. For wood and wooden products there are different labels, e.g. those of FSC and PEFC.

With little exception the markets are global, respectively international. To label raw material is usually sensitive, if it takes place on an international level. A clear exception is the market for construction material presenting a multitude of stakeholders, and rather zoned regional markets. According to this, within this segment even with an initiative that spreads maximum on a national level, or regional level, a meaningful labelling of primary material can be achieved.

This measure also aims on the prevention of waste quantities that accrue in the raw material extraction – here: stones and earths. The deposits of raw material reserves are differentiated according to their share of overlying rock and layers with a less promising in their yield. The reduction of the purchased raw material is therefore directly connected to the reduction of waste, or rather surplus quantities.

Ready-mixed concrete is a high-quality construction product manufactured from sand and stones, water and chemical auxiliaries. An extensive use of secondary aggregates in competition to gravel and crushed rock is allowed, but to date rarely in practice.

7.1.3.1 Example measure B I 3.1: Labelling scheme for resource-conserving concrete

Background

Dependent from the type of concrete and the exposition classes, the German Board for Reinforced Concrete (Deutscher Ausschuss für Stahlbeton) allows to a predetermined extent aggregates that originate from the recycling of rubble, through its guideline “Concrete according to DIN EN 206-1 and DIN 1045-2 with recycled aggregates according to DIN EN 12620, part 1”⁵⁶ (DafStB 2010). For structural concretes according to this only a maximum of 45 % of the aggregate might be made from RC material. The requirements on the product characteristics of ready-mixed concrete are the same as of conventional concrete made of formulas solely based on primary raw material.

Although this guideline exists since the year 2004 this is in the construction sector rarely known. The manufacturing of concrete according to this guideline is only in few German regions in practice⁵⁷. The area of Stuttgart has to be named here above all. Starting from an impulse project, in the meantime at least three factories for ready-mixed concrete have changed their formulas, and use now for the manufacture of conventional structural concrete RC aggregates to the maximum extent permissible according to the guideline. Several construction waste recycling facilities in the area of Stuttgart produce the RC aggregates, and carry out the supply of the factories for ready-mixed concrete.

This recourse to secondary aggregates protects primary raw material for which, in order to be extracted, it is strongly interfered with ecosystems and landscape's appearance, to the same extent.

Hence, through this measure ready-mixed concretes that use at least 20 Vol. % secondary aggregates in their formulas should be labelled and advertised as resource protective concrete. The setting of frame conditions for this label should be carried out in cooperation of the Bundesverband Transportbeton (federal association for ready-mixed concrete) and the Federal Ministry for Environment, or Construction Ministry, or as well on the level of the individual Federal States, and here with the corresponding associations and ministries on the states level.

⁵⁶ translated from the German original

⁵⁷ cf. www.rc-beton.de

The above mentioned scientific monitoring of the impulse project in Stuttgart (IFEU 2010)⁵⁸ revealed that typical environmental effects related to the manufacturing of concrete (in particular the greenhouse gas effect) tend to balance out “resource protective concrete” to “conventional concrete”, when the concerned formulas for the concrete types contain equal masses of cement. Accordingly this would be an important frame condition to be established for any label.

If this is ensured, it leaves transportation efforts to be classified from the conventional environmental perspective. The concentration of construction activities on dense urban areas that can in general be observed, is rather advantageous for option of RC concrete, since in this case the raw material occurring as construction rubble can be used (urban mining), whereas primary rock deposits usually have to be extracted from outside of the conurbation, and therefore need to be delivered over longer transportation distances.

Because of the direct and noticeable cost effects of both, the cement input as well as the transportation, the advantage of concrete labelled as resource-protecting, also under other environmental perspectives (beside the resource conservation), over the conventional concrete should be ensured, facing the price sensitivity in regards of this construction product that depends on the market price for this product.

In the end the decision of builders and clients will always considerably be influenced by the purchase price of construction material. But a label “resource-protecting concrete” can make a difference in the decision of builders and clients in case the prices are equal.

Objectives

The measure aims on the prevention of waste quantities accruing while mining and processing of natural stones for the purpose of concrete manufacturing. In using products that are partly or in totally made from secondary raw materials, all burdens will be saved which are connected to the extraction and processing of primary raw material. Included are burdens from the generation and disposal of waste and surplus quantities. This means that, although manufacturing of RC aggregates is a recycling process, the use of these aggregates for the production of concrete represents waste prevention.

What matters here are the top layers, overlaying the deposits that have to be removed, and the remains from the preparation of natural stones, which are not conform to the construction physics.

Characterisation

A voluntary agreement on labelling of resource-protecting concrete for the structural engineering will be determined between the federal association for ready-mixed concrete and the institutions of the Federation. Structural concretes with a secondary aggregate share of > 20 Vol. % from the overall aggregates are to be labelled as resource-protecting.

⁵⁸ IFEU Institute Heidelberg (Institute for Energy and Environmental Research); High-quality recycling of construction rubble as an additive for the concrete production; Documentation of the project part of the BMV Bau- und Wohnungsverein Stuttgart, on behalf of the Ministry for Environment, Nature Conservation and Transport Baden-Wuerttemberg, Heidelberg October 2010 [title translated from the German original].

Initiators and addressees

Federal Ministries in collaboration with the Federal Association Ready-mixed concrete, or the Federal States Ministries in collaboration with the corresponding associations on states level.

Waste prevention potential

In the extraction of gravel and sand also masses accrue, which are not marketable. They reach approx. 10 % of the mined volume. Taking carbonate rocks as example for the extraction of natural stones, the surplus quantities are around 16.4 % of the mined volume here (FGRB BaWue 2006). In the overall mining quantity of stones and earths of approx. 540 million annual tons this results annually in approximately 70 million tons overburden, which could in theory be prevented. A reduction in the purchase of these raw materials means a prevention of waste quantities to the same extent.

To a large extent the primary materials which can be applied to manufacture those high-quality RC aggregates, are already today in use in the road construction, but also in other, rather subordinated application areas. Those products rely to a smaller extent on high-quality aggregates. Therefore the shift will not burden their product quality, and will not have to be substituted by the recourse to primary aggregates.

Environmental impacts

Strengthening the recourse to secondary aggregates reduces the necessity to explore and exploit natural stone deposits, and therefore as well the related interferences within ecosystems and landscapes.

In all other classic environmental aspects, the resource-protecting concrete is not in general different to the conventional ready-mixed concrete (see above). Since the “raw material deposit” of RC aggregates is usually closer located to the construction material demand than those of primary rocks, in the result ecological advantages also occurs from the reduction of transportation efforts.

Indicators

The number of ready-mixed concrete companies labelling their products can be used as an indicator to examine the successful implementation of the measure.

Social and economic aspects

No negative impacts to be expected.

Conclusion

The measure can support savings of significant overburden quantities from the mining of stones and earths in Germany. Beyond this, the interference within ecosystems and landscapes can significantly be reduced.

Recommendation

The example measure is recommended for the implementation.

Example Measure B I 3.1: Labelling scheme for resource-conserving concrete	
Objective	The measure aims to prevent waste quantities that are generated in the exploitation and processing of natural stones for the manufacturing of concrete.
Characterisation	A voluntary agreement on labelling of resource-protecting concrete for the structural engineering will be determined between the federal association for ready-mixed concrete and the institutions of the Federation. Structural concretes with a secondary aggregate share of > 20 Vol. % from the overall aggregates are to be labelled as resource-protecting.
Link to measures set out in Study I	-
Link to Annex IV WFD	Not to be categorised exactly: 13. Support of reliable eco-labels 9. The use of voluntary agreements
Instrumental character	Voluntary agreement; labelling
Initiators	Federation
Addressees	In the end companies that manufacture ready-mixed concrete.
Waste prevention potential	In the extraction of annually approx. 540 million tons stones and earths, an annual overburden volume of approx. 70 million tons can be calculated. The preventable share cannot exactly be determined.
Environmental impacts	Reduction of interferences within ecosystems and landscapes.
Indicators	Number of ready-mixed concrete companies labelling their products.
Social impacts	No negative impacts to be expected.
Economic impacts	No negative impacts to be expected.
Conclusion	The measure can support savings of significant overburden quantities from the mining of stones and earths in Germany. Beyond this, the interference within ecosystems and landscapes can be significantly being reduced.
Recommendation	The example measure is recommended for implementation.

7.2 Measures in the point of leverage II: Waste prevention in manufacturing facilities

7.2.1 Measure B II 1: Universally binding restrictions at EU level on material inputs to production processes adopted

Background

The reduction of the pollutant level in waste streams is an important point of leverage for waste prevention. Effective reductions of pollutants can in particular be reached by preventing the input of corresponding pollutants into product streams and production processes upstream to the generation of waste.

Generally binding bans of substances, and restrictions on the use them, i.a. in the industrial and commercial sector⁵⁹ were anchored in the past in Germany in the Banned Chemicals Regulation. After implementing the EU REACH Regulation⁶⁰ the respective regulations were transferred to the corresponding REACH annexes (Annex XIV list of substances subject to authorisation, and Annex XVII list of material restrictions) in order to develop an EU-wide effect.

To understand the mode of action of laws governing chemicals, the question which stage of a chemical's life-cycle is addressed is important.

1. **Authorisation (substances of Annex XIV):** the concept of authorisation as a key element of REACH presents a general ban of substances or substance groups reserving the right of permission. This reservation takes effect when a market actor after application receives an authorisation for the use. This use is restricted for a specific utilisation which was to be described in the application. The authorisations are valid for a limited time, and issued by EU authorities (EU Commission, ECHA) after considerations of the risks (partly by evaluating the social-economic use) through the applicant.

Thereby the use according to REACH is only the direct application of a substance, or its use to manufacture a mixture ("chemical product"), or a product.⁶¹

In opposite to chemical products, the occurrence of a substance in a product (e.g. in product imports), will not cause a ban of use⁶². Accordingly, products with a certain level of harmful substances are not regulated in terms of their marketability by REACH authorisation.

2. **Restriction (substances according to Annex XVII):** a restriction regulated by REACH prohibits very specifically defined life-cycle/utilisation stages of a substance. All other utilisations, and the occurrence in products and/or chemical products which were not matter of restriction, continue to be allowed.

Restrictions are issued by authorities and are to be implemented by the market players. Restrictions can only be issued for substances/groups of substances which are not brought on the market with the aim of technical use (e.g. production-related impurities, contaminations of input material), and they can (in opposite to the authorisation case) also address the occurrence of substances in imported products.

Specification of the measure in view of a (strong) governmental intervention

Beside the above outlined options to regulate substance input at EU level through laws governing chemicals, there is furthermore the option of a national regulation. But as being interventions into the free movement of goods in the EU internal market, their notification is subject to usual reservation of the EU. And therefore they also need special justification.

⁵⁹ I.e. in particular in terms of auxiliary and/or working material in production processes.

⁶⁰ Regulation (EC) No. 1907/2006 (REACH Regulation). REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals.

⁶¹ A "product" has to be seen in terms of REACH, paragraph 3 (e.g. the printed paper in newspapers), and not colloquially as a product. Products can according to the laws governing chemicals as well be so-called mixtures, in the exemplary case the printing colour.

⁶² Because in terms of REACH this does not present a use in itself.

Reasons for such justification of national variants can in particular be found in the field of health protection, i.e. in the field of foods, commodities, and interior products.

The obligations as operator as described in the BImSchG (Bundesimmissionsschutzgesetz/Federal Pollution Control Act (especially in Art. 5)), and the corresponding examination obligations of this process concerning authorisation and control of plants, offer another alternative: the specific examination of an individual case where it is examined whether substances can or must be used that develops less negative environmental effects. In the framework of requirements according to Art. 5, 1.3 BImSchG, this examination obligation explicitly includes the generated waste.

If a corresponding measures is supposed to develop waste prevention effects (here: “reduction of pollutants in waste”) for larger waste streams, in the opinion of experts, the possibilities offered in the substance restrictions of REACH are, compared to the above mentioned alternatives, particularly targeting. Taking this turn, it is allowed, independent of the restrictions of notifying, or the limitation to some selective sources (plant authorisation); to address the pollutant's put into a product stream in a targeted manner, but to the full range of a market.

Beside the “initiation” of suggestions on restrictions through the German authorities, also the “support” of corresponding activities of other actors (Member States, EU Commission, and European Chemicals Agency (ECHA)) is an important aspect of the suggested waste prevention measure.

Currently various Member States introduce their proposals for restrictions to the EU for discussion and coordination in rather quick succession. Those restriction proposals rarely have their reason in waste related considerations, but in aspects like consumer protection, protection of employees, or e.g. the water conservation. The targeted introduction of waste prevention aspects, for instance the reduction of pollutants in waste and the resulting

- i. lower environmental burdens in waste disposal, and/or
- ii. improved circulation of waste fractions

can support corresponding restriction proposals during the processes of considerations. On the other hand, focussing restrictions (i.e. intensifying/expanding the subject of restriction) would enable effective waste prevention effects.

7.2.1.1 Example measure B II 1.1: Initiation of a restriction proposal for cold-set offset printing ink

Background

A relevant waste-preventing effect can be developed by a decree of legal “quality” requirements on base oils for coldset/offset-printing colours.

Surveys of the cantonal laboratory Zurich of autumn 2009 had revealed that daily newspapers printed by using the coldset-offset⁶³ technology in an average contain approx. 3,000 mg mineral oil per kg newspaper, and food (cardboard) packaging made from it contains 300 to 1,000 mg mineral oil per kg packaging cardboard. The mineral oil has a relatively small

⁶³ This kind of printing procedure is predominantly used to print daily papers in Germany, but as well in Europe.

molar mass (C18-C22), and contains between 15 and 20 % aromatic hydrocarbons⁶⁴. Hence, packaging from recycling cardboard can contain mineral oil increased by factor 10 than cardboard packaging from fresh fibre.

Those mineral oils contain two problematic substance fractions:

- paraffin-like and naphthenic-like carbon hydrides - “mineral oil saturated hydrocarbons” (MOAH), < 24 C-atoms
- aromatic carbon hydrides - “mineral oil aromatic hydrocarbons” (MOAH) which are mainly composed by 1-4 ring systems, to the largest extent highly alkylated, so-called polycyclic aromatic hydrocarbon compounds (PAH).

According to information of the Bundesinstitut fuer Risikobewertung (Federal Institute for Risk Assessment (BfR)) the exact composition of the problematic mineral oil fractions in the printing/paper production is yet unknown. In particular this is valid for the MOAH fractions which are made of hundreds of individual substances, and were to date only scarcely examined. There is a high probability that substances causing cancer are part of the complex mixture of mainly PAH which are characteristic for those MOAH fractions⁶⁵.

Contaminations of food with problematic mineral oil fractions are undesirable considering health protection. Short-chain carbon hydrides are easily taken in from the body, in a way that when contaminated foods are often consumed, the toxicological values can go beyond the limit. According to the BfR transmissions from recycling paper and cardboard to food should immediately be minimised. Via the gas phase these mineral oil fractions can be passed on to food, partly even through intermediate packaging.

Beside the outlined environmental risks it is likely, according to the expert's estimations, that the aromatic compounds have persistent, bio accumulative and toxic properties (PBT) according to the criteria of Annex XIII of REACH⁶⁶ just like the 16 EPA-PAH which were examined more closely, and which have a structural similarity. Therefore, from an eco-protective point of view, the minimisation of environmental contaminations⁶⁷ would become mandatory.

Examination of alternative regulation approaches

Because of the above listed considerations of health protection, the BMELV has taken the initiative lately⁶⁸ to modify the Consumer Goods Ordinance with two Amendment

⁶⁴ N.n. (TBA?): BfR statement 008/2010 of 09.12.2009: „Übergänge von Mineralöl aus Verpackungsmaterialien auf Lebensmittel“ (“Transmission of mineral oil from packaging material to food”) http://www.bfr.bund.de/cm/216/uebergaenge_von_mineraloel_aus_verpackungsmaterialien_auf_lebensmittel.pdf

⁶⁵ Cf. lecture of Wölflé and Hellwig, BfR 2009; additionally confirmed pers.com Wölflé, Jan. 2012. Above this> Pfaff, K., Hutzler, C.: Gesundheitliche Bewertung der Übergänge von Mineralöle (Evaluation of health matters concerning the transmission of mineral oil), lecture workshop: “Mineraloelanalytik im Lebensmittelbereich” (“mineral oil analysis in the food area”) 10./11.June 2010

⁶⁶ PBT properties count as well as highly alarming.

⁶⁷ The substitution of pollutants in use is generally part of such minimisation efforts.

⁶⁸ Previous efforts proved futile to dispose the EU Commission to take action on an EU level.

Regulations⁶⁹. Through draft of the 21. variations regulation of the so-called “Druckfarben VO” (printing colours regulation) the contents of colours for printing food packaging are regulated in a “positive list”. The draft of the 22. variations regulation of the so-called “Mineralöl VO” (mineral oil regulation) the transmission of problematic mineral oil fractions in cardboard packaging for food is supposed to be prohibited (beyond a detection limit). If both variations regulations would be accepted, the corresponding modified Consumer Goods Ordinance would surely regulated the negative effects on the consumer. The negative effects on the waste paper stream (-cycle) caused by pollutant input to newspaper printing would not be affected by this action.

Requirements concerning legal authorisation in the framework of Art. 5 1,3 BImSchG are not effective in this case, because the addressed facilities for paper printing do not fall under those facilities requiring authorisation (BImSchG in connection with 3. BImSchG).

Ökopol has investigated this, whether the current efforts⁷⁰ at EU level to include certain PAH containing mineral oil fractions into the so-called candidate list under REACH of substances with particularly alarming properties (Substances of Very High Concern SVHC) is appropriate to be used for this case (“basic oils in coldset printing colours”). This is not the case.

Objectives

The WP measure “Initiating a restriction proposal for coldset-offset-printing ink (newspaper printing) that is not fulfilling defined material requirements” aims towards significant reduction of contaminations in a mass-related waste stream – the collected waste paper – and thereby to allow their use for the packaging production. In doing so, the input of fresh fibres can be reduced in this field.

Another effect would be to avoid additional interior packaging (plastic, cardboard made of fresh fibres), which would possibly become necessary in future to prevent the migration of problematic mineral oil components to the food inside. The chart following (figure 7-1) shows the system context once more in a schematic overview.

Characterisation

The WP measure would in this example comprise the initiation of a restriction proposal by the German (waste and environmental) authorities in the framework of the European Regulation on Chemicals REACH, which regulates in material terms that only coldset printing colours⁷¹ can be brought on the market not exceeding a maximum content of MAOHs⁷². This value should be within the range of the detection limits (orienting at the 22. variations regulation).

⁶⁹ After first drafts of August 2011 with date of 27. December 2011 modified versions of these regulation drafts proceeded to consultations among governmental departments.

⁷⁰ The corresponding REACH Annex XV dossiers for pitch, coal tar, high temp., various anthracene compounds were introduced by the EU Commission, respectively the latter by Germany.

⁷¹ Within the framework of Annex XV's Dossier Development, it will certainly have to be reviewed, if an expansion of these requirements on all offset printing colours would be advisable.

⁷² MOAHs = mineral oil aromatic hydrocarbons. In the draft of the „Zweiundzwanzigste Verordnung zur Änderung der Bedarfsgegenständeverordnung“ (22. regulation on the amendment of the Consumer Goods Ordinance) of 27. December 2011, the MOAHs are specified as “sum of aromatic mineral oil hydrocarbons with a quantum of carbons between 10 and 25”. According to the reason in this

Concretely the German authorities would have to develop a corresponding REACH Annex XV dossier, and the EU procedures would have to be fed into ECHA.

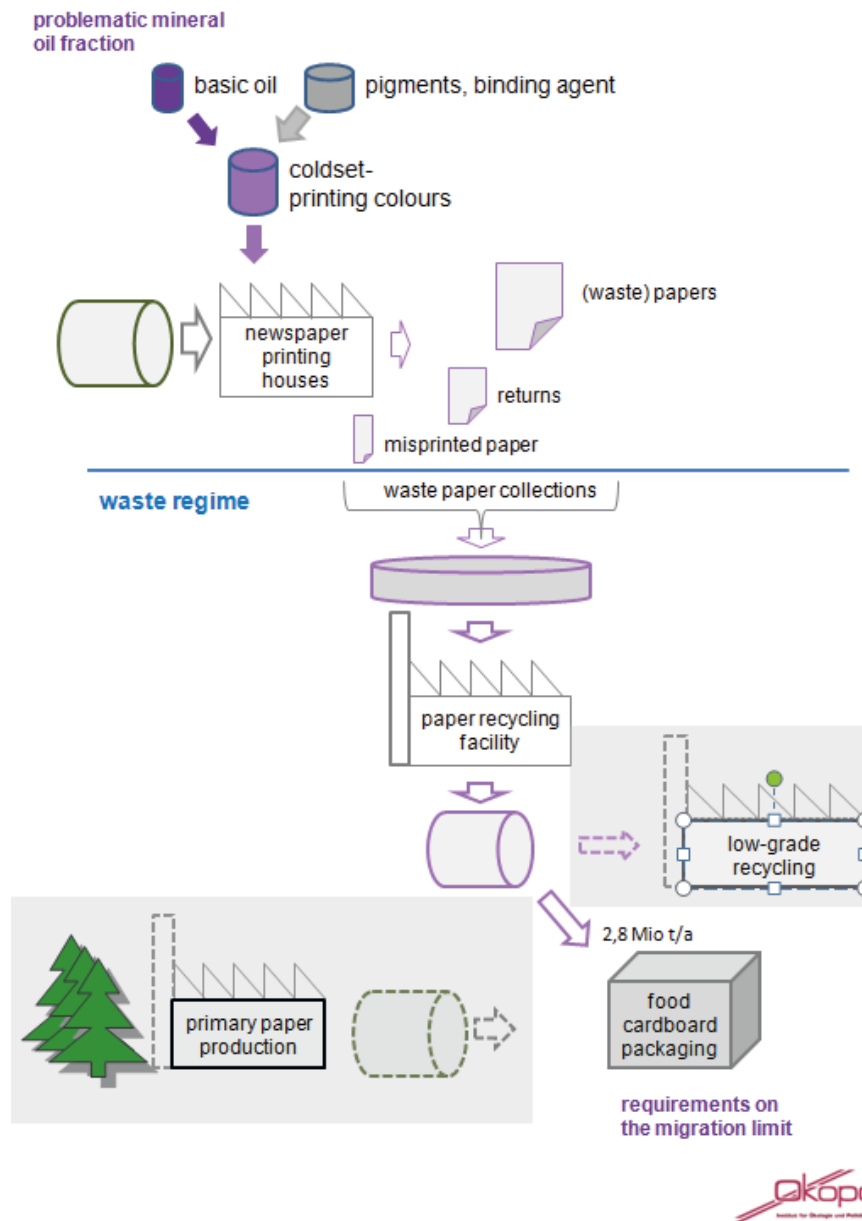


Figure 7-1: Schematic overview about connection between problematic contents in printing colours, the migration requirements of food packaging, and the waste paper cycle

Initiators and addressees

A restriction under REACH can according to Article 69 be developed on initiative of a Member State, or by the ECHA on behalf of the EU Commission. In this case initiator would

regulation draft, it is assumed here that setting a separate maximum quantity for saturated mineral oil hydrocarbons (MOSH) is not required, because the share of saturated to aromatic hydrocarbons is approximately constant.

be the Member State Germany⁷³.

A restriction under REACH is an EU-wide measures, and is applicable 1:1 immediately in every Member State. A national limitation is not necessary.

Addressees on a restriction are in this case the market players as there are:

- Manufacturers (formulators) of printing colours, which have to adapt their formulations \Rightarrow old formulations not marketable any longer.
- Importers of printing colours from outside of the EU, which are allowed to import only colours meeting the requirements of the market restriction.
- Printing houses, which are allowed only to use colours, conform to the restriction.

Waste prevention potential

The measure aims on reducing the contamination potential of newspaper printing colours (coldset-offset-printing) in order to directly reduce the corresponding content of harmful substances in the print products as well, or rather the content of harmful substances in the collected waste papers from both, commercial collection (misprinted paper and returns), as well as household-related collections (waste newspapers).

The waste paper emerging in Germany in 2007 was 15 million t in total (VDP 2007)⁷⁴.

In absolute figures the annual waste paper input for manufacturing packaging papers of 9.2 million t is about twice the volume as for manufacturing graphical papers (4.4 t). 2.8 million t of this volume is dedicated for the direct or indirect contact with food. If those papers would be replaced with fresh fibres, the waste paper input for packaging would decrease from 101 %⁷⁵ to 70 %. The German rate of utilised waste paper would in total decrease from currently 71 to 57 % (according to Kersten et al. 2011).

Environmental impacts

The central environmental impact of the measure is the removal of hazardous substances in a quantity-related waste paper stream.

In 2011 the overall circulation of newspapers in Germany was approximately 24 million (BDZV 2012⁷⁶). The larger part of the newspaper used in Germany is collected separately for

⁷³ Inside of Germany the right to initiate restriction proposals is divided by the three “evaluation departments” of REACH, the Umweltbundesamt(UBA), Bundesamt für Risikobewertung (BfR) und Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)

⁷⁴ (VDP 2007): Verband Deutscher Papierfabriken (vdp) (=Association of German Paper Factories): Papier recyceln, Bonn.

⁷⁵ In the manufacturing of paper fibres are lost during the production process. For this reason waste paper rates above 100 % in relation to the finished product are possible.

⁷⁶ BDZV 2012: Pasquay A.: The German Newspapers in Figures and Data (translated from the German original); Bundesverband deutscher Zeitungsverleger e.V. (BDZV) Berlin (Federal Association of German Newspaper Publishers).

the waste paper recycling. The waste paper return rate (waste paper emergence/paper consumption) in the year 2009 was 83.2 %⁷⁷.

In the current waste paper recycling streams the harmful substances either remain in the paper – and lead from there to the possible health risks as outlined or they are transferred to other waste fractions in the course of the utilisation process⁷⁸, where they might lead to risks due to their (also) eco-toxicological impacts.

To remove harmful substances from printing colours it is necessary to change the material basis of the basic oils used in coldset printing colours. In order to put this into practice, the processing oils (high viscosity oils from vacuum distillation) used to date could either be replaced by oils on vegetable basis⁷⁹, or by mineral oils that were dearomatised (hydrogenation process)⁸⁰. While the latter particularly increases the energy demand for the manufacturing, the use of oils on vegetable basis leads to a shift of environmental impacts to completely other impact categories.

In the following it will be assumed that vegetable oils on rape seed or soy methyl ester can replace the quantity of mineral oil in the basic oil of coldset-offset-printing colours one-to-one. The environmental burdens of basic oil are compared to the burdens of rapeseed and soy oil in table 7-3.

For the manufacture of dearomatised “white oil”, the burdens (energy demand and exploitation losses) of a corresponding additional dearomatisation step are considered.

For the waste treatment phase solely burdens are examined, because credits for the thermal utilisation of the calorific value of printing colours would be equal in most of all variations. If the share of mineral oil in printing colours for the web offset-coldset printing (64,000 t/a, Frank 2011⁸¹) would be replaced throughout Europe by rapeseed, or soy oil, the annual savings of greenhouse gas would result in 35,277 t, or rather 92,595 t CO₂-eq. But this would also increase the annual acidification potential to 897 t, or rather 582 t CO₂-eq. Standardised the reduction of the greenhouse gas potential is smaller than the increase of the acidification potential.

From the environmental perspective also relevant are the impacts of changed formulas of basic oil on the de-inkability of printed papers. In particular in the colour formulations based on vegetable oil ester, the available referring experiences (Kersten et al. 2011) reveal

⁷⁷ <http://www.umweltbundesamt-daten-zur-umwelt.de/umweltdaten/public/theme.do?nodeIdent=2314>; accessed on 09.02.11; source: Verband deutscher Papierfabriken e.V., Papier 2010, Ein Leistungsbericht (performance report).

⁷⁸ E.g. through quantitative transfer to deinking slurries in using the more elaborate de-inking process (cf. Kersten et al. 2011, p. 9ff).

⁷⁹ As raw material basis in other offset printing procedures soy, rapeseed, sunflower, palm tree, or linseed oils are used.

⁸⁰ At EU level the branch association Concave and the European institutions of health protection are currently coordinating corresponding quality requirements. In the end, using the in relation more complex procedures of hydrogenation, it enables the production of the so-called white-oils which are, i.a. applied in the cosmetics industry, where they reach the relevant health protection requirements.

⁸¹ Frank (2011): Frank, E., Mineralöle in Lebensmittelverpackungen – Lösungsansätze aus der Druckfarbenindustrie (Mineral oils in food packaging – solution approaches of the printing colour industry (translated from the German original)), BfR 22.09.2011

that i.a. the cross-linking reactions occurring in the course of time lead to a deteriorated removal of colours from the paper-fibres, so the de-inking result is less good. For basic oils from “white oil” currently no corresponding referring experiences are available, but due to the material properties, rather nor, or only small influences on the de-inkability are to be expected.

Table 7-3: Ecological evaluation of rapeseed and soy oil compared to mineral oil, on European basis⁸²

			Basic oil (ifeu)	White oil (ifeu)	Rapeseed methyl ester (Europe) (EI 2.2)	Soy oil methyl ester (USA) (EI 2.2)
	Masse	t/a	64,000	64,000	64,000	64,000
Manufacturing	CO ₂ -eq	kg/kg	0.43	0.91	2.70	1.25
	CO ₂ -eq.	t/a	27,405	58,419	172,614	79,891
	SO ₂ -eq	kg/kg	0.0022	0.005	0.0175	0.0086
	SO ₂ -eq	t/a	141	322	1,121	553
Disposal (only burdens)	CO ₂ -eq	kg/kg	2.85	2.85	0	0
	CO ₂ -eq	t/a	182,400	182,400	0	0
	SO ₂ -eq	kg/kg	0.00018	0.00018	0.00018**	0.00018**
	SO ₂ -eq	t/a	11.52	11.52	11.52	11.52
Total without credits	CO ₂ -eq	t/a	209,805	211,359	172,614	79,891
	SO ₂ -eq	t/a	152	370	1,132	565
Balance	CO ₂ -eq	t/a	0	31,014	-37,190	-129,914
	SO ₂ -eq	t/a	0	181	980	412

**Assumption that the burdens are from the specific vegetable oil and mineral oil incineration (with exception of greenhouse gas potential).

The additional environmental effort for the increased quality of printing colours mentioned is related to further environmental relief effects from the pollutant removal resulting from the otherwise necessary adjustment reactions of the food cardboard packaging field with respect to the increased requirements. Those adjustments can dependent of their individual “environmental effort” be found in the following alternatives:

- removal of recycling paper from the manufacturing of food cardboard packaging, and hence increased fresh paper demand in this field;
- use of additional layers protecting from migration, made of plastics, inside of the food cardboard packaging, and
- implementation of a very far reaching, separated collection of newspaper, and printing products of other waste papers.

⁸²

In Germany annually approx. 30,000 t coldset-offset printing colour is used with an overallshare of basic oil of approx. 12,000 t; i.e. the environmental burden in Germany is approx. 20 % of the values calculated in the table.

Indicators

The effectiveness of the measure is provable in the framework of waste paper analysis, where the content of problematic MOAHs should decline in the course of time.

Social impacts

The central social impact of the WPM is the reduction of possible environmental risks resulting from the contact, respectively the migration, of problematic mineral oil fractions to food, and/or other commodities.

The presumably increasing printing colour costs for newspaper printing could contribute to increasing costs of newspaper, considering the developments of the branch that are economically difficult anyway. At least in theory⁸³, this has an impact on the free access to information, also for those groups in the population who are socially less fortunate.

The use of vegetable oil as substitute for mineral oil can, besides the environmental effects, also have disadvantageous social aspects due to increasing the competition between industrialised and food-related utilisation of the corresponding vegetable basis (reduction of access to reasonably priced nutrition).

Economic impacts

The re-formulation of newspaper printing colours formulas will in any case for both, in short term (costs for changing the system), as well as in the medium term (more expensive raw material basis) lead to increased costs for printing colours, and hence burden the newspaper publishers, or rather increase the newspaper costs for the consumers.

Those costs are against the cost relief (or avoided increasing costs) in overall societal terms, in the field of utilising recycled waste paper.

The costs for the actual WP measure “Initiating a restriction proposal...” divide into the following cost categories⁸⁴:

- development of the technical basis, and implementation to a REACH Annex XV Proposal => according to experts estimation on the basis of the available information approx. 30,000 Euro;
- coordination of Annex XV proposal between the participating concerned departments; => here no reliable data to demands or costs are available for the experts;
- attending the professionals' discourse, and coordination at EU level => here no reliable data to demands or costs are available for the experts.

⁸³ In view of the comparably small share of printing costs in the overall costs of newspapers, the experts assume that such an impact will in fact rather remain a “theory”.

⁸⁴ The level of the estimated effort to develop a solid Annex XV dossier (reason for the restriction proposal by a Member State) is of decisive significance that in the specific example case in Germany (at the UBA) already numerous sound information on the professional characterisation of the realistic situation, as well as estimations about possible consequences of the regulation, are available. In transferring to other restriction projects with waste-preventing effect, where the data base is less well prepared, the efforts for the preparative research can presumably exponentiate up to 10 times, i.e. up to 300,000 Euro).

Because material restrictions under REACH develop a direct EU-wide effect, there are no additional costs for the implementation under German law.

Conclusion

Besides the concrete, and direct, qualitative waste prevention, the measure enables indirectly a less harmful operation of recycling (material cycle) due to the qualitative waste prevention. Through the use of recycled materials at least in the field of raw material further waste will be prevented.

Recommendation

The example measure is recommended for the implementation.

Example measure B II 1.1: Initiation of a restriction proposal for cold-set offset printing ink	
Objective	The content of harmful substances of collected waste paper is to be significantly decreased. Thereby the use of fresh fibres in the packaging production is to be reduced. Another effect would be to avoid additional interior packaging (plastic, cardboard made of fresh fibres).
Characterisation	The German (waste and environmental) authorities initiate a restriction proposal in the framework of the European Regulation on Chemicals REACH, which regulates in material terms that only coldset printing colours can be brought on the market not exceeding a maximum content of MAOHs
Link to measures set out in Study I	-
Link to Annex IV WFD	4. Support of Eco-Design
Instrumental character	Regulatory
Initiators	Federal Environmental Authorities
Addressees	Printing houses, as well as manufacturers and importers of printing colours
Waste prevention potential	The annual waste paper input for manufacturing packaging papers of 9.2 million t is about twice the volume as for manufacturing graphical papers (4.4 t). 2.8 million t of this volume is dedicated for the direct or indirect contact with food. If those papers would be replaced with fresh fibres, the waste paper input for packaging would decrease from 101 % ⁸⁵ to 70 %. The German rate of utilised waste paper would in total decrease from currently 71 to 57 %.
Environmental impacts	The share of mineral oil in printing colours for the web offset-coldset-printing (64,000 t/a, Frank 2011 ⁸⁶) would be replaced throughout Europe by rapeseed, or soy oil, the annual savings of greenhouse gas would result in 35,277 t, or rather 92,595 t CO ₂ -eq. But this would also increase the annual acidification potential to 897 t, or rather 582 t SO ₂ -eq. Furthermore the measure would enable saving of fresh fibres for packaging cardboard to an extent that leads to more significant savings being environmentally effective.
Indicators	Long term: contents of problematic MOAHs in waste paper in time course. Short and medium term: successful implementation of restrictions concerning EU law.

⁸⁵ In the manufacturing of paper fibres are lost during the production process. For this reason waste paper rates above 100 % in relation to the finished product are possible.

⁸⁶ Frank (2011): Frank, E., Mineralöle in Lebensmittelverpackungen – Lösungsansätze aus der Druckfarbenindustrie (Mineral oils in food packaging – solution approaches of the printing colour industry (translated from the German original)), BfR 22.09.2011

Example measure B II 1.1: Initiation of a restriction proposal for cold-set offset printing ink	
Social impacts	Reduction of possible environmental risks from the contact, or migration, of food and/or other consumer goods. The presumably increasing costs for printing colours for newspaper printing can result in increasing costs for newspapers. The increased use of vegetable oils can strengthen the competition between industrial and nutrition-related use of plants.
Economic impacts	The costs for initiating the actual WP measure are low. Short and medium term: higher prices for newspaper printing colours are to be expected.
Conclusion	Besides the concrete, and direct, qualitative waste prevention, the measure enables indirectly a less harmful operation of recycling (material cycle) due to the qualitative waste prevention. Through the use of recycled materials at least in the field of raw material further waste will be prevented.
Recommendation	The example measure is recommended for implementation.

7.2.1.2 Example measure B II 1.2: Support for a restriction proposal for plastics additives (phthalates)

The following example is to present exemplary how the support, and if necessary the modification, of material restriction proposals (in the framework of REACH) motivated by waste prevention aspects, can take action while it was originally initiated by other protective intentions. The example uses a realistic contemporary restriction proposal (as of 26.01.2012). This proposal is currently discussed.

Background

Numerous additives are used in plastics. These additives are to give plastic either technical properties (e.g. softeners, stabilisers), or prepare the design of the future product (e.g. colorants). Numerous of those additives can harm humans and the environment. Most of the time additives are integrated in the plastic matrix, and thus become waste together with it.

A group of additives that is particularly harming for humans and environment are phthalates. The phthalates:

- DIBP, di-isobutyl phthalate
- DBP, dibutyl phthalate
- BBP, benzyl butyl phthalate
- DEHP, (Bis(2-ethylhexyl) phthalate

were already identified as particularly harmful substances in the course of the approval procedures of REACH, and are already included in Annex XIV of REACH⁸⁷, so from a date set there⁸⁸, within Europe any utilisation of these substances is prohibited⁸⁹.

⁸⁷ The current Annex XIV is to be found under: <http://echa.europa.eu/web/guest/addressingchemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisationlist/authorisation-list>

⁸⁸ 21. February 2015 for DBP, BBP, DEHP, and DIBP

⁸⁹ With reservation of the overall exceptions listed in Annex XIV. The insertion of phthalates into a product is as well seen as utilisation.

By including the substances in Annex XIV the utilisation within Europe (from the respective “sun-set dates” on) is prohibited, and can therefore only under certain qualifications (i.e. specific approval based on corresponding, reasonable application of individual companies) be included into products. Not comprehended however, is the import of products onto the European market where the substances are added.

Beyond the future utilisation restriction, prohibition already exists for these substances:

- According to entry 51 of the Annex XVII (restrictions) of REACH, DEHP, DBP and BBP are not allowed as substances or in mixtures for toys, or products of child care. Additionally plastic materials of these products may not contain more than (in total) 0.1 % of these substances.⁹⁰
- Furthermore the Toy Safety Directive (2009/48/EC) regulates after 20. July 2013 that no CMR substances above the specific value defined for them are allowed in parts, respectively in structures that are micro structurally distinguishable (e.g. coating of a part). All four substances were classified as toxic for reproduction under category 1b.

How it was already mentioned, a prohibition through approval only comprises the production within Europe. Many products that proved to contain phthalates, are products abroad outside of Europe, and get to it by being imported. For this reason Danish authorities have decided to implement REACH⁹¹ by developing a restriction proposal for the marketability of phthalate-containing products⁹².

A restriction proposal submitted by Denmark and currently under coordination/consultation comprises a prohibition of marketability (restriction according to the standards of REACH) of products that are used in the interior space, or are touching skin, or mucous membrane, of humans while they are in use. Many consumer goods would be affected by this restriction proposal, if they would pollute indoor air, or when a close contact to the consumer could be presumed⁹³.

Form the waste preventions' perspective relevant is that these restriction proposals do not include a number of also quantity and waste-relevant products⁹⁴. Some examples:

- cable insulation for outdoor use;
- installation material and outdoor coverings;
- roof materials;

⁹⁰ In practice, this leads to a de facto exclusion of the substances from products, because the technical function only unfolds in relevantly higher concentration.

⁹¹ DANISH ENVIRONMENTAL PROTECTION AGENCY

⁹² The full report about the restriction proposal is available at <http://echa.europa.eu/documents/10162/c6781e1e-1128-45c2-bf48-8890876fa719>

⁹³ In order to give an idea about the concerned products, in the following an infinite list: child care products (for DIBP), interior accessories of cars, trains, ships, boats, planes etc., wall panelling and floor coverings, cable insulation for the inside, electro devices, coated material for furniture, for bags and for suitcases et al., carpet tiles with backside foam, waterbeds and air mattresses, wall paper, shoes, textiles, water sports equipment (life jackets, water wings, swimming rings etc.), sponges and erasers, sitting and gymnastic balls, sex toys, garden hoses, gardening tools with phthalates in the handles.

⁹⁴ This is due to the “strictly” consumer protection-oriented approach of the Danish restriction proposal.

- vehicle substructure;
- garden tools with phthalate-containing parts which are not the handles.

Objectives

The WP measure “supporting a restriction proposal for plastic additives (phthalates)” aims on significantly reducing the content of harmful substances quantity-relevant waste streams – products close to the consumer with a share of additive plastics. This measure has therefore direct impact on waste prevention according to the definitions of the WFD. Above this, such a measure also leads to a removal of harmful substances in the related recycling-plastic fractions⁹⁵.

Characterisation

The proposed WP measure comprises the active support of the federal German waste management authorities for current restriction proposals under REACH, including the examination/supplement/expansion of the existing proposal, e.g. on further product groups.

The support of the specific Danish restriction proposal on phthalates (as plastic additive) will be discussed exemplary.

In the framework of this restriction proposal, the distribution of products containing the substances DIBP, DBP, BBP, and DEHP will be limited. In the result, the pollutant inventory of the products in utilisation phase will be reduced, and thus as well in the resulting waste streams.

1. In the framework of dossier submitted by Denmark it is analysed that from the waste disposal phase of the products to be restricted a significant share of emissions results, and it is stated that thus i.a. the absorption of the substances into the food chain results. To remove the contaminations from the waste stream in terms of the WFD already presents a concrete waste prevention measure.
2. The removal of harmful substances from the waste stream leads in this specific case to a situation where the subsequent plastic recycling results in a recycling product which is of higher quality (since less polluted).

In the opinion of the consultants this analysis should result in active support of the (waste management) authorities of the Member States (in this case Germany) for the restriction proposal.

From the perspective of waste prevention it should furthermore be considered to expand the present proposal to products that are not addressed yet, because they lead as well to the respective pollution of the waste disposal phase, and thus in the end to emissions into the environment, and/or spreading into the recycling-plastic streams. Systematically in terms of waste prevention there is no difference to the products getting close to the consumers addressed already in the Danish proposal.

⁹⁵ During the established primary material plastic recycling, no exfiltration of the comprised plastic additive takes place.

Initiators and addressees

The procedures under REACH provide two rather “informal” and two “official” consultation procedures for the annotation / support of restriction proposals (cf. procedure of a restriction, Figure 7-2).

The BMU and/or the individual Federal States can either present their own considerations on waste policies to the official consultations, or add their positions in the course of the coordination with the other specialised departments to the corresponding statement of Germany. The latter would probably be more targeted, but to date the relevant systematic coordination/circulation procedures within the environmental administration are lacking. These would have to be established.

If German authorities are responsible in developing restriction proposals, it seems to be appropriate also to make argumentations, considerations, and surveyed data accessible as soon as possible to the leading departments of each working level. This way their activities would be effectively be supported. Also here the administration internal standard procedures to systematically ensure an early participation of other specialist departments are lacking. Those are to be developed as well.

Excursus: Possibilities for participating in consultation processes

The times to transmit information (figure 1, green boxes 1-4) are according to the stepwise process of REACH restrictions in their orientation, which is accompanied by a regular publishing of documents, and where stakeholders are invited to participate actively. The national authorities have clearly better options to interact, than this is prepared for the broad public. In the following therefore different options of interaction are described briefly:

1. Start activities to develop a restriction proposal:

In this state of the process there are activities on a substance due to a not precisely defined reason (e.g. conspicuousness in monitoring activities, unusual occurrence of substances in consumer products, etc.). Here the cooperation of waste disposal authorities is usually limited to projects developed by the individual Member State, or their own administration. Nevertheless it is important, particularly in this stage, that every available knowledge is pooled in a structural manner, in order to underline the prolongation of the project, or to dispel concerns.

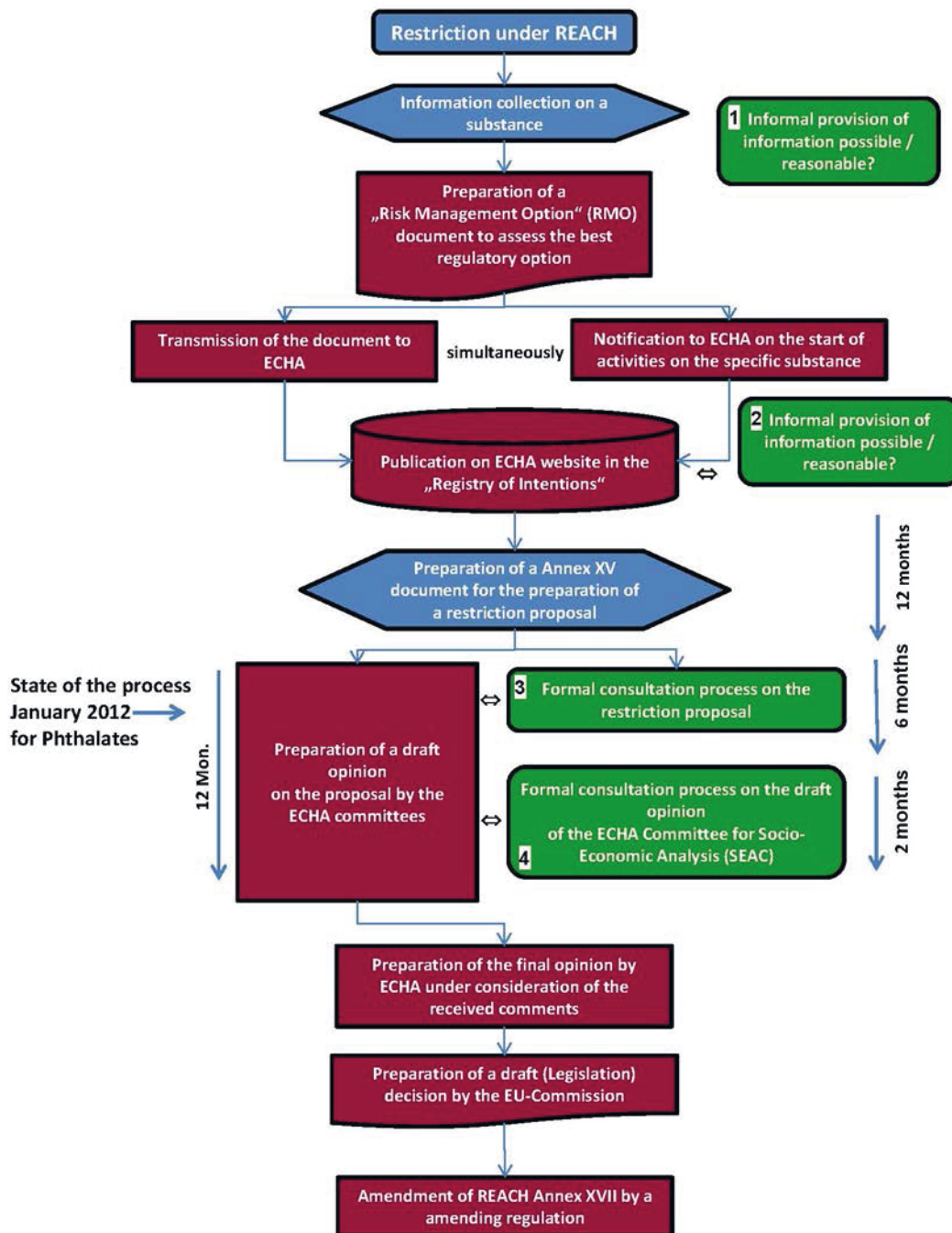


Figure 7-2: Flow chart of a restriction procedure under REACH and the current state in the phthalate process

Suggestion: According to the estimations of the experts it is sensible in this early stage to organise an efficient exchange among the specialised departments of the administration.

2. Official start to develop a concrete project:

This start is accompanied by publishing the activities in the so-called “Registry of Intentions”⁹⁶. In this media a Member State (or the Commission/ECHA) publishes for the first time that an activity has

⁹⁶

<http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/registry-of-intentions>

started on a certain substance. At the same time there is a first exchange of the Member States authorities about the REACH/CLP implementation⁹⁷, where it should be ensured that the own Member State authority has consulted other involved authorities beforehand, and can already refer to the available knowledge from the relevant country.

Suggestion: In this stage it is recommendable to organise a structured exchange about the regular REACH processes. The continuity in the exchange enables the specialised departments to be prepared about the content in an early stage.

3. First public consultation phase:

In this stage of the process it is recommendable to concentrate on the gaps of the submitted proposal dossier in order to support an argumentation. It might be the case that some gaps can be closed with short-term research activities, if this is necessary from the specialised department's point of view.

4. Second public consultation phase:

In this state it is less important to feed new substantial information of the process, but rather to comment the assessment of the Socio-economic Analysis Committee (SEAC) where the socio-economic analyses are evaluated.

Conclusion: In order to make running regulatory processes (here: approval/restriction under REACH) available for the waste disposal authorities, it is important to ensure their early involvement in the discussion process. At the same time it is important for the waste disposal authorities to know about the process, and to understand how the quality of the collected information should be.

In view of the specific example the waste disposal authorities should feed their argumentation supporting the current proposal, or suggesting an expansion of the proposal, to the public consultation process⁹⁸. In carrying this out, it can be expedient to pronounce socio-economic arguments that justify the restriction proposal so that the removal of harmful substances of the waste stream leads to a better recyclability of materials⁹⁹.

Excursus consultation processes between German authorities

In Germany the central department of all REACH activities is the Bundesstelle für Chemikalien (Federal Department for Chemicals (BFC)). This department invites all other departments involved to submit comments, and transfers these as one German annotation.

The addressed departments are:

- BAuA department 3 responsible as valuator concerning occupational safety
- UBA as valuator concerning environmental issues
- BfR as evaluator concerning consumer protection

The internal consultation within departments outside of the above listed REACH responsibility is incumbent upon the authorities concerned.

Importers of products for the EU market are the main addressees.

⁹⁷ Competent Authorities

⁹⁸ In the specific case the consultation procedure was carried out until 16. March 2012.

⁹⁹ The annotation will start September 2012.

Waste prevention potential

The measure has the potential to eliminate large quantities of particularly harmful substances from products within the EU. The creators of the restriction proposal assume that the restriction will include products with a total content of the four substances resulting in 170,000 t/a (with regard to the years 2009-10) (information note Danish restriction proposal¹⁰⁰).

For Germany this means an annual overall import volume of the four substances of 40,000 / 45,000 t¹⁰¹.

Environmental impacts

In the framework of the restriction proposals for each substance a risk assessment was prepared. The authors assume that 63 % of the overall emission of DEHP will go back to the waste phase of the products. Hence it can be stated that disposal is a relevant route of exposure (emission into the environment → absorption of the substance by food → absorption by humans) for humans, and therefore the reduction of the content of harmful substances in the products would result in a clear lowering of this potential¹⁰².

Other environmental impacts were not part of the valuation of the restriction proposal, because the substances were to be restricted mainly due to their effect on the human health.

At the same time there are indications that the substances in question are also hormonally active in organisms, which leads to the assumption that other negative impacts on the biosphere exist.

Indicators

Useful indicators to control the measure's success are:

- long term – the progress of the substances in question in the plastic parts of waste devices, and/or in the recycling products gained from these.
- medium term – decline of the import volume of these substances in plastic products, and
- short term – successful implementation of the restriction proposal in EU law.

Social impacts

Social aspects, in terms of an economic disadvantage, were not seen in the framework of the restriction proposal for the European market. Reason was that all debated utilisation fields have technically and economically suitable alternatives.

Relevant from the waste-related point of view is the fact that further material recycling of plastics containing the respective softeners (e.g. soft PVC) will be impossible by the

¹⁰⁰ <http://echa.europa.eu/documents/10162/81c9253a-2571-4af5-a365-eff08742076a>

¹⁰¹ Within the EU overall imports of the relevant goods, the German share is approx. 25 %.

¹⁰² Naturally this is only valid under the assumption that the substances which would replace the prohibited phthalates present a lower harming potential for health and environment. The corresponding risk assessments according to REACH are in the responsibility of the individual registrant (manufacturer or importer) of these substances.

regulatory regulation composed of both, the authorisation obligation for the substances, and the restriction of the marketability of the products. This could lead to the consequence that a part of the recycling companies at least temporarily limit their business, and hence might have to reduce their employment level.

Excursus: Impacts of authorisation and restriction on soft PVC recycling

A usual procedure in the practical recycling of soft PVC is the fine grinding, and the subsequent use for backside upholstering of carpets. The grinding process would, if leading to an end of the waste characteristic, present a manufacture of substances, and the use of these substances would be prohibited through the authorisation ordinance (unless the respective authorisation would be applied, and issued). If the grinding material would remain within the waste regime, and would enter the carpet upholstering during a related waste recycling step, a product would be created which then would not be marketable any longer due to the proposed market restriction.

The same could be valid for the reuse of complete products. They also present products that, if losing their waste characteristic, are not marketable.

For waste disposal streams like this in future – at least temporarily – an exclusively energetic utilisation of the PVC parts would be conceivable. However, the substantial recycling of such waste, if known, is not very common in Europe to date. Therefore, these effects were not recognised as being particularly relevant.

The outlined problem has to be considered as temporal, because most of the examined products containing soft PVC have a rather short lifespan, and therefore the pollutants in waste plastics needing disposal should actually abate comparably quickly.

On the other hand the pollutants in recycling plastics decreasing over a certain time period can offer the perspective of new, high-quality distribution possibilities in the medium and long term. This development could reverse the above mentioned tendency to lower the employment level. To the opposite, it would open up new business fields where jobs were provided on a reliable (secondary raw material) basis.

Economic impacts

According to estimations from the restriction proposal, increased costs of 3 to 6 million € are to be expected in reference to the imported products. Because the most budget material alternative is suitable for almost all kind of utilisations, a value of the lower end of the range is preferably assumed.

Because utilisations that could not be substituted are unknown, and the costs are only minimally higher for the alternatives, no larger impacts are expected.

If a restriction as proposed should be issued, it would be impossible for these substances to get an authorisation for production based on Art. 60 (6), because this would mean to weaken an existing restriction.

The costs for the actual WP measure “Supporting a restriction proposal for plastic additives (phthalates)” file into the following cost blocks:

- developing specific fundamentals and implementing them into a REACH Annex XV proposal => according to the experts estimation based on the currently available information approx. 10,000 Euro¹⁰³;
- supporting the coordination of the Annex XV proposal between the participating specialist departments => no reliable effort, or cost data are available here to the experts;
- supporting the consultation of the department's discussions, and the coordination at EU level => no reliable effort, or cost data are available here to the experts.

Because substance restrictions under REACH have a direct EU-wide effect, no further costs for the implementation to German law must be calculated.

Conclusion

In the examined example the measure (examination/supplement/support of the existing Danish restriction proposal for phthalates) proves to be expedient. From the experts' point of view it is therefore recommendable to integrate the waste disposal authorities of the Federation in the discussions on current restriction proposals actively in future in order to include the specific aspects of waste prevention, as well as other consideration about waste management in EU processes early and in a professional manner.

Recommendation

The example measure is recommended for the implementation.

Example Measure B II 1.2: Support for a restriction proposal for plastics additives (phthalates)	
Objective	The content of harmful substances of products close to consumers is to be significantly decreased. The direct waste-preventing reduction of harmful substance in future waste disposal streams also has a possible positive impact on the environment and the human health. Additionally this leads to a removal of pollutants from the corresponding recycling fractions.
Characterisation	Active support of current restriction proposals under REACH through the German waste disposal authorities, plus examination/supplement/expansion of existing proposals, e.g. on other product groups. Exemplary the support of a concrete Danish restriction proposal on phthalates (as plastic additives) is discussed here.
Link to measures set out in Study I	-
Link to Annex IV WFD	4. Support of Eco-Design
Instrumental character	EU law
Initiators	Federal waste authorities
Addressees	Importers of (plastic) products to the EU
Waste prevention potential	Through the restriction products of a total content of four phthalates with an EU-wide total content of 170,000 t/a, in Germany 40,000-45,000 t/a.

¹⁰³

Calculated on the basis of necessary consultation costs in an authority-external development.

Example Measure B II 1.2: Support for a restriction proposal for plastics additives (phthalates)	
Environmental impacts	<p>63 % of the total emissions of DEHP go back to the waste phase of the products. Hence it can be stated that disposal is a relevant route of exposure (emission into the environment → absorption of the substance by food → absorption by humans) for humans.</p> <p>At the same time there are indications that the substances in question are also hormonally active in organisms, which leads to the assumption that other negative impacts on the biosphere exist.</p>
Indicators	In the long term the progress of the substances in question in the plastic parts of waste devices, and/or in the recycling products gained from these. In the medium term the decline of the import volume of these substances in plastic products. In the short term the successful implementation of the restriction proposal in EU law.
Social impacts	<p>For all discussed utilisation fields there are technically and economically reliable alternatives available.</p> <p>A substantial recycling of soft PVC would be impossible for a longer transition period due to the restriction of the marketability of recycling products (which still have a residual content of phthalates).</p>
Economic impacts	<p>The costs for initiating the actual WP measure are low.</p> <p>Because utilisations that could not be substituted are unknown, and the costs are only minimally higher for the alternatives, no larger impacts are expected.</p>
Conclusion	Because utilisations that could not be substituted are unknown, and the costs are only minimally higher for the alternatives, no larger impacts are expected. A systematic examination/consultation of future restriction proposal (REACH) is recommended from a waste prevention perspective.
Recommendation	The example measure is recommended for implementation.

7.2.2 Measure B II 2: Adjustment to the state of waste prevention technology of sub-statutory rules and regulations governing installations requiring permits

Background

For a very long time the German law on installation authorisation (BImSchG) contains a direct obligation of operators of plants which are subject to licensing to prevent waste.

Art. 5 Obligations of operators of plants subject to authorisation

- 1. Plants subject to authorisation are to be constructed and operated in a way to ensure a high level of protection for the environment in general*

...

*3. waste is avoided, unavoidable waste is recovered and waste not able to be recovered is disposed without impairing the public welfare; waste is not to be avoided insofar as it is technically impossible, or unreasonable; the avoidance is not permitted, insofar it leads to more disadvantageous environmental impacts than the recovery would; the recovery and the disposal of waste is carried out according to the provisions of the Closed Substance Cycle Waste Management Act ("KrW-/AbfG") and the other ordinances valid for waste.*¹⁰⁴

¹⁰⁴

Translated from the German original

In the framework of plant authorisation (including amendment and adjustment authorisations) and through subsequent arrangements, this operator obligation is in terms of waste prevention to be addressed directly towards the authority. In the process of the authorisation procedure and the sub-legal regulation (i.a. in the general sample administration regulation of LAI (Working Group on Immission Control of Federal States and the Federation) on the prevention, recovery and disposal of waste according to Art. 5, 1, 3 BImSchG¹⁰⁵) the corresponding examination obligations and fields are set very clear for operators and authorities.

In a number of sectoral sample administration regulations of LAI on the implementation of BImSchG Art. 5 1,3 those obligations are specified through naming specific waste prevention technologies, or methods to operate processes.

Keeping the waste hierarchy is therefore an integral part in operating plants subject to authorisation after examination/assessment of possible counterproductive effects in other environmental areas (in acknowledgement of the reasonableness). This ought to be respected in view of measures for a national waste prevention programme¹⁰⁶.

In light of the outlined legal situation, the different points of leverage to name a direct, efficient governmental intervention go beyond the existing obligations. The measure outlined here starts at this one of these points.

Characterisation of the measure and relation to alternative measures

The operators' obligations on waste prevention according to Art. 5 1,3 BImSchG are specified sector-related in technical terms in Germany, in particular through relevant sample administration regulations (MVwV) of the LAI¹⁰⁷ as well as through the corresponding ATV-DVWK guidelines¹⁰⁸.

Many of these documents are older than 10 years¹⁰⁹. An adjustment to the state-of-the-art technique seems to be necessary from a professional point of view, as well as sensible, to perceive the legal obligations for operators and control administrations in a technical and constructive manner.

Adaptation of a sub-legal regulatory manual for plants subject to authorisation to technical progress systematically differentiates in two plant sectors:

1. Updating existing sectoral implementation guidelines
2. Initial preparation of sectoral implementation guidelines

¹⁰⁵ General sample administration regulation of LAI on the prevention, recovery and disposal of waste according to Art. 5, 1, 3 BImSchG, release of 28.09.2005

¹⁰⁶ Inter alia because parts of the past branch programmes carried out on states level do not represent new/autonomous activities, but were to identify implementation deficits in order to make suggestions for improvements of concrete operational situations on a rather technical level.

¹⁰⁷ Working Group on Immission Control of the Federal States and the Federation (Länderausschusses Immissionsschutz LAI)

¹⁰⁸ ATV = Abwassertechnische Vereinigung = Water Management Association;
DVWK = Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall = German Association for Water, Wastewater and Waste

¹⁰⁹ Last updates of MvwV were in the year 2005.

Both variations can be found in the following detailed and evaluating examples. Important, however, seems from the experts' point of view the note that coverage and potential of this measures go far beyond the implementation examples. In fact, actually all industry sectors are covered over the time.

The periodical adaptation of sub-legal regulations were and are (actually) also necessary in order to transfer the results of the information exchange about “best available state-of-the-art technologies” on European level, to specific operator obligations and implementation actions. Nevertheless this process was rather slow by now.

When new guidelines on industrial emissions (IED RL)¹¹⁰ take effect, the BVT (BAT hereafter) reference papers get a considerably more binding character, in legal terms, and the “implementation” of the adjusted BAT reference papers to national law, will in future be valid for a period of four years.

These impacts of this development of information exchange are not yet to be foreseen. And their effects on the implementation requirements in Germany are not completely to be foreseen from the perspective of the LAI. This is stated in a relevant report of the year 2010¹¹¹.

“Based on the new obligation of the BAT conclusions, and the already mentioned implementation deadline, it might be possible that, from a German perspective, the balance between developing the BAT reference papers and the national legislative process might be postponed. While to date the BAT reference papers only were one of many sources of knowledge for national amendment, the connection under the regime of Article 15 (3) of the IED Directive now is much more concrete, as well as verifiable. Therefore a more intense inclusion of management authorities of the Federal States during the acquisition of data on German contributions to the BREF documents is considered to be necessary.”¹¹²

Regardless the future, possibly stronger, direct binding effects of BAT reference papers from the “Sevilla Process”, according to the experts opinion it will also in future be necessary to make execution/implementation guides for operator obligations accord. to Art. 5 1,3 BImSchG available.

Due to the structural and procedural limits of the Sevilla Process¹¹³ any measure on waste prevention from the BAT reference papers, which are usually in practice in Germany, are (to date) not sufficiently specified for concretely acting, or not included at all.

¹¹⁰ Directive 2010/75/EC of the European Parliament and the Copuncil of 24. November 2010 on industry emissions (integrated prevention and reduction of environmental pollution) (new version); translated from the German original.

¹¹¹ Participation of the Federal States in the implementation of the IPPC (Integrated Pollution Prevention and Control (IPPC)) guideline, and in the development of the BAT reference papers” (translated from the German original); joint report of the LAI, and the Working Group on Water Management of the Federal States and the Federation, 2010, page 4.

¹¹² Translated from the German original

¹¹³ The BAT reference papers have to cover in many areas a very wide range of most different processes, and plant constellations (e.g. the STM-BREF, covering all plants for treatment and coating of metallic surfaces). The reason for the limitation of emissions to air and water as chosen qualifying quantity caused the inclusion of different plants in Annex I of the IVU guideline. This focus continues with the weighing in developing the BAT reference papers; i.e. that waste prevention measures, which are not directly linked to limitation of emissions to air or water, are described rather cursory.

In the course of the current implementation of the requirements on Industrial Plants Emission Directive (IED) it will have to be discussed in which form, and by which committee, such action-guiding execution/implementation guides can be developed best in Germany. This means that, if in the following exemplary implementation examples, concrete sample administration regulations of the LAI (MVwV), or the DWA reference papers, are addressed, then the reference has to be understood as an exemplary way of preparing information, which has adapted the waste prevention and waste recovery aspects to the German state of plant technology (and also the disposal management) in the past.

7.2.2.1 Example measure B II 2.1: Updating of enforcement/action guidance for waste prevention in metal surface treatment through etching and conversion processes

Background

In the field of chemical and electrolytic treatment of metallic surfaces, process-related wastewater and waste accrue, from which most of them have to be classified, due to their contents typical for the processing, as “hazardous waste”.

Facing this, in the year 2000 for instance, a relevant sample administration regulation of the LAI¹¹⁴ was published, where i.a. prevention options were listed very specifically for the generation processes of the typical waste, and where they were evaluated in view of their reasonableness and prevention effect. Additionally in December 2003 the reference paper ATV DVWK-M 358¹¹⁵ was published. But here the prevention measures will be described only briefly and rather cursory. In the year 2005, the BAT reference paper “surface treatment of metals and plastics (electroplating)” was published. Here as well the waste prevention options are described, but as well not detailed to the degree of LAI MVwV.

While the reference paper ATV-DVWK-M 358 was withdrawn in November 2011 and replaced by an updated reference paper (reference paper DWA-M 358), *“due to the technical progress in the area of metal surface treatment, and changes in the legal situation”*¹¹⁶, a corresponding adjustment of the LAI MVwV was not carried out to date. Although the new conversion processes lead to relevantly changed specific conditions of waste generation and prevention approaches¹¹⁷.

Objectives

The updating of requirements to the state-of-the-art technology (process handling, the plant technical equipment, and the methods how the installation is used) to prepare metallic surfaces by staining and conversion treatment in plants for the galvanic surface coating, can

¹¹⁴ Sample administration regulation of LAI on the prevention and recovery of waste accord. to Art. 5 1,3 BImSchG, new in Annexes accord. to No. 3.10, column 1 of the Annex on the 4th BImSchG (cf. as well No. 2.6 of Annex I of the IVU guideline 96/61/EC of 24.09.1996); installations for surface treatment of metals or plastics using electrolytic or chemical processes with a volume of treatment vats exceeding 30 m³ (here: phosphating installations).

¹¹⁵ Reference paper ATV-DVWK-M 358: treatment, recovery and removal of product specific waste: slurries from zinc or iron phosphating facilities, December 2003 (translated from the German original).

¹¹⁶ Translated from the German original of the prologue of the reference paper DWA-M 358, waste and wastewater from the metal surface treatment by conversion processes, November 2001)

¹¹⁷ C.f. inter alia reference paper DWA-M 358, p.20

contribute to reduce the generation of process-specific waste significantly, and/or diminish the content of harmful substances in this waste.

In the result of this example measure these requirements are to be included within the relevant sub-legal regulations (particularly in the LAI sample administration regulations on the prevention and recovery of waste accord. to Art. 5 1,3 BImSchG). This will lead to reviewing and implementing those measures to the framework of obligations of operators accord. to Art. 5 1,3 BImSchG¹¹⁸. The same is valid for the administrative acting in the course of (amendment) authorisations, and/or of issuing corresponding subsequent arrangements. Therefore the direct binding effect throughout sectors in plants subject to authorisation is caused. During the execution procedure the corresponding waste prevention potential can thus relatively quick, and harmonised, be achieved.

Characterisation

The MVwV phosphorilation installations are (exemplary) adjusted in view of the characterisations and evaluations of the waste prevention measures, according to the technical progress how it is i.a. described in the reference paper DWA-M 358.

Initiators and addressees

The WP measure is to be initiated by the Federation as being a participant of LAI (Working group for Immission Control of Federation and the Federal States).

Due to the very close interactions between measures on waste removal and measures on waste prevention that are specific for the field of galvanic installations, above this the early inclusion of the Working Group on Water Management of the Federal States and the Federation (LAWA) is necessary¹¹⁹.

Addressees are the permitting authorities and the operators of galvanic plants subject to authorisation which operate the corresponding process steps.

Waste prevention potential

The following list presents waste typical for processes of staining and conversion in galvanic installations.

This extract shows that the existing MVwV is not corresponding to the current legal bases of the Directive on the List of Waste Materials (Abfallverzeichnis Verordnung (AVV)). There are clear systematic differences in regard of both, the structuring of waste types, as well as the notions¹²⁰ to an extent that even from the formal, legal perspective a fast adjustment of the MVwV seems to be advisable.

¹¹⁸ The inclusion of corresponding requirements to the corresponding regulations implies a presumption of conformity with the technical and sector-specific conditions.

¹¹⁹ In terms of a holistic and trans-media approach, in deriving requirements on waste prevention, the current LAWA documents on revision of Annex 40 of the Wastewater Directive “metal processing” in particular are to be considered.

¹²⁰ And most important “hazardous waste” instead of “waste requiring special supervision”

Beside these “formal” aspects, the new process management according to the state-of-the-art technology will change both, the quantities, as well as the material composition of the generated waste.

Table 7-4: Typical waste types according to the MVwV phosphating unit of the year 2000

Type of waste	Location of generation	Waste code	Waste identification/type of waste	Req. special monitoring
Activation baths	pre-treatment	11 01 04	Waste free of cyanide, without chrome	x
Stain, acidic	pre-treatment	11 01 05	Acidic staining solvents	x
Degreasing baths	pre-treatment	11 01 07	Lyes a.n.g.	x
Filter materials	After bath care	15 02 99D1	Absorbents, filter materials, wiping cloths and protective clothing with hazardous dirt	x
Contents of oil separator	Oil separator in water-based degreasing baths	13 05 02	Slurries from oil and water separators	x
Contents of oil separator	Slurries from inlet shafts	13 05 03	Slurries from inlet shafts	x
Passivation baths	after-treatment	11 01 03	Waste free of cyanide, without chrome	x
Phosphating slurries	Waste from wastewater treatment phosphating bath care	11 01 08	Phosphate slurry	x
Slurries free of chrome	phosphating	11 01 04	Waste free of cyanide, without chrome	x
Slurries free of chrome		11 01 04	Waste free of cyanide, without chrome	x
		11 01 03	Waste free of cyanide, without chrome	x

An example mentioned here is the change of the conversion processes from “conventional” iron-phosphating, or zinc-phosphating¹²¹, to zirconium/titanium-based processes. At this more effective conversion layers result, while at the same time the primary material is significantly less stained and thus relevantly lower (primary¹²²) quantities of slurry accrue.

¹²¹ or rather of the traction phosphating using zinc, nickel or manganese.

¹²² Discussing waste prevention/reduction measures in galvanic installations, it is important to differentiate the primary effects (quantity effects direct to each treatment bath and final rinsing), and secondary effects (input of auxiliary material and waste quantities from the treatment of streams of exhaust air/wastewater). The outlined process conversions lead to primary prevention effects directly during the treatment process, in the first place. According to the experts information, no counterproductive effects (e.g. increase of the specific quantities of treatment sludges) occur during the wastewater treatment (see as well explanations below).

Table 7-5: Process characteristics of different conversion processes (according to DWA-M 358, 11/2011)

	Iron-phosphating	Zinc-Manganese-phosphating (free from nickel)	Zirconium-Titanium Processes
Corrosions protection effect of steel	3	7	8-10
Relative quantity of slurry (in reference to zinc-phosphatising)	20-30 %	100 %	1-10 %
Process steps	2-6	7	4
Temperature [°C]	45-70	50-60	approx. 25
Requirements to the installation material	Normal steel (possibly stainless steel)	Stainless steel	Stainless steel

The generated waste (slurries) is not only differentiated regarding its quantity, but also concerning their substantial composition. The analysis data in table 7-6 present this clearly.

The process slurries from the new conversion processes contain thus significantly less metals and phosphates. They can be disposed as metal hydroxide sludge.

Also in regard of the “indirect” sludge accrual from the wastewater treatment, changed quantities, and material compositions result. However, these are to a large extent dependent from the individually used treatment/prevention technologies. Here as well with new processes in combination with the corresponding treatment/prevention measures (like ion exchange/reverse osmosis), relevant prevention potentials can be developed.

Table 7-6: Exemplary analyses of sludge from conversion processes (accord. to DWA-M 358, 11/2011)

	Zn (%)	Fe (%)	Ni (%)	Mn (%)	Cu (%)	Ca (%)	K (%)	Mg (%)	Al (%)	Ti (%)	Zr (%)	P₂O₅ (%)	SiO₂ (%)
Phosphate slurry Nickel-free process	6.8	21.0	1.0	<0.02	0.03	0.3	1.2	<0.1	0.3	n.b.	n.b.	41.0	0.1
Phosphate slurry Nickel-related process	8.2	27.0	1.9	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	n.b.	n.b.	23.2	n.b.
Process slurry zirconium- /titanium based(I)	<0.05	37.8	<0.002	<0.05	3.7	0.1	<0.05	<0.05	0.5	<0.0 1	0.09	3.9	0.1
Process slurry zirconium- /titanium based (II)	0.03	6.6	0.02	0.03	0.02	7.3	0.2	n.b.	4.5	n.b.	n.b.	2.0	4.8

Reliable figures on numbers of plants subject to authorisation treating metallic surfaces are not directly available. Therefore for illustration of the overall potential of waste-preventing

measures information derived from a branch research at North Rhine-Westphalia was used.¹²³

Table 7-7: Number of plants requiring authorisation per sector

Type of plant	Number of plants at NRW (Date May 2004)
Hot-dip galvanisation plants	76
Wire-pullers	17
Steel staining plants	95
Anodising plants	33
Galvanisers	107
Staining, pickling	55
Total	383

In the course of proceeding concentration processes in this business sector, not only driven by the high investment demand for amending existing plants to progressed technology, the number of plants decreased significantly in the last years.

In these facilities the types and quantities of waste most characterising for the economic sector accrued like listed in the following table 7-8.

Table 7-8: Types and volume of waste based on the evaluation of 331 operational waste accounts, basic year 2002 (Grossmann, Ipsen & Jepsen, 2005)¹²⁴

Waste Code	Waste designation (AVV)	3.9. und 3.10 facilities	manipulator	hot-dip-galvanizing	stainless steel pickling	Anodizer	electroplating	pickle
		Total tons	% to sum	% to sum	% to sum	% to sum	% to sum	% to sum
06 01 01*	Sulfuric acid and sulphurous acid	1.583	1	0	3	0	3	92
06 01 02*	hydrochloric acid	264	4	43	0	0	53	0
06 01 03*	hydrofluoric acid	497	0	0	51	49	0	0
06 01 04*	Phosphoric and phosphorous acid	166	0	0	54	0	46	0
06 01 05*	Nitric acid and nitrous acid	555	0	0	92	0	2	5
06 02 05*	other bases	1.053	2	18	7	0	70	3

¹²³ Grossmann, Ipsen & Jepsen (2005): „Branchengutachten zur Abfallvermeidung in Anlagen der Nr 3.9 und 3.10, 4. BImSchV“, established of the Ökopol GmbH on behalf of the Ministry for Environment and Nature Conservation, Agriculture and Consumer Protection of the individual Land (state) of the Federal Republic of Germany North Rhine-Westphalia

¹²⁴ Please note that this is an original quote of an evaluation from the year 2002. Neither the structure, nor the expressions concerning the waste types, correspond the current state of the AVV of the year 2007.

Waste Code	Waste designation (AVV)	3.9. und 3.10 facilities	manipulator	hot-dip-galvanizing	stainless steel pickling	Anodizer	electroplating	pickle
		Total tons	% to sum	% to sum	% to sum	% to sum	% to sum	% to sum
06 05 02*	Sludges from on-site wastewater treatment, with dangerous substances	10.310	0	73	3	0	20	4
06 05 03	Sludges from on-site effluent treatment	65.632	2	0	92	3	2	1
11 01 04	electroplating sludge	1.409	0	7	4	61	16	13
11 01 05*	pickling	26.612	24	45	6	2	6	16
11 01 06*	acids	1.030	0	71	1	1	24	3
11 01 07*	pickling bases	6.441	2	3	5	15	33	40
11 01 08*	phosphated sludge	1.165	24	19	9	1	2	44
11 01 09*	Sludges and filter cakes with dangerous Substances	15.640	3	1	11	8	66	11
11 01 11*	Aqueous rinsing with dangerous Substances	2.993	11	6	12	1	55	15
11 01 13*	Degreasing wastes with dangerous Substances	1.809	0	0	98	0	2	1
110198*	Other wastes found. fabrics include	631	0	0	9	0	55	36
11 05 01	hard zinc	1.104	0	100	0	0	0	0
11 05 02	zinc ash	2.251	0	100	0	0	0	0
11 05 03*	Solid waste from gas treatment	267	0	100	0	0	0	0
11 05 04*	Used Flux	114	0	100	0	0	0	0
19 02 01	Wastes from physico-chemical treatment with dangerous substances	4.224	2	1	13	1	40	43
19 02 05*	Sludges from physico-chemical treatment with dangerous Substances	7.153	0	7	8	5	45	34
sum		152.902	6	17	45	4	17	11

Environmental impacts

The above outlined treatments of metallic surfaces according to progressed state-of-the-art technology, leads to a lower input, a lower erosion, and a lower discharge of (precious) metals, with concurrently better protection effects (corrosion) of the applied layers.

This leads to direct (process waste) and indirect (prolonged lifespan of the manufactured products) relief of the consumption of raw material.

The addressed, and by process conversion preventable, waste quantities can be quantified through waste statistics. According to Destatis for instance, in the year 2008 in Germany in total 11,500 t phosphating slurry was disposed in correspondence to ASN 11 01 08. By process conversion 20-30 %, or rather 2,300-3,400 t/a, of this quantity are preventable according to the experts' estimation.

Due to the variety of pre-products treated in the conversion processes, such estimations about saving potentials of the used raw materials, and the effects on the prolongation of lifespan, are not possible.

Counterproductive effects (additional environmental burden) are unknown¹²⁵.

Indicators

Suitable indicators are the (declining) quantities of relevant process slurries (here: phosphating slurry, ASN 110108) in the long and medium term, and the number of companies implementing the state-of-the-art technology.

Social impacts

Increasing requirements on implementation of process technology according to the current state-of-the-art, and the accompanying need of investment, but just as well of qualification, strengthen the concentration process in the surface coating segment which is running for quite a long time and therefore also the related loss of jobs. On the other hand, the implementation of new, more efficient treatment processes is an important location argument in the global competition, and hence will support the safeguarding of employment.

Economic impacts

The new treatment processes are competitive in economic terms, despite higher requirements in respect of the correct process operation, and therefore increasing demand of qualification and automation inside the facilities, due to their increased effectiveness. Indirectly this is, however, only valid for new facilities. When converting existing plants, the economic effects depend very much on the original state. In productions continuously adjusted to the technical progress, they are nonetheless to be classified as “proportional” according to the experts' estimations.

The effort for the actual measure “Up-dating the execution/action guides” divides into efforts for development, the practical basis, and the effort indispensable for the necessary coordination of the committees on federal and states level. Additionally, in another step the information of the responsible executional departments in the individual Federal States would as well cause expenses.

The effort for the development of the practical basis for waste prevention techniques in facilities for corrosion treatment of metallic surfaces is estimated about < 60,000 Euro¹²⁶.

¹²⁵ The inclusion of corresponding detailed expertise for the further examination/confirmation of this estimation is not part of the measure.

¹²⁶ Based on the referencing experiences of the consultants in regards of technologies, the available information, the necessary volume of up-dating and in reference to the usual daily rates of experienced branch experts.

The effort of the administration-internal coordination process cannot sensibly be quantified by the experts¹²⁷

Conclusion

As explained, the exploratory evaluation carried out, refers only to a part of the aspects that would have to be discussed in case of a complete up-dating of the executorial guides according to the state-of-the-art technology¹²⁸. But already this section reveals clearly that in the course of examining a need of up-dating of sub-legal regulations, relevant material and formal adjustment of waste prevention, according to state-of-the-art technology, can be identified.

For this reason the implementation of the WP measure is estimated by the experts as very recommendable. Like presented in the general characterisation of the waste prevention measure B II 2, is a revision of the relevant MVwV only one of other possible options to offer sub-legal execution guides.

In view of the desired integrated character of environmental protection measures for industrial facilities (in particular galvanisation plants), in any case, a very close interlinkage with parallel activities on reduction of wastewater and exhaust air is important.

Recommendation

The example measure is recommended for the implementation.

Example Measure B II 2.1: Updating of enforcement/action guidance for waste prevention in metal surface treatment through etching and conversion processes	
Objective	Process-related waste quantities are to be significantly decreased and/or their content of harmful substances diminished. Requirements on this are to be included in the relevant sub-legal regulations (e.g. the sample administration regulations of LAI on prevention and recovery of waste according to Art. 5 1,3 BImSchG).
Characterisation	The sub-legal execution/action guides (e.g. MVwV phosphating facilities) are to be adjusted, in regard of the description and evaluation of waste prevention measures, to the progressed state-of-the-art technology (like it is i.a. described in the reference papers DWA-M 358).
Link to measures set out in Study I	-
Link to Annex IV WFD	Cannot explicitly be assigned.
Instrumental character	Administration regulations
Initiators	Working Group on Immission Control of the Federation and the Federal States (LAI)

¹²⁷ Relevant calculations of efforts from earlier MVwV processes of the LAI are not available. Above this, in the context of the IED implementation, in Germany the question is, which committees will develop and coordinate such documents in future.

¹²⁸ And beyond this, the example measure focusses as well only on a section of the sub-legal regulations which would all have to be examined during the measure in terms of their need of being up-dated.

Example Measure B II 2.1: Updating of enforcement/action guidance for waste prevention in metal surface treatment through etching and conversion processes	
Addressees	Administrations responsible for authorisation, operators of galvanic facilities subject to authorisation.
Waste prevention potential	In NRW only in 2003 in galvanic facilities more than 150,000 t/a branch-typical, mostly hazardous waste accrued. Through adjusting to state-of-the-art technology relevant quantitative and qualitative savings are possible.
Environmental impacts	<p>Treating metallic surfaces according to progressed state-of-the-art technology leads to a lower input, a lower erosion, and a lower discharge of (precious) metals, with concurrently better protection effects (corrosion) of the applied layers. This leads to direct (process waste) and indirect (prolonged lifespan of the manufactured products) relief of the consumption of metallic raw material. According to the experts' estimation, the accrual of phosphating slurries for instance could be reduced by approx. 3,000 t/a) respectively by approx. 25 %).</p> <p>Due to the variety of pre-products treated in the conversion processes, such estimations about saving potentials of the used raw materials, and the effects on the prolongation of lifespan are not possible.</p>
Indicators	<p>Declining quantity of relevant process slurries.</p> <p>Number of companies implementing state-of-the-art technology.</p>
Social impacts	The concentration process in the surface coating segment running for a long time will be strengthened, and therefore also the related loss of jobs. On the other hand, the implementation of new, more efficient treatment processes is an important location argument in the global competition, and hence will support the safeguarding of employment.
Economic impacts	<p>The implementation effort divides into development of the practical basis, and the effort for the necessary coordination of the committees on federal and states level. Additionally, the responsible executional departments in the individual Federal States are to be informed.</p> <p>The induced process changes at staining and conversion facilities, towards productions continuously adjusted to the technical progress, are classified as "proportional" according to the experts' estimations.</p>
Conclusion	The necessity of a very close interlinkage with measures in the field of emission protection (wastewater and exhaust air) is pointed out.
Recommendation	The example measure is recommended for implementation.

7.2.2.2 Example measure B II 2.2: First establishment of sector-specific enforcement/action guidance for waste prevention in heat-set printing installations

Background

Facilities for printing materials formed tabular or web-like with rotary printing machines including the related drying sections are subject to authorisation according to No. 5.1 of the 4th BImSchG, insofar as they consume more than 150 kg/h or 200 t/year of organic solvent, or if the colour or varnish

- *consume organic solvent with a share of more than 50 % by weight of ethanol, and in the plant the overall consumption of organic solvent is between 50 kg and less than 150 kg per hour, or between 30 tons and less than 200 tons per year, or*

- *contain other organic solvents, and in the plant the overall consumption of those is between 25 kg and less than 150 kg, or between 15 tons and less than 200 tons per year.*

Beside others the heatset-offset-printing facilities printing jobs of medium and high circulations fall within this scope (e.g. magazines, advertising supplements, but also brochures and/or larger book editions). In Germany in the year 2002 in total approx. 74 of those facilities existed¹²⁹. These facilities processed approx. 40,000 t/a printing colours and another 10,000 t/a solvent. Approx. 21 larger facilities fell within the scope of No. 5.1 of the 4th BImSchG, and are therefore subject to authorisation obligation.¹³⁰

In offset-printing facilities process-related large quantities of waste accrue. Due to the process-specific contents, this waste is classified as “hazardous waste”.

In the following, sector-specific waste with typical disposal paths and company internal origin are listed:

- waste paper => paper recycling
 - blank paper from: remains of roll or format paper, edge off-cuts, chad
 - printed paper from: misprinted paper, returns, clippings,...
- remains of colours => special waste incineration
 - fouled colours (remaining quantities, ink fountains and mixing containers),
 - remainder filling quantities in containers (e.g. expired (special) colours)
- remainders of solvents => redistillation/incineration
 - from midterm and final cleaning of machines, and component's cleaning, and paint thinning
- cleaning rags (clothes) => reusable rags washing or incineration
 - from midterm and final cleaning of machines
- packaging materials => separate collection systems / household waste-like commercial waste
 - shrinking foils, pallets , canisters, metal packaging of raw material purchase and delivery of supplements
- printing plates decoating => CP treatment of printing plate development

¹²⁹ In the third report of the FR Germany on the implementation of Directive 1999/13/EC on limitation of emissions of volatile organic compounds which occur during certain operations, and in certain facilities while using organic solvents (cf. http://www.bmu.de/files/pdfs/allgemein/application/pdf/bericht_loesungsmittel_2008_2010_anhang_bf.pdf)

¹³⁰ Until 2008 the volume of processed heat set-offset-printing colours has increased to approx. 50,000 t/a. Whereas (in relation to year 2010) the number of facilities declined to a total of 74 of which 29 are classified as IVU facilities. The increase of processing capacities in significantly less facilities was in particular caused by the replacement of old machines with new ones with larger pressing width and higher pressing speed.

- discarded fountain solutions => SP treatment/special waste incineration from periodical maintenance of machines
- dependent of the production (or rather products) further waste like e.g. remains of glue and varnish, ...

In the past years in different individual Federal States branch expertise and/or cooperating activities on (special) waste prevention and recovery from offset-printing facilities were carried out (i.a. Lower Saxony 1991, 1993, 1997; Baden-Wuerttemberg 1997, and Schleswig-Holstein 2010). These projects developed specific waste quantities, prevention measures, and recovery options for the above mentioned waste fractions.

Sub-legal regulations on waste prevention with generally binding character do not exist in Germany for this sector of facilities¹³¹. Between 2000 and 2003 in Germany a background document waste developed for the information exchange about BAT references paper “surface treatment using organic solvents” which comprises corresponding BAT suggestions, and referring annexes with examples (Jepsen/Teibert 2003). Central aspects of this background document were included in the final version of the BAT references paper¹³². But the background document already, and even more clearly the BAT references paper, target the reduction of VOC emissions from the solvent utilisation. Therefore waste-preventing measure are solely to be found in the reference paper, when they create a reduction of solvent emissions at the same time (e.g. waterless offset printing which avoids both, isopropyl emissions from fountain solution systems, as well as corresponding waste fountain solution system fillings needing disposal). Reducing special colour utilisations, or such that are exclusively waste-preventing, were not included.

Objectives

In the result of this example measure the different waste prevention options in heat set-printing facilities are to be adjusted according to the state-of-the-art technology in a comprehensive manner in order to present an execution/action guide (in particular for the sample administration regulations of LAI on the prevention and recovery of waste according to Art. 5 1,3 BImSchG).

The measures would have to be substantially examined and implemented in the framework of operator obligations according to Art. 5 1,3 BImSchG. The same is valid for administrative action during (adjustment) authorisations, and/or issuing corresponding subsequent requirements. Hence, a binding effect throughout the sector is directly achieved for facilities subject to authorisation, and the corresponding waste prevention potential will be developed relatively quick and harmonic in the course of the execution.

¹³¹ Relevant is i.a. the VDI (Verband Deutscher Ingenieure (Association of German Engineers)) Guideline “Emission reduction – roll offset printing facilities with hot air dryers”, VDI 2587, leaflet 1 of November 2001 (reviewed & extended 2007). But in this VDI guideline comprises no references on waste prevention of product specific waste.

¹³² Reference document on Surface Treatment Using Organic Solvents, May 2007, <http://eippcb.jrc.es/reference/sts.html>

Characterisation

An execution/action guide ("MVwV heatset-printing facilities") is to be developed that describes the prevention options for process-typical waste according to the state-of-the-art technology, and that evaluated those in terms of their implementability, their potentials and reasonableness.

Initiators and addressees

The WP measure is to be initiated by the Federation as participant in the Working Group on Immission Control (LAI). The corresponding committees of LAGA and LAWA are to be participated.

Addressees are the administrations for authorisation, and operators of heat set-printing facilities that are subject to authorisation.

Waste prevention potential

The waste prevention potential is not exactly determinable for a sector with many (approx. 100) facilities of very different size, technical equipment, and last but not least also different products.

Table 7-9: Utilisation of operating material in heat set-printing facilities – comparison of BAT to old facilities (ÖKOPOL 2003)

Flows of input material	Old facilities [in kg per t used colour]	BAT facility [in kg per t used colour]	Waste prevention methods
Offset-printing colours	6 kg of which approx. 2 -2,5 kg as colour remains, 1 % as remaining colours, 2,5-3 kg in cleaning rags	1,5 kg of which approx. 1,2 kg as colour remains, 0,3 kg in cleaning rags	returnable containers for ink supply tubed colour input optimised (midterm) cleaning (automatic washing unit)
Cleaning agents	95 kg (mainly VbF class A II and A III)	24 kg (higher-boiling A III- substances and/or vegetable oil ester)	
Fountain solution additives	500 kg isopropyl 150 kg additives	100 kg isopropyl 50 kg additives	optimised fountain solutions (servicing, control, rollers) ¹³³
Cleaning rags	450 units (mainly reusable rags)	200 units (mainly reusable rags)	optimised machine cleaning (i.a. automatic washing installations)

In order to enable a professional estimation, in table 7-9 some specific input quantities for heat set-printing facilities, which are according to the state-of-the-art technology (named as BAT facility), and typical (old) facilities, are compared.

If it is conservatively assumed that in Germany currently only 20 % of the overall heat set colour volume of approx. 48,000 t/a is used in "old facilities", the following "prevention quantities" result, if, in the course of implementing this WP measure (and the corresponding

¹³³

From the technological perspective there are prevention options reaching further (up to 100 %), through conversion to waterless offset-printing. For heat set facilities though, there are yet no references available in Germany.

execution of Art 5 1,3 BImSchG stipulations in the facilities) all facilities would be adjusted according to the state-of-the-art technology.

Table 7-10: Estimation of prevention volume by implementing waste prevention measures in “old facilities” (heat set-printing)

Volume flow	volume		Notes regarding “significance”
Prevented printing colour input	45	t/a	highly refined product of the fine chemistry
Prevented printing colour waste	20	t/a	go to the larger part to the special waste incineration declared as “special waste” (e.g. ASN 08 01 13*)
Reduced cleaning agent input	710	t/a	refined chemical product
Prevented waste from mixtures of cleaning agents with water	1.700	t/a	go to the larger part to the special waste incineration declared as “special waste” (e.g. ASN 08 01 13*)
Prevented isopropyl	4.000	t/a	refined chemical product
Prevented fountain solution additives	1.000	t/a	highly refined product of the fine chemistry
Prevented times washing cleaning rags	2,5	M/a	mostly reusable cleaning rags are used
Reduced printing colour quantity in cleaning rags	27	t/a	are severed in the industrial textile cleaning and subsequently incinerated

The volume estimation deliberately refers (only) to old facilities, because it has to be assumed, due to the economic usefulness (mainly self-containing, see below), and in view of the equipment which is standard today for new machines, that in the planning for new facilities (initial authorisation) the potential for corresponding orders of Art. 5 1,3 is significantly lower.

However, the reservation has to be made that the above estimations are based on structural data of facilities from the years 2000 to 2002. More timely data are not sufficiently detailed available.

Because of the structural changes in the market for job printing it is possible that the share of facilities which are still run today (respectively, the quantities of printing colours turned over in them) is relevantly smaller than assumed above¹³⁴. The structural changes can be outlined as the following:

- massive investment in new (heatset-) printing facilities, and thus relevant expansion of printing capacities, particularly in the years 2000 to 2006;
- relevant decline in the market for job printing during the economic crisis with corresponding consequences (decommissioning of facilities, insolvencies etc.).

Environmental impacts

In accordance with the nature of waste prevention, this waste prevention measure inhibits that primary products, operating or auxiliary materials (input materials) become waste. These effects were quantified in the example above.

¹³⁴

The above already mentioned dramatic decline in the facility-related figures (from 160 in the year 2000 to 74 in the year 2010) gives clear signals of a structural change being correspondingly fundamental.

The input materials in question in the heatset-printing are mainly highly refined products of the (fine) chemistry with a corresponding “ecological value”. For illustration table 7-11 presents a basic formula for heatset-offset-printing colour.

Table 7-11: Average basic formula for heatset-offset-printing colours¹³⁵

Component	Content	Share (% of weight)
Binding agent		
- solvent components	mineral oils (boiling range approx. 240°C - 300°C)	30 – 35 %
- binding components	resins, vegetable oils	45 – 50 %
Colorant	organic, inorganic pigments (the 3 scale colours and black are mainly in use)	15 – 20 %
Colour additives	siccatives and dry substances (metal soaps and oxidation inhibitors (e.g. butylated hydroxytoluol hydroquinone), antioxidant (e.g. cyclohexanoneoxim), complexing agent (e.g. EDTA, tartrate)	< 10 %
Physical properties: solid content approx. 67 %; lower caloric value > approx. 36 MJ/kg; flash point > 100°C		

Estimating the avoided manufacturing demands using available values of eco-balance sheets, the relief effects present as in the following table.

Table 7-12: Environmental effort providing different operational substances and possible saving effects (heatset-printing)

Fraction	balanced through (source)	CO ₂ -eq (kg/kg)	SO ₄ -eq (kg/kg)	CED (MJ/kg)	saved quantity (t/a)	CO ₂ -eq (t/a)	SO ₄ -eq (kg/a)	CED (GJ/a)
Heat set-off-set-printing colours	printing colour, offset, 47,5 % solvent ex factory (Europe) (EI 2.2); comprises finished printing colour	1.81	9.94E-03	73.3*	45	81	447	3,297*
Cleaning agent offset-printing	industrial washing agent for blue work clothes (ifeu and EI 2.2 based on Eberle/Grießhammer 2000)	2.33	1.55E-02	41.4	710	1,652	10,997	29,372
Isopropyl	isopropyl, ex factory (Europe) (EI 2.2)	1.85	7.21E-03	60.7*	4,000	7,394	28,837	242,893*
Washing cleaning rags	demand for washing one cleaning rag in European laundry weighing 40 g (ifeu)	2.49E-02**	5.91E-05**	3.99E-01**	2,500**	62	148	998

*: Ecoinvent balances the CED with a gross caloric value; otherwise lower caloric value

** unit: one piece cleaning rag in laundry; weight 40 g

In this estimation the highly refined formula contents (pigments, additives, etc.) with their significantly higher specific environmental burden, are not included. Therefore the real prevention effects would presumably be clearly higher.

Disposing waste though can in many cases contribute to recovery proportional to the lower caloric value because of the high potential of hazardous substances, and thus necessary emission protection installations (e.g. in all thermal utilisations of printing house waste an effective lowering of dioxin is necessary due to the halogenated organic components from printing colours), those contributions will, however, relevantly be diminished.

Counterproductive (causing an additional environmental burden) effects do not occur in the majority of the prevention measures. For some rare measures a slightly increased energy demand can be induced (e.g. in the use of automatic cleaning systems), but the currently available estimations¹³⁶ generally reveal that prevention effects overcompensate the additional demands clearly.

Indicators

Declining quantities of relevant waste streams (e.g. 08 01 13* and 08 01 19*) from facilities according to No. 5.1 of 4th BImSchG.

The number of relevant subsequent arrangements in old facilities could as well be a structural indicator.

Social impacts

As already explained, the sector of heat set-printing facilities (respectively the job printing in total) is currently in a difficult market situation. Furthermore, there is a quantity-related share of imports to Germany. Facing the limited “margins”, increased costs for the conversion of old facilities could, as the case may be, lead to negative effects concerning the location or the employment.

Economic impacts

Waste-preventing technologies, on which the above estimations referred to in regard of their potential, will amortise in the usual periods¹³⁷. In converting existing facilities, the economic effects depend strongly on the initial state. Continuously to the state-of-the-art technology adjusted productions are rated as “proportional” according to the experts' estimations¹³⁸.

The effort for the actual measure “Initially establishing sector-related execution/action guides” divides into expenditures for the development of the practical basis, and the effort for the necessary coordination in the committees on federal and states level. Additionally, the responsible executional departments in the individual Federal States are to be informed.

¹³⁶ Exploratory estimations on ecological effects of converting cleaning systems were i.a. carried out in the course of corresponding projects on trend estimations of VOC emissions (Ökopol 2007).

¹³⁷ In the frame of the UFOPLAN project (Ökopol 1999) for instance, corresponding amortisations were calculated for various (also) VOC reducing conversion measures.

¹³⁸ Measures that would require an elementary conversion of the facilities (e.g. the conversion to waterless offset-printing with a 100 % prevention of the corresponding material flows), were not included within the considerations.

The expenditures for the development of the practical basis of waste prevention technologies in heat set-printing facilities is estimated by < 50,000 Euro¹³⁹.

Conclusion

As explained, the exploratory evaluation carried out partly bases on older market and structural data. Before implementing, an updating of the information basis should be carried out. From the experts' perspective it seems to be possible that in the result of such an updated analysis only a small waste prevention potential remains.

The example measure, however, stands only as an example for other possible specifications (i.e. initial establishment of sub-legal execution/action guides) in other sectors of facilities and plants which are subject to authorisation. Examining more detailed, those other plant sectors should be analysed.

From a professional point of view, the systematic review of the development of relevant execution and action guides seems indispensable, if a uniform and ambitious implementation of waste prevention attempts in industrial facilities (here the printing house sector) is targeted.

Recommendation

The example measure is recommended for the implementation under the condition that the mobile potentials ought to be reviewed.

Example Measure B II 2.2: First establishment of sector-specific enforcement/action guidance for waste prevention in heat-set printing installations	
Objective	The different waste prevention options in heat set-printing facilities are to be adjusted according to the state-of-the-art technology in a comprehensive manner in order to present an execution/action guide (in particular for the sample administration regulations of LAI on the prevention and recovery of waste according to Art. 5 1,3 BImSchG).
Characterisation	A sub-legal execution/action guides ("MVwV heat set-printing facilities) is to be developed describing the prevention options for waste typical for the related processes according to a state-of-the-art technology, and evaluating their potential and reasonableness.
Link to measures set out in Study I	-
Link to Annex IV WFD	-
Instrumental character	Administration regulations
Initiators	Working Group on Immission Control of the Federation and the Federal States (LAI) by participation of the corresponding committees of LAGA and LAWA.
Addressees	Administrations responsible for authorisation, operators of heat set printing facilities subject to authorisation.

¹³⁹

Relevant calculations on expenditures from former MVwV processes of the LAI are not available. Above this, in the context of the IED implementation, in Germany the question is, which committees will develop and coordinate such documents in future.

Example Measure B II 2.2: First establishment of sector-specific enforcement/action guidance for waste prevention in heat-set printing installations	
Waste prevention potential	The potential of converted old facilities to the state-of-the-art technology is high, e.g. in offset colours and cleaning agents up to 75 %. The overall potential can hardly be estimated on the basis of the available data.
Environmental impacts	In accordance with the nature of waste prevention, this waste prevention measure inhibits that primary products, operating or auxiliary materials (mainly highly refined products of the (fine) chemistry with a corresponding "ecological value") become waste. Estimating the overall potential of environmental relief is not possible. Counterproductive (causing an additional environmental burden) effects do not occur in the majority of the prevention measures. For some rare measures a slightly increased energy demand can be induced, but the currently available estimations generally reveal that prevention effects over compensate the additional demands clearly.
Indicators	Long term: declining quantity of relevant waste streams. Short term: number of relevant subsequent arrangements in old facilities.
Social impacts	Facing the limited "margins", increased costs for the conversion of old facilities could, as the case may be, lead to negative effects concerning the location or the employment.
Economic impacts	The effort for the actual measure (Initially establishing sector-related execution/action guides) is low. Continuously to the state-of-the-art technology adjusted productions are rated as "proportional" according to the experts' estimations
Conclusion	From the professional perspective it is apparent that an updating analysis of the de facto situation of heat set facilities is necessary, before any measure can be implemented in this sector. From an overarching perspective of a waste prevention strategy, the systematic review of the development of relevant execution and action guides within the various industrial sectors seems indispensable, because no documents are available there, yet.
Recommendation	The example measure is recommended for the implementation under the condition that the mobile potentials ought to be reviewed.

7.2.3 Measure B II 3: Provision of support to advance the state of waste prevention technology in facilities

Regarding the legal obligations of operators of facilities/plants subject to authorisation according to Art. 5 1,3 BImSchG the operator has to examine each time whether new / additional measures are implementable as well as reasonable given the sector-specific circumstance.

Reliable indications to assume an implementability and reasonableness result, beside from existing sub-legal execution/action guides (cf. measure B II 2), in particular form the existence and the (successful) operation of large-scale (pilot) facilities concepts.

The targeted support of the erection and the operation of large-scale facilities with advanced state-of-the-art waste prevention technology can thus create a spill over effect clearly beyond the individual facility.

Such a targeted support of waste-preventing facilities by governmental administrations can in principle happen in the framework of various promotional and supportive measures, as

long as the concerned programmes¹⁴⁰ allows to set requirements on an advanced stage of waste prevention is (also) demanded in order to fulfil the support criteria. Hence, it is relevant whether the facilities are completely new, or if existing facilities aim at being developed further.

In the following, the mechanism outlined in the beginning (further development of operator obligations regarding waste prevention by targeted support of new waste-preventing facility concepts) will be described by using the example of the Umweltinnovations-Programm (Environmental Innovation Programme (UIP)) of the BMU. Because the UIP addresses accurately i.a. this function: *“In the framework of the Environmental Innovation Programme (UIP) projects are supported presenting in Germany for the first time in a large scale, how advanced processes and combinations of processes to prevent and reduce environmental burden can be realised.”*¹⁴¹

7.2.3.1 Example measure B II 3.1: Promotion, through the German environmental innovation programme, of the industrial-scale realisation of facility designs with an advanced state of waste prevention

Background

The Environmental Innovation Programme of the Federal Ministry for Environment, Nature Protection and Nuclear Safety (BMU) exists since 1979. While in the beginning investments in the field of air pollution control of old facilities was focussed, since the middle of the eighties the support activities were expanded to new facilities, and then successively to the additional fields, waste management and wastewater treatment, noise reduction, soil conservation and lastly renewable energies, climate protection and energy efficiency (cf. RWI 2003).

The programme development is carried out in cooperation of the Federal Environmental Agency (UBA) and the Kreditanstalt fuer Wiederaufbau (KfW). The technical expertise is carried out by the UBA, the economic examination and administrative handling is done by the KfW, the final decision is made by the BMU.

The BMU supports in the framework of the UIP both, projects with pilot character in technical terms, as well as such with demonstration character in large scale technology. Gaining a multiplying effect was explicitly included into the objectives in the year 2002.

The following figure presents the current target hierarchy of the UIP in a schematic overview.

In the following – regard to the last evaluation report of the UIP (Prognos 2009) – an exploratory examination is carried out in order to find out, if the UIP is suited to initiate the described mechanisms.

¹⁴⁰ In respect of other corresponding legal requirements

¹⁴¹ Extract of the current “advertising” flyer on UIP, translated from the German original.

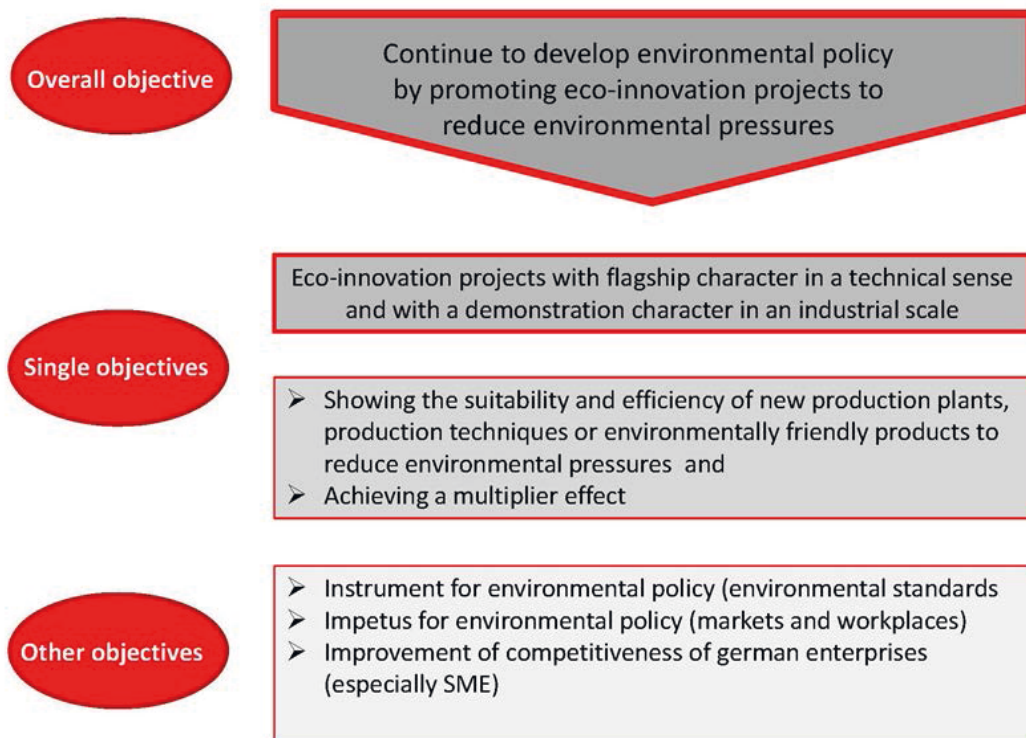


Figure 7-3: Objectives of the UIP 1999-2008 (according to: Prognos 2009)

Objectives

The targeted support of demonstration facilities, which use for the first time waste-preventing technology in a large industrial scale, is to develop the stage of technology further.

The (successful) operation of such (waste-preventing) demonstration facilities is to be considered in the implementation and execution of operator obligations according to Art. 5 1,3 BImSchG in other facilities of the corresponding sector. In doing so, waste prevention effects are gained throughout the whole range of a branch.

Characterisation

To gain the outlined effect, it is necessary that

- 1 (also) waste-preventing technology is matter of the support of demonstration projects in the UIP, and that this support option is used;
- 2 the results that were achieved during the implementation of the waste-preventing measure, and thus the “new state of waste-preventing technology”, are documented;
- 3 this “new state of waste-preventing technology” is made available for operators and the execution on a federal level, e.g. by publishing in the corresponding media, and in corresponding execution/action guides.

Initiators and addressees

The UIP is an active offer of the BMU to plant/facility operators searching for financial support to realise new environmentally relieving facility and product concepts.

The specific initiative for individual support activities had accordingly be initiated by a market actor. The participating public administrations (UBA, BMU, KfW) review and grant, as the case may be, the support application. The support is thereby i.a. linked to corresponding documentation and report obligations.

To manage suitable projects, BMU and UBA can on one hand try to identify interested plant operators in cooperation with the individual Federal States administrations, and motivate them to take that pioneering role. On the other hand, it is the aspect of waste prevention that can stressed even more in the external presentation of the major support fields.

Multiplication of results is the aim of the UIP, but a direct obligation of the individual actor does not result from this.

Waste prevention potential

Because a support programme, which aims in particular on the multiplication of results, naturally cannot be evaluated in a sensible way in terms of the prevented waste quantities of the supported projects themselves, a quantitative evaluation is carried out here examining, if the necessary stipulations for the targeted effects (broad waste prevention impact) are given (see above “description”).

Measures on waste prevention, recovery and disposal are directly addressed by the UIP in their focus of support. In the period from 1999 to 2008 the clear focus of support in the UIP was on these subjects, together with measures on energy saving and efficiency, and renewable energies with each 45 %. Following the integrated understanding of both, the UIP, as well as the modern facility concept, beyond this, close interlinkages with other support focuses are common. In particular to wastewater-related measures there are many links to waste-related improvement efforts.

An important element (1) of the WP measure is thus realised at the UIP¹⁴².

On the material level, the evaluation report (Prognos 2009) states above this:¹⁴³

The reduction of environmental pollution through waste was addressed and implemented in 35 support projects. A complete prevention of waste was secondary and was only in few projects the major purpose.

In the foreground of the considered waste streams was mainly the reduction of hazardous waste requiring (special) monitoring, like for instance colour and varnish slurries, oils and fats, acids, etchings and lye's, solvents, metal-containing waste, chrome-containing waste and dusts.

*The reduction of the accrual of waste streams, and the treatment, occur mainly in the producing industry, the metal- or plastic-processing industry, the chemical industry, and in galvanic enterprises.*¹⁴⁴

¹⁴² In the evaluation report the authors suggest to expand energy efficiency and waste prevention on the topic “resource conservation / resource efficiency” as a new focus in the program content of the UIP. (cf. Prognos 2009, p. 93)

¹⁴³ Prognos 2009, p. 67f

¹⁴⁴ translated from the German original

The documentation of experiences in implementing and operation supported plant engineering is matter to the support requirements, so that after finishing the measure respective valid information and data are available¹⁴⁵.

The support directive on the UIP of the BMU (UIP Förderrichtlinie 1997) comprises the consent of the operator that the project and the achieved environmental effects can broadly be published¹⁴⁶.

For the effectiveness of the WP measure suggested by the consultants, the multiplying effect of the UIP support in terms of influencing further environmental instruments (by further development of the technical state), is of particular interest.

In regard of this, it is of importance to know that already in the application phase during the vote of the specialist compartment, the “Federal Interest” related to the support project, is documented. The federal interest comprises mostly national and European regulations, a follow-up of state of technology, respectively of the BAT reference papers, a contribution to reach the climate change objectives, and other national confirmations concerning environmental protection. In the analysis of documents of the UIP period 1999 to 2008 by Prognos, in 65 compartment-related vote's federal interest was documented. Including 24 times the further development of laws/ordinances/standards/limit values; 7 time's new findings for the Sevilla-Process of the BAT reference papers, and 19 times the improvement of the technological state.¹⁴⁷

In the framework of a brief enquiry 2008¹⁴⁸ an evaluation of the implemented transfer effects regarding the 47 finished projects was published. It reveals that in 15 projects (32 %) activities to change the environmental legislation were adapted to standard regulations.¹⁴⁹ The overall state of technology underwent an improvement in 16 projects (34 %).

The following table presents more detailed in which fields this was the case.

Prognos 2009 resumes on this “The extent of the direct environmental policy follow-up activities for the projects makes clear that the broad implementation of programme results through legal measures, and advanced environment policies-concerning findings based on them, supports the state of technology in a broad manner.”¹⁵⁰

¹⁴⁵ However, it has to be remarked that the support measures often end shortly after putting new plant concepts into operation, so data concerning a longer running regular operation are only partly available.

¹⁴⁶ Cf. No. 5 (1) of the directive of the BMU on supporting investments with demonstration character to reduce environmental burden of February 1997.

¹⁴⁷ On various topics

¹⁴⁸ Answer of the Federation to the brief inquiry of the representatives Katrin Kunert, Luty Heilmann, Dr. Gesine Löttsch, Eva Bulling-Schröter, Roland Claus and the parliamentary group DIE LINKE, Drucksache 16/8846 – Support of projects in the course of the Environmental Innovation programme (translated from the German original).

¹⁴⁹ 14 times of that on contributions about BAT reference papers (mainly surface treatment using organic solvents) or on other BAT processes, and one time a contribution about the annex of the wastewater ordinance.

¹⁵⁰ Translated from the German original

Table 7-13: Influencing the “state of technology” (BT Drucksache 16/8846 2008)¹⁵¹

Further development of the state of technology	No.
decreased energy demand of the plant / the process	6
solvent or heavy metal-free process	6
circulation of process water or wastewater-free	6
resource efficient production	3
lowering the production noise	1
emissions diminished	1
waste recovery instead of disposal	1
physical treatment instead of wet-chemical methods	1

Environmental impacts

Because the support measure experiences an intense analysis before the application is approved, particularly due to the possible counterproductive effects they could have on other environmental media or such, no problems are to be expected in terms of relevant shifts.

The saving that can be achieved cannot be quantified precisely due to the indirect and supportive effect of the measure.

Indicator

For the actually desired indicator, the overall waste-preventing effect of each support measure, that could be calculated schematically from the amount of the specific waste prevention in the demonstration plant multiplied with the number of transferences to other plants, unfortunately especially the information on the numbers of transferences are not missing.

Here is a demand for further ex-post evaluations and/or routines that ensure that the systematic follow-up of implementing possible multiplying effects.

Social impacts

The implementation of measures supported by financial resources of the UIP is linked for many applicants with the desire to protect existing jobs, to create new jobs, as well as to improve labour conditions and to prepare the company for future (market) requirements.

According to results from surveys under UIP participants, these objectives are mostly met.¹⁵²

¹⁵¹ The number 25 in “State of Technology influences” in (only) 16 relevant projects results from the fact that many projects addressed several aspects.

¹⁵² cf. Prognos 2009, p.84

Economic impacts

In implementing the measures, the applicants target particular cost reductions.

According to results of surveys, these objectives are also mainly met. Although it is reported often that these reduction effects occur only after a longer period of time, because start-up difficulties are to be overcome, and an efficient inclusion of the new technologies require changes in the operational routines.

From the macroeconomic point of view (again) the question of the occurred multiplications is of crucial significance, as with each new transference to further plants, the effect is multiplied without increase of the public funds (for the support of the demonstration project).

Levying multiplying effects that go back to the adjusted regulations, it is, however, only then possible, when these come into force, and were accompanied by effective execution over years. Therefore (currently) no corresponding systematic data is available.

Observations in the surrounding field of the support receivers though indicate that transferences happen. For instance, in 11 of 19 finished projects such transferences are known to the experts¹⁵³.

Conclusion

The UIP is according to the evaluation results being present well suited in structural terms, to meet the objective of a further development of the state of technology – also concerning waste prevention aspects.

Systematic evaluations on how broad the multiplying effects will occur are not (yet) available. Due to the will to further develop relevant regulations how it was documented from the compartment-related votes, and the available data on implementation of this target, it can, however, be assumed that a corresponding transference will take action in the further execution of the rules.

In these terms the consultants evaluate the measure as expedient.

The consultants, however, do not share the estimation of the authors of the evaluating study (Prognos 2009) that the further development of the state of technology in regulations will be less important in future.

Findings supported by data are not available concerning the thesis that the self-interest of the entrepreneurs in implementing waste prevention measures that are not self-sustaining, should be increased compared to the previous years.

The necessity of an individual economic, and therefore as well general economic interest to initiate a support measure, may above this as well be seen as limitation of the measure's potential. Waste-preventing technology, not contributing in the long term to the economic success, will hardly be established in these procedures.

¹⁵³ cf. Prognos 2009, p.89

Recommendation

The example measure is recommended for the implementation.

Example Measure B II 3.1: Promotion, through the German environmental innovation programme, of the industrial-scale realisation of facility designs with an advanced state of waste prevention	
Objective	Further development of the state of technology as reference to the execution of sophisticated waste prevention measures.
Characterisation	Supporting demonstration projects firstly using waste-preventing technology in a large industrial scale, the state of the art is develop further. This is considered when implementing/executing the operator obligations according to Art. 5 1,3 BImSchG in other plants of the same sector, so corresponding waste-preventing effects occur in the whole branch.
Link to measures set out in Study I	(278): Waste prevention through researching innovative technologies (NRW) (279): Waste prevention through further development of existing technology in the field of massive forming
Link to Annex IV WFD	5. The provision of information on waste prevention techniques with a view to facilitating the implementation of best available techniques by industry.
Instrumental character	Financial support
Initiators	BMU & UBA are aiming with the support of the individual Federal States to identify plant operators interested in erection of eligible demonstration facilities.
Addressees	Applying enterprises, creators of sub-legal execution/action guides, enterprises
Waste prevention potential	Not to be quantified in advance, dependent on the degree of transmission to action.
Environmental impacts	No negative interactions to be expected.
Indicators	Degree of transference to the state of technology, documentations
Social impacts	No negative impacts
Economic impacts	Efficiency of public funds used in dependency of the degree of transference/multiplication.
Conclusion	The UIP is according to the evaluation results being present well suited in structural terms, to meet the objective of a further development of the state of technology – also concerning waste prevention aspects. Systematic evaluations on how broad the multiplying effects will occur are not (yet) available. Due to the will to further develop relevant regulations how it was documented from the compartment-related votes, and the available data on implementation of this target, it can, however, be assumed that a corresponding transference will take action in the further execution of the rules.
Recommendation	The example measure is recommended for the implementation.

7.2.4 Measure B II 4: Enforcement of uniform implementation of waste prevention obligations, both in installations requiring permits and those not requiring permits

Background

Art. 22 (1),2 BImSchG offers the opportunity to the regulatory authority to equate operators of plants not subject to licensing to those operating plant that are subject to licensing in regard of the obligations according to Art. 5 1, 3.

Art. 22 Obligations of the operator of plants not subject to licensing

(1) Plants not subject to licensing are to be erected and operated in a way that hazardous environmental impacts are prevented, which can be prevented according

to the state-of-the-art of technology; hazardous environmental impacts that cannot be prevented according to the state-of-the-art of technology, are to be limited to a minimum, and in a way that the waste accruing in operating the plant can be disposed properly.

(2) The Federation is empowered, after having heard the parties concerned to define the plants by legislative regulation in accordance with the Federal Council based on the type and quantity of all or separate accruing waste fractions for which the requirements of Art. 5 1,3 are valid.

To date the regulatory authority did not avail this authorisation. In light of the new obligations of the Member States resulting from the Waste Framework Directive, i.a. on the establishment of waste prevention programmes and on the implementation of corresponding waste prevention efforts, it seems to be objectively justified to review if in individual plant sectors the transfer of obligations according to Art. 5 (1) No. 3 would not be expedient.

Particularly in adjusting the measures on waste prevention to a progressed state of technology, effective (“binding”) execution is hardly possible without such a transfer according to Art. 22 (2)¹⁵⁴.

In order to ensure a uniform and effective execution, such transference accord. to Art. 22 would in general have to be combined with the development of appropriate an execution and action guide on waste prevention technologies within the concerned plants.

In the following it will be presented by example, how such transference of the binding waste prevention obligations could be designed for the field of coldset newspaper printing facilities, and which effect this would have. This plant area is exemplary for other areas of facilities not subject to authorisation where “hazardous waste” accrues to a relevant extent. In the course of implementing the WP measures B II 4, a systematic analysis of this, in principle for transference according to Art. 22 suitable plant areas would have to be integrated in order to focus reasonably.

7.2.4.1 Example measure B II 4.1: Application of Article 22 para 1 Sentence 2 BImSchG to offset printing installations not subject to permit requirements

Background

Facilities for printing materials formed tabular or web-like with rotary printing machines including the related drying sections are subject to authorisation according to No. 5.1 of the 4th BImSchG, insofar as they consume more than 150 kg/h or 200 t/year of organic solvent, or if the colour or varnish

- *consume organic solvent with a share of more than 50 % by weight of ethanol, and in the plant the overall consumption of organic solvent is between 50 kg and less than 150 kg per hour, or between 30 tons and less than 200 tons per year, or*

¹⁵⁴

Not implemented waste prevention measures usually not endanger inhabitants or environment, which would otherwise give reason to the responsible authorities for suitable mandatory orders in case of plants not subject to authorisation.

- *contain other organic solvents, and in the plant the overall consumption of those is between 25 kg and less than 150 kg, or between 15 tons and less than 200 tons per year.*

Not under this jurisdiction in Germany are both, the newspaper printing houses, of which almost all in Germany use the so-called coldset-offset-printing, as well as sheet offset printing houses regardless of size, since they have no “drying facilities”.

While differentiating them from heat set-offset- printing facilities might be useful¹⁵⁵, in view of waste prevention it is hard to comprehend. Both, the specific waste intensity (waste quantity per consumed colour) as well as the absolute quantity, are significantly higher in the area of plants not subject to authorisation.

Realising this resulted in the past from branch expertise/analysis in different Federal States (i.a. Lower Saxony 1991, 1993, 1997; Baden-Wuerttemberg 1997, and Schleswig-Holstein 2010). Here both, the heat set facilities requiring authorisation, and the facilities not requiring such were assessed. The following overview evaluating branch structures (Jepsen/Teibert 2003) presents once more relevant branch data.

Table 7-14: Branch data on different offset-printing procedures (as of 2002)

Printing process	Colour input [in t/a]	Plants [units approx.]	Employees [typical number per plant]
Heatset-Offset	40,800	160 ¹⁵⁶	50 - 100
Coldset-Offset („newspaper printing“)	26,500	200	50 - 200
Sheet-Offset	14,100	10,000	10-20
	Source: VdD ¹⁵⁷	Source: bvdM ¹⁵⁸	Ökopol ¹⁵⁹

In offset-printing facilities process-related large quantities of waste accrue. Due to the process-specific contents, this waste is classified as “hazardous waste”. In the following, sector-specific waste with typical disposal paths and company internal origin are listed:

- waste paper => paper recycling
 - blank paper from: remains of roll or format paper, edge off-cuts, chad,
 - printed paper from: misprinted paper, returns, clippings,...
- remains of colours => special waste incineration
 - fouled colours (remaining quantities, ink fountains and mixing containers),
 - remainder filling quantities in containers (e.g. expired (special) colours)
- remainders of solvents => redistillation/incineration

¹⁵⁵ Although for instance also in view of VOC emissions the heatset facilities that are subject to authorisation are less relevant than the offset-printing facilities which are not subject to authorisation

¹⁵⁶ For 2010 no update available (74 plants in total)

¹⁵⁷ Verband der deutschen Druckfarbenhersteller (association German printing colour producers)

¹⁵⁸ Bundesverband Druck und Medien (Federal association print and media)

¹⁵⁹ Information from Ökopol internal branch data base (with data of approx. 340 plants)

from midterm and final cleaning of machines, and component's cleaning, and paint thinning

- cleaning rags (clothes) => reusable rags washing or incineration

from midterm and final cleaning of machines

- packaging materials => separate collection systems / household waste-like commercial waste

shrinking foils, pallets , canisters, metal packaging of raw material purchase and delivery of supplements

- printing plates decoating => CP treatment of printing plate development
- discarded fountain solutions => SP treatment/special waste incineration from periodical maintenance of machines
- dependent of the production (or rather products) further waste like e.g. remains of glue and varnish, ...

These waste fractions accrue in general in all offset-printing procedures. The quantity relation between those waste fractions and the level of the specific waste though vary depend on the main printing procedure (heat set, coldset, sheet-offset).

The highest specific waste volume is to be found in the sheet-offset-printing. In particular this is due to the fact that the colours here are “oxidative”, i.e. they dry in contact with air. Correspondingly higher is the cleaning demand. Beyond this, in this area, characterised by multiple changes in the print jobs due to typical product range (print jobs of small and medium-sized editions, name cards or brochures), the demand for conversion and intermediate cleaning is higher, and so is the waste quantity as well.

In knowing this situation, the measure described in the following still (for the start) refers to the area of newspaper printing houses (coldset-offset-printing); mainly for structural reasons. Regarding their size and number of facilities, newspaper printing houses (still) seem to be suitable for a regulatory execution analogue to other facilities (requiring permission).¹⁶⁰

Objectives

Implementing the measure enables (later) regulatory orders to implement and use waste-preventing technologies in the field of newspaper printing facilities.

Hereby the precondition for a broad and uniform implementation of such technologies is created, which will relevantly reduce the generation of waste in this industrial sector.

¹⁶⁰

In the field of sheet-Offset printing houses completely different control structures would be necessary, because of the high number of small and smallest companies.

Characterisation

An ordinance according to Art. 22 (1, 2) will determine the stipulations of Art. 5 (1, 3) for (beside others)¹⁶¹ all coldset-offset-printing facilities based on the type and volume of the accruing waste.

Parallel a sub-legal execution/action guide (“MVwV coldset newspaper printing facilities”) will be developed, describing prevention possibilities for process-typical waste according to the current state of technology, and evaluating those in terms of their implementability, their potential and their reasonableness.

Initiators and addressees

The WP measure is to be fed into the legislative procedures as an ordinance through the Federation.

The development of an execution/action guide is to be initiated by the (participants of) the Working Group on Immission Control of the Federal States and the Federation (LAI). The corresponding committees of LAGA and LAWA are to be included.

Addressees are the operators of coldset-offset newspaper printing facilities.

Waste prevention potential

The waste prevention potential is not exactly determinable for a sector with many (approx. 200) facilities of very different size and technical equipment.

In order to enable a systematic estimation, the waste prevention potential can be assessed by comparing the specific waste types and quantities facilities which are according to the state-of-the-art technology, and “average” (old) facilities.

If it is conservatively assumed that in Germany approximately 25 % of the overall coldset-offset colour of approx. 30,000 t/a is used in “old facilities”, the following “prevention quantities” result, if, in the course of implementing this WP measure (and the corresponding execution of Art 5 1,3 BImSchG stipulations in the facilities) measures would be implemented according to the state-of-the-art technology.

The volume estimation deliberately refers (only) to old facilities, because it has to be assumed, due to the economic usefulness (mainly self-containing, see below), and in view of the equipment which is standard today for new machines, that in the planning for new facilities (initial authorisation) the potential for corresponding orders of Art. 5 1,3 is significantly lower.

¹⁶¹

Facing the effort for issuing an ordinance, it seems sensible that in implementing the WP measure also the use of Art. 22 BImSchG is considered for other plant sectors, beyond the specific example.

Table 7-15: Estimation of prevention volume by implementing waste prevention measures in “old facilities” (offset-printing)

Volume flows	volume	Notes regarding “significance”
Prevented printing colour input	45t/a	highly refined product of the fine chemistry
Prevented printing colour waste	20t/a	go to the larger part to the special waste incineration declared as “special waste” (e.g. ASN 08 01 13*)
Reduced cleaning agent input	710t/a	refined chemical product
Prevented waste from mixtures of cleaning agents with water	1.700t/a	go to the larger part to the special waste incineration declared as “special waste” (e.g. ASN 08 01 13*)
Prevented isopropyl	4.000t/a	refined chemical product
Prevented fountain solution additives	1.000t/a	highly refined product of the fine chemistry
Prevented times washing cleaning rags	2,5M/a	mostly reusable cleaning rags are used
Reduced printing colour quantity in cleaning rags	27t/a	are severed in the industrial textile cleaning and subsequently incinerated

Environmental impacts

In accordance with the nature of waste prevention, this waste prevention measure inhibits that primary products, operating or auxiliary materials (input materials) become waste. These effects were quantified in the example above.

The input materials in question in the coldset-offset-printing are mainly highly refined products of the (fine) chemistry with a corresponding “ecological value”. For illustration, in the following a basic formula for coldset-offset-printing colour is shown.

Table 7-16: Average basic formula for coldset-offset-printing colours¹⁶²

Component	Content	Share (% of weight)
Binding agent		
- solvent components	mineral oils (boiling range approx. 240°C - 300°C)	25 – 30 %
- binding components	resins, vegetable oils	40 – 50 %
Colourant	organic, inorganic pigments (the 3 scale colours and black are mainly in use)	10 – 20 %
Colour additives	siccatives and dry substances (metal soaps and oxidation inhibitors (e.g. butylated hydroxytoluol hydroquinone), antioxidant (e.g. cyclohexanoxim), complexing agent (e.g. EDTA, tartrate)	< 10 %
Physical properties: solid content approx. 95 %; lower caloric value > approx. 35 MJ/kg; flash point > 100°C		

Estimating the avoided manufacturing demands using available values of eco-balance sheets, the relief effects present as in the following table.

Table 7-17: Environmental effort for providing different operational substances and possible saving effects (offset-printing)

Fraction	balanced through (source)	CO ₂ -eq (kg/kg)	SO ₄ -eq (kg/kg)	CED (MJ/kg)	saved quantity (t/a)	CO ₂ -eq (t/a)	SO ₄ -eq (kg/a)	CED (GJ/a)
Coldset-offset-printing colours	printing colour, offset, 47,5 % solvent ex factory (Europe) (EI 2.2); comprises finished printing colour	1.81	9.94E-03	73.3*	45	81	447	3,297*
Cleaning agent offset-printing	industrial washing agent for blue work clothes (ifeu and EI 2.2 based on Eberle/Grießhammer 2000)	2.33	1.55E-02	41.4	1.125	2,618	17,425	46,541
Washing cleaning rags	demand for washing one cleaning rag in European laundry weighing 40 g (ifeu)	2.49E-02**	5.91E-05**	3.99E-01**	3,000**	75	177	1,198

*: Ecoinvent balances the CED with a gross caloric value; otherwise lower caloric value

** unit: one piece cleaning rag in laundry; weight 40 g

In such estimations the highly refined formula contents (pigments, additives, etc.) with their significantly higher specific environmental burden, are not included. Therefore the real prevention effects would presumably be clearly higher.

Disposing waste though can in many cases contribute to recovery proportional to the lower caloric value because of the high potential of hazardous substances, and thus necessary emission protection installations (e.g. in all thermal utilisations of printing house waste an effective lowering of dioxin is necessary due to the halogenated organic components from printing colours), those contributions will, however, relevantly be diminished.

Counterproductive (causing an additional environmental burden) effects do not occur in the majority of the prevention measures. For some rare measures a slightly increased energy demand can be induced (e.g. in the use of automatic cleaning systems), but the currently available estimations¹⁶³ generally reveal that prevention effects overcompensate the additional demands clearly.

Indicators

Declining quantities of relevant waste streams (e.g. 08 01 13* and 08 01 19*) from the field of facilities (newly) addressed by the ordinance.

The number of relevant subsequent arrangements in old facilities could as well be a structural indicator.

¹⁶³

Exploratory estimations on ecological effects of converting cleaning systems were i.a. carried out in the course of corresponding projects on trend estimations of VOC emissions (Ökopol 2007).

Social impacts

Since newspaper printing houses in Germany currently are in a difficult situation, because of the increasing competition of electronic media. Furthermore, for years there is a remarkable concentration process of the printing capacities¹⁶⁴. The implementation of sophisticated waste prevention requirements can accelerate this process additionally, and hence contribute to downsizing the staff.

Economic impacts

Waste-preventing technologies, on which the above estimations referred to in regard of their potential will amortise in the usual periods¹⁶⁵. In converting existing facilities, the economic effects depend strongly on the initial state.

Continuously to the state-of-the-art technology adjusted productions are rated as “proportional” according to the experts' estimations.

The effort for the actual measure “Using Art 22 (1,2) BImSchG for offset-printing facilities not subject to authorisation” that requires the standards of Art. 5 (1, 3) for (i.a.)¹⁶⁶ all coldset-offset printing facilities, based on the type and quantity of accruing waste, divides into different costs:

- development of technical reasons based on current branch and plant data on the level of the Federation;
- development of an ordinance draft and its coordination on the level of the Federation;
- carrying out the legislative procedure, and
- implementation of the ordinance in the individual Federal States.

For estimation about the expenditures for carrying out and consulting this process through the administration no referring value are available to the consultants.

Conclusion

The exploratory evaluation carried out reveals that significant waste prevention effects could be indicated. This evaluation partly bases on older market and structural data. Before implementing, an updating of the information basis should be carried out.

The administrative effort to issue an ordinance might, however, not be in a balanced relation to the quantitative prevention effects. However, the example measure (Using Art. 22 (1, 2) BImSchG on coldset-printing) stands exemplary for further possible specifications.

¹⁶⁴ Increasingly newspapers of different publishers are produced in larger printing centres.

¹⁶⁵ In the frame of the UFOPLAN project (Ökopol 1999) for instance, corresponding amortisations were calculated for various (also) VOC reducing conversion measures.

¹⁶⁶ Facing the effort for issuing an ordinance, it seems sensible that in implementing the WP measure also the use of Art. 22 BImSchG is considered for other plant sectors, beyond the specific example.

Other plant sectors should also be analysed in a detailed review, so they could, if suitable, be treated in the same ordinance.¹⁶⁷

From a professional point of view, the systematic review of an implementation of waste-preventing techniques on the same level in different industrial facilities, independent of their emission relevance, is necessary for a rational waste prevention strategy.

Recommendation

The example measure is recommended for the implementation.

Example Measure B II 4.1: Application of Article 22 para 1 Sentence 2 BImSchG to offset printing installations not subject to permit requirements	
Objective	In the field of newspaper printing (later) regulatory arrangements concerning the implementation and use of waste-preventing technologies will be enabled. This creates the preconditions for a broad and uniform implementation of such technologies, and thus leads to a relevant reduction of waste accrual in this industry sector.
Characterisation	An ordinance according to Art. 22 (1, 2) will determine the requirements of Art. 5 (1, 3) for (beside others) ¹⁶⁸ all coldset-offset-printing facilities based on the type and volume of the accruing waste. Parallel a sub-legal execution/action guide ("MVwV coldset newspaper printing facilities") will be developed, describing prevention possibilities for process-typical waste according to the current state of technology, and evaluating those in terms of their implementability, their potential and their reasonableness.
Link to measures set out in Study I	-
Link to Annex IV WFD	7. The inclusion of measures to prevent waste production at installations not falling under Directive 96/61/EC.
Instrumental character	Ordinance
Initiators	Working Group on Immission Control of the Federation and the Federal States (LAI) by participation of the corresponding committees of LAGA and LAWA (execution/action guide).
Addressees	Administrations responsible for authorisation, and operators of coldset-offset newspaper-printing facilities.
Waste prevention potential	The waste prevention potential is not exactly determinable for a sector with many (approx. 200) facilities of very different size and technical equipment.
Environmental impacts	In accordance with the nature of waste prevention, this waste prevention measure inhibits that primary products, operating or auxiliary materials (mainly highly refined products of the (fine) chemistry with a corresponding "ecological value") become waste. Estimating the overall potential of environmental relief is not possible. Counterproductive (causing an additional environmental burden) effects do not occur in the majority of the prevention measures. For some rare measures a slightly increased energy demand can be induced, but the currently available estimations generally reveal that prevention effects over compensate the additional demands clearly.

gh, in terms of waste, non-optimised production procedures, relatively high waste quantities accrue in this connection. This can markedly be reduced within the application of established technology (e.g. the (almost) dry processing).

¹⁶⁸ Facing the effort for issuing an ordinance, it seems sensible that in implementing the WP measure also the use of Art. 22 BImSchG is considered for other plant sectors, beyond the specific example.

Example Measure B II 4.1: Application of Article 22 para 1 Sentence 2 BImSchG to offset printing installations not subject to permit requirements	
Indicators	Long term: declining quantity of relevant waste streams. Short term: number of relevant subsequent arrangements in old facilities.
Social impacts	The remarkable concentration process in the newspaper publishing business in Germany, as well as the related downsizing of jobs, can be accelerated by implementing sophisticated waste prevention requirements.
Economic impacts	In continuously to the state-of-the-art technology adjusted productions are rated as "proportional" according to the experts' estimations
Conclusion	From a professional point of view, the systematic review of an implementation of waste-preventing techniques on the same level in different industrial facilities, independent of their emission relevance, is necessary for a rational waste prevention strategy.
Recommendation	The example measure is recommended for the implementation.

7.2.5 Measure B II 5: Institutions and structures to advise facility operators on waste-prevention options

Background

The consultation of industrial and commercial companies on possibilities of production-integrated environmental protection already has a long tradition in Germany. The measure are mainly initiated (up to now) by the individual Federal States. To a smaller extent there are also consultations on PIUS¹⁶⁹. The Federation has supported and promoted these structures and measures altogether by means of research projects (Dehoust et al. 2010). Partly there are already collaborations among the individual Federal States. Potentials to increase the efficiency and the exploitation of further potentials are in particular to be found in the expansion of the different organisations and programmes in Germany, as well as in the creation of networks among them.

Therefore the following example measure lays at hand: "Nation-wide expanding and networking among institutions and structures in order to advise plant operators about production-integrated environmental protection, here with a focus on waste prevention possibilities".

Synergies can also be created through intense cooperation with the measure B II 7: Strengthening the autonomous waste prevention by integration into operative control systems (cf. chapter 7.2.7). This can for example be audits according to EMAS, Ökoprotit or DIN-ISO. The introduction of environmental management systems is already today a general part of the existing consultancy projects (cf. e.g. Kahlenborn/Freier 2005 and UBA/BMU 2005).

¹⁶⁹ For instance the Abfallvermeidungsagentur AVA Lünen: <http://www.ava-beratung.de> (waste prevention agency)

7.2.5.1 Example measure B II 5.1: Nationwide expansion and networking among institutions and structures that provide to facility operators on Integrated Pollution Prevention and Control, with a focus on waste prevention options

Background

Successful approaches to advise plant operators about waste prevention potentials in their enterprises were already presented in the previous study (Dehoust et al. 2010). Although waste prevention is not always the central aspect, but is in general one of the central areas of activity.

Most of the times the consultancy comprises numerous projects, instruments and methods like:

- trainings
- coaching
- internet platforms
- internet tools
- branch information, and guides
- technical background information
- financial check-ups (e.g. operational environment-data-analysis)
- certification
- advice on management systems
- energy check-up
- efficiency check-up
- benchmarking
- legal advice, legal fundamentals
- newsletter
- measure catalogue
- practice tools
- etc.

Many of these measures run under the keyword “production-integrated environmental protection”, like e.g. the project **EffCheck**. The EffCheck is a project of the efficiency network Rhineland-Palatinate (EffNet)¹⁷⁰, which since end of the year 2005 is available in particular to small and medium sized enterprises as a central and comprehensive, non-profit platform for information and consultancy about questions concerning the environment, energy and resource efficiency. In the framework of the project EffCheck, the publicly funded company consultancies identify measures with positive impact on environment and operational costs. Especially saving potentials in the fields of waste, energy, water, material and emission are

¹⁷⁰

www.effnet.rlp.de

to be determined, which serve as foundation for the implementation of company-internal measures.

Eco-Best, the benchmarking programme of the Umweltallianz Hessen (environmental alliance) was a project that succeeded on one hand to inform the participating companies about their situation compared with other companies of their branch, and thus give substantial hints how to reduce operational costs. On the other hand measures of company-internal environment and resource conservation were related. Companies of the vehicle trade and repair, printing houses, hair cutters, butchers, bakeries and schools were invited to participate. Besides, since 2007 under the label of **EcoDialog** 17 events with up to 200 participants were carried out according to the motto “companies and administrations in dialogue”¹⁷¹.

The **BIVA-Beratungsprogramm** (consultancy programme) was carried out in Hessen between 1993 and end of the year 1998. In the course of this programme 2,900 free on-site consultancies in companies were carried out, 54 information papers (guides and info sheets) were developed and approx. 50 seminars were held, and 5 working groups were established¹⁷².

Also the **Effizienz-Agentur NRW (EFA)** (efficiency agency), founded on the initiative of the MUNLV, sees its task in the promotion of Integrated Pollution Prevention and Control, and of environmental management systems. To support Integrated Pollution Prevention and Control the following instruments were developed: 1) **PIUS-Check**: companies are analysed by an external consultant in view of the environmental relevance of their production processes and material flows. Potentials that can increase the resource efficiency are detected, and suitable measures developed in cooperation with the company. 2) **JUMP** – Yes to the environmentally compatible product design: The JumpTool is an advisory instrument that supports enterprises in developing new products in an environmentally compatible design. 3) The **Ressourcenkostenrechnung RKR** (resource cost accounting) is an instrument to ensure lasting process efficiency inside of a company. The focus is on increasing the resource productivity. 4) **Ökoeffizienz-Check Handwerk** (eco-efficiency check for the craft sector): With this the EFA offers an instrument designed for the requirements of craft enterprises that highlight those benefits, so they can take the full advantage of it.

Objectives

The measure aims at the expansion, networking and general support for consultancy measures through public institutions. The measure is to start comparable activities on the Federal level, which enable consultancy and the exchange on the subject among companies about ecological optimisation, whereby questions on waste prevention and resource efficiency are important components.

Characterisation

The Federation should approach the Federal States, or rather directly the LAGA in order to

¹⁷¹ www.umweltallianz.de

¹⁷² <http://www.denz-umweltberatung.de/pius-ressourcen-effizienz-betrieblabfallmanagement/abfallberatungsprogramm-biva/>

discuss with them the possibilities, respectively examine the existing options, in order to increase the efficiency of the company's consultations in the field of Integrated Pollution Prevention and Control in general, and here on waste prevention in particular. This is to be carried out especially through networking and a nation-wide expansion of the individual existing regional consultancy structures. Thereby synergies can be harnessed in creating the foundations and consultancy concepts. The level of awareness of a consistent consultancy structure is significantly to be increased towards the current situation, not least because of a mutual public relation campaign supported by the Federation.

In the course of consultations with the individual Federal States an analysis of the available activities should be created where the following questions are to be clarified:

- 1) Which activities and consultancies are available?
- 2) For which target group, which objectives?
- 3) Which environmental improvements can be achieved?
- 4) Which costs occur?

Another analysis should reveal the optimisation possibilities in general and in connection with networking in particular. The public availability of the results has to be ensured.

The necessity of networking was already acknowledged by the Federal States NRW, Rhineland-Palatinate, Schleswig-Holstein, Hessen, Baden-Wuerttemberg and Lower Saxony. Together they operate the PIUS internet platform www.pius-info.de where the experiences from their projects are brought together.

Initiators and addressees

Main initiators are the BMU, the UBA and the ministries for environment as well as the corresponding departments of the States. The national level is at hand mainly because of strengthening the networking among the many individual measures, which are on the states level or regionally more or less successful.

Addressees are the existing consultancy organisations and in the end the companies that (should be) are advised.

Waste prevention potential and environmental impacts

Waste prevention measures of the Integrated Pollution Prevention and Control affect the full range of commercial waste. Additionally they also aim on aspects of the qualitative waste prevention through substituting hazardous substances in the production process.

The effects of the already implemented measures are often only badly documented, but nonetheless there is no doubt that waste-preventing effects of significant quantities have resulted (cf. UBA/BMU 2005). Beyond this, the environmental effects strongly depend of the individual company, which indicates that the approaches of measures they propagated are oriented towards the demands of the participating companies, or organisations, and indeed target existing weaknesses¹⁷³.

¹⁷³

cf. Kahlenborn/ Freier 2005, p. 54

Thereby waste prevention is already emphasised. In the framework of research on environmental management systems in Germany, almost 80 % of the participating enterprises stated that they have opened up potentials to prevent waste. From the perspective of qualitative waste prevention, additionally there are 61 % of the enterprises using less quantity of harmful substances. Hence, the waste segment is, after energy, ranking at the second position of the priority fields. The participants of the survey were also asked to estimate the level of the saving effects on a scale of 1 = strong relevance to 6 = weak relevance. In the estimations the effects concerning the waste reduction were actually estimated most strongly (2.2), even before energy saving effects (2.3). Diminishing the water consumption (2.8) and the reduction of harmful substances (2.9) were ranking on the positions 3 and 4, still with a relatively high significance. In 85 % of these measures the enterprises stated that the savings have a lasting effect¹⁷⁴. From this it can be assumed that the described prevention successes go back to the consultancies of the PIUS consultancy structures, respectively that the circumstances are similar there, despite the reference of the survey to environmental management systems.

Social and economic impacts

The consultancy services are to be understood explicitly as a contribution to increase the competitiveness of the German industrial enterprises, and hence, to secure jobs. Despite the high saving potentials the measure is related to relevant cost as well: only the Deutsche Bundesstiftung Umwelt (Federal Foundation for the Environment) has funded around 8,000 projects in the course of its PIUS support¹⁷⁵. And also in the concerned companies investments are necessary: up to now though only few enterprises have documented the time spent during the PIUS consultancies, or for the introduction of an environmental management system. If an entry took place, the values had an extremely large variance.

According to the Deutsche Materialeffizienzagentur (demea) (German material efficiency agency) the average saving potential of material costs in small and medium enterprises is approx. 220,000 Euro per year and enterprise – that is 2.5 % of their average turnover¹⁷⁶.

Conclusion

Networking among existing individual projects on the national level is seen as possessing a particular potential in the framework of a national waste prevention programme.

Recommendation

The example measure is recommended for the implementation.

¹⁷⁴ Kahlenborn/ Freier 2005, p. 50ff.

¹⁷⁵ cf. DBU 2011

¹⁷⁶ cf. DBU 2001

Example Measure B II 5.1: Nationwide expansion and networking among institutions and structures that provide to facility operators on Integrated Pollution Prevention and Control, with a focus on waste prevention options	
Objective	The possibilities of consultancies for companies, and here in particular SME, i.a. about questions concerning waste prevention, is to be extended by creating a network among the existing structures.
Characterisation	The initiatives and programmes in the individual Federal States to offer consultancies for enterprises towards increasing efficiencies and here especially about ecological optimisation, are followed up to create a nation-wide network. Hereby ideas and experiences are evaluated, and the nation-wide network is used to optimise and increase efficiency, i.a. through intense and uniform public relation.
Link to measures set out in Study I	(135) Efficiency Agency (NRW) (136) AVA – (municipal) Waste Prevention Agency GmbH Lünen (137) Hazardous Waste Management Company (SAM) (139) Production-integrated environmental protection (PIUS) (150) Information platform for environmental protection (B-W) (151) Consultation programme ECO+ (B-W) (165) Information and advice on prevention and recycling of waste requiring special monitoring (BIVA – Hessen) (183) Newsletter for the operational environmental protection, AVA Lünen (79) EffCheck - PIUS-Analyses
Link to Annex IV WFD	5. The provision of information on waste prevention techniques with a view to facilitating the implementation of best available techniques by industry.
Instrumental character	Institutional, respectively informatory solution
Initiators	BMU and UBA
Addressees	Enterprises, especially SME
Waste prevention potential	According to former experiences long-term effects are achieved, particularly in the aspect waste prevention; the potential though cannot be quantified concretely.
Environmental impacts	No negative interactions to be expected.
Indicators	Degree of networking
Social impacts	No negative effects.
Economic impacts	The actual networking of the structures should not be related to financial effort. Facing the high number of companies, the actual consultation service is costly though, but with a high benefit.
Conclusion	Special potential is detected in the networking of existing individual projects on the national level within the framework of a national waste prevention programme.
Recommendation	The example measure is recommended for the implementation.

7.2.6 Measure B II 6: Provision of support for intercompany cooperation on waste prevention

Background

Since middle of the nineties in specialist discussions on the subject of reducing the emergence of (hazardous) production waste it was increasingly stated that especially the interaction among companies still offers clear additional waste prevention potentials (cf. UBA texts 11/97).

These estimations were i.a. fed from the findings during the implementation of individual operational waste preventions measures were it could e.g. be stated that

- (1) relevant shares of company-internal accruing waste are “caused” by the “behaviour” of suppliers and/or requirements from customers.
- (2) in operational processes surplus materials and/or remainders are generated which could actually be used directly for other utilisations and productions, without relevant separation or preparation efforts, but which is not possible in a useful manner due to the operational structure of the concerned business model.

For illustration in the following brief examples from real consultancies of the experts:

regarding 1.: Establishing a material-related system of key performance indicators in a printing house of a regional daily paper¹⁷⁷ it is stated that approx. 30 % of the residual-like commercial waste results exclusively from packaging remains of the supplements from external printing houses (in particular non-reusable palettes, outer packaging foils, partly even PVC foils, as well as metal strips etc.);

regarding 1.: Analysing the waste of a medium sized manufacturer of highly specialised industrial plant components¹⁷⁸ it is striking that the emergence of waste colours and colour remains amounts to almost 25 % of purchase quantity. The cause analysis reveals that this is rooted in the hardly manageable number of special colour preferences of customers to the delivered facility components. After consultation with the distribution department and key clients it is possible to convert to a standardised colour system. The quantities of colour remains and varnish waste decrease dramatically to normal values of approx. 5 %.

regarding 2.: In the course of a regional material flow analysis¹⁷⁹ it becomes apparent that a large manufacturer of logistical products periodically disposes larger quantities of fine-grained blasting abrasives. A local manufacturer of brake pads needs exactly such fine-grained replacement material. Laboratory analyses and the examination of the waste administration in charge confirmed that here, in a local relation, a direct waste-preventing reuse¹⁸⁰ of the material is possible¹⁸¹.

Thus, the prevention of waste can consist of decisions on suitable measures in form of arrangements between enterprises which are part of the value-added chain and their key clients. Targeted support of such cross-company collaborations should develop corresponding waste prevention potential in the framework of the present WP measure. To support such cross-company collaborations, in particular two ways of implementation are at hand:

¹⁷⁷ Example from the implementation of a key figure system to control material flow and waste (KeMaCo) in the course of a sector survey (cf. Ökopol/vdn 1999).

¹⁷⁸ In the course of developing a sectoral guidance for metal processing companies (cf. BSU/ Ökopol 1999).

¹⁷⁹ In the course of the BMBF project “Nachhaltige Metallwirtschaft Hamburg” (“sustainable metal economy Hamburg”) (v. Gleich 2004).

¹⁸⁰ Whether from a legal point of view this would not rather be waste recycling, was not finally examined by the time of former activities.

¹⁸¹ In the end such an economic and ecological very positive measure can, however, not be implemented, because the effort for the quality ensuring certification of the material which is necessary for safety reasons (production of brake pads) is not presentable in logistical terms for the quantities of remainders.

- Collaborations in a (close) spatial context, e.g. in the framework of an (also) environment-oriented industrial park management;
- collaboration in value-added chains, i.e. along the distributional linkages.

Both implementations are described in the following examples.

7.2.6.1 Example measure B II 6.1: Waste-preventing integration of material streams in spatial context (industrial parks)

Background

Linking material and energy flows of neighbouring facilities/companies is established practice for many decades, especially in the chemical industry, but as well in the iron and smelting industry.¹⁸²

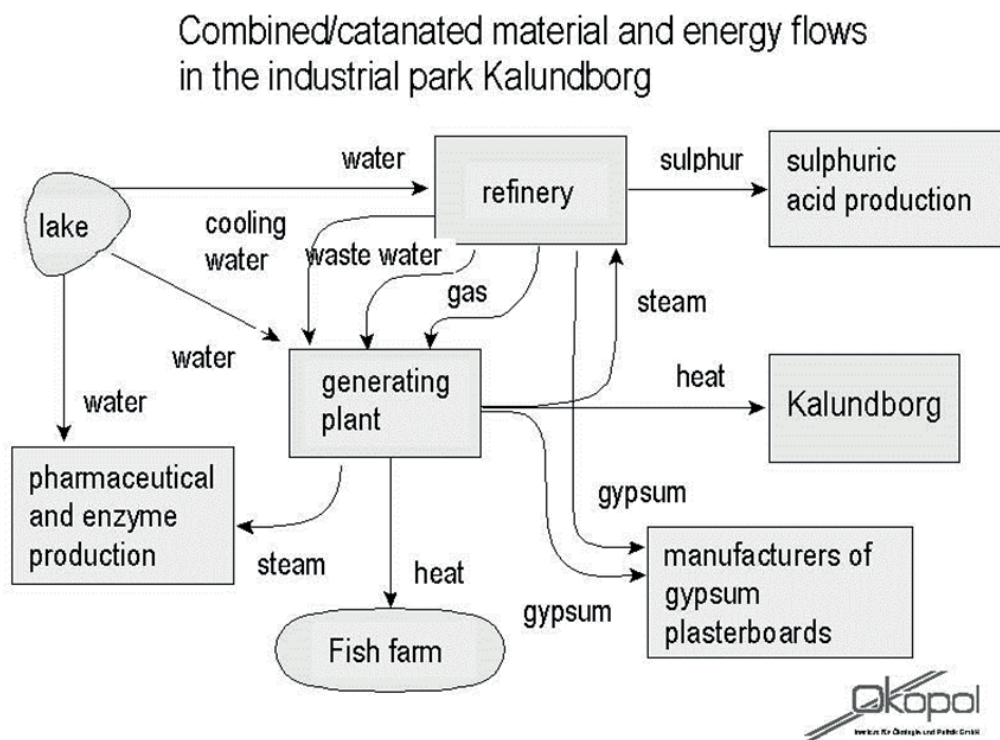


Figure 7-4: Linking material and energy flows in a Danish industrial park (according to Christensen 1998)

In the middle of the nineties different States/regions strived for stronger networking of neighbouring companies, also across industrial sectors. A much-debated model was the Danish industrial park Kalundborg by that time, where many efficient cross-company networks were established (see figure 7-6).

Also in Germany the possibilities of such approaches was recognised in theory (cf. UBA texts 11/97), and in some regions accordingly initiated through implementation projects.

¹⁸²

Common terms are “integrated location”, “compound site”, or as well “chemical park”.

The possibilities and limits of these approaches are described in the following in taking a recourse to the specific findings of those activities.

As referring example the project activities of “Regionale Stoff- und Energievernetzung im Gewerbegebiet Henstedt-Ulzburg/Kaltenkirchen” (regional material and energy networking in the industrial park Henstedt- Ulzburg/Kaltenkirchen) are used, which were carried out between 1996 and 2004 through an initiative of the Ministry of Environment Schleswig-Holstein.¹⁸³ The industrial park is located in Henstedt-Ulzburg in the south of Schleswig-Holstein, where about 300 companies are settled of which about 70 have more than 10 employees. About 45 companies were actively involved in the project.

The project and its objectives files into the endeavours and concrete implementation strategies of the States Governments for a sustainability strategy by developing specific models and fields of action, and implementing these in a practical manner¹⁸⁴. One of the emphases of that initiative was to set up a sustainable design and management for industrial parks.

Objectives

In the direct further development of “by-product” material flows to input materials for neighbouring facilities the generation of waste can be avoided, and in particular by substituting primary raw materials, an environmental relief effect is gained.

In the context of the referring example (DBU/MUNLV, 2003) the following objective was formulated:

“Primary and long-term goal for the industrial park Henstedt-Ulzburg/Kaltenkirchen is to develop a regional energy and material flow management. The material flow management can in this occasion be oriented towards substances as well as products. The expression material flow management is understood in accordance to the definition of the Enquetekommission (commission of enquiry) ‘Protection of human beings and environment by means of sustainable design of material flows’.”¹⁸⁵

Characterisation

In supporting the systematic analysis of input and output flows of settled companies, or those who are willing to, within an industrial park, network possibilities are identified (cf. Figure 7-4).

In the referring example a comprehensive potential analysis based on waste management data of the municipalities and the regional waste disposal enterprises was carried out¹⁸⁶.

¹⁸³ The project Regionale Stoff- und Energievernetzung im Gewerbegebiet Henstedt-Ulzburg/Kaltenkirchen (DBU/MUNLV-SH 2003) was carried out in several steps. Besides being supported by the Ministry of Environment it was funded by the Deutsche Bundesstiftung, and by the county councils and municipalities “on site”.

¹⁸⁴ Cf. the decision of the States Government on the topic “Zukunftsfähiges Schleswig-Holstein” (sustainable Schleswig-Holstein), of 14. November 2000.

¹⁸⁵ Translated from the German original

¹⁸⁶ Incompatibility of different data bases and an almost impossibility of direct IT supported evaluation were central obstacles in this.

Since the descriptions of the material qualities of the different waste fractions were insufficient in the waste management data for the combination / catenation analysis, they were continued more detailed and with more complementary information on stipulations for input material in cooperation with the companies.

In order to establish a reliable cross-company material flow, it might above this be helpful to support the participating partners with an overarching coordination in clarifying possible questions addressing waste, transportation, authorisation, but as well warranty legislation.

The significance of the availability of such supporting structures was an important learning experience of the pilot activities.¹⁸⁷

Initiators and addressees

The measure is to be initiated by an “independent” governmental department¹⁸⁸. This independent governmental department has two central tasks. On one hand it should bring the local companies together and initiate the necessary analysis of the current state, where being in charge as an independent third party would be sensible in order to evaluate and condense the information each company. On the other hand, the governmental actor is in charge, when the implementation of the cross-company material flow networks requires permissions for construction or planning (e.g. crossing public properties and streets or such). The independent governmental department can here also be integrated as part of a municipal and/or regional economy/settlement support.

Addressees are the commercial industry companies locally settled or willing to settle, and operators of industrial facilities.

Waste prevention potential

As already lined out in the section “objectives”, waste-preventing impacts result when the settled companies generate “by-products” in terms of Art. 4 of the KrWG (Closed Substances Cycle Act) instead of waste needing to be disposed. In this case the by-products can be fed into the production of neighbouring enterprises.

For such a cross-company networking of by-product flows within an industrial park, value with a general validity cannot be stated. In practice it totally depends on the “connectivity” of the generated output flows to the existing stipulations on input materials¹⁸⁹. The question of connectivity hence is a very individual in each case.

The pilot activities carried out reveal that already determining necessary basic information requires both, high performances from analysing the data, as well as support from the locally settled enterprises.

¹⁸⁷ During the pilot activities the respective tasks were taken by different project participants. But in view of continuity, this was the point where the need of institutional support was expressed in mutual agreement.

¹⁸⁸ Independence is an important factor, because it can counteract possible interest conflicts and concerns regarding secrecy that would occur if the measure would have to be organised by one of the business actors and/or only on a collaborative level among the companies.

¹⁸⁹ And above this also from legal aspects concerning waste, i.e. review/clarification of the question whether it is in fact a by-product according to Art. 4 KrWG.

In cross-company linkages of non-waste/by-products corresponding detailed analyses revealed mainly obstacles in the field of warranty on quality and quantity of the accruing by-product flows.

Established measures were therefore only to be found on a very low (refinery) level of direct energetic utilisation of pollutant-free wood/paper and plastics in heating/steam facilities of neighbouring companies.

For volume-relevant networking on a higher level obviously a targeted settlement policy is necessary, if it is not supposed to remain on a level of “by chance” business constellations.

The situation is different in cross-company optimisation of waste management, i.e. in measures not being attributed to waste prevention. Clear waste management potentials arose here from the evaluation. Predominantly though these were to be found in improved cross-company disposal logistics (joint use of differentiated waste collection containers enabling/supporting a high-quality reuse etc.). Although this has without a doubt a relevant positive ecological and economic effect, but not in terms of waste prevention.

Environmental impacts

The degree of relieving the environment is, beside the volume, particularly dependent on the level of refining the materials that are brought to further utilisation, and naturally the question, whether the further utilisation takes place on the same level, or if it is rather a case of “down-grading”.

Besides the environmental relief from the saved primary resource and production material input, on any rate a reduction of transportation demands and the related burden occurs.¹⁹⁰

When properly carried out, the passing on and the further utilisation of materials between the companies cause no counterproductive environmental effects.¹⁹¹

Indicators

A direct indicator would be (solely) the quantity and the quality of the material flows continued to use directly among the companies. To separate such an additional, waste-preventing material flow statistically from “normal” commercial flows between the neighbouring companies is not without problems.

Indirectly the effect of such a measure can surely as well be pursued through the development of the waste quantities of the respective industrial park. The complication that occurs here though, is the interaction/mixture with other measures (process conversion, business development, collection structures etc.) which are based on completely other reasons.

¹⁹⁰ Part of the relieving effect goes in any case beyond other forms of recycling/reuse of material flows outside of the spatial context. This specific advantage of spatial proximity was taken into account in the example project by creating an internet-supported logistical market, where joint transport was communicated between the companies.

¹⁹¹ Using valuations based on eco-balance sheets eliminated in the outlined thermal utilisation of the inter-company material flow that more pollution resulted than within other possible material utilisations. Concretely this was a matter of mixed fractions.

Social impacts

From the social point of view strengthening the collaboration of companies settled in a neighbouring area is to be seen as positive. On one hand, established collaboration structures have a stabilising effect on the location, on the other hand new and more dense networks, positive as well for completely different business measures (e.g. joint marketing efforts, innovative solutions) (can) result through the necessary cooperation in the course of analysing and implementing networking solutions.¹⁹²

Economic impacts

Positive is the effect for partners of “successful” networking because of cost savings on both sides: prevented waste disposal costs, and reduced purchase prices.

Negative, i.e. cost increasing, are the relatively high expenditures for the necessary material flow analysis in order to identify the “material” starting position. Facing the constant changes in the combination of local companies in “normal” industrial parks, an active industrial park management is indispensable in order to carry out analyses, as well as for the further advisory support which is necessary in establishing cooperations. How the respective (additional) costs are to be split, can be found in different models.

Reliable information on which of both cost effects is predominant over longer periods are not available for the experts.

Conclusion

In theory effective waste-preventing effects can result from the measure. The present pilot experiences indicate, however, that realistic potentials depend strongly on specific (occasional) structures of the corresponding locations.

In view of these findings and in regard of the necessary resource input, it seems not to be sensible, from the consultant’s perspective, to include such networks of a local-spatial context into a comprehensive waste prevention strategy.

Regardless this estimation it can, however, be very useful in specific cases, e.g. in structuring new industrial settlements, to implement this waste prevention measure.

The measure is recommended by the experts under the condition that an up-dated information basis has to present a relevant waste prevention potential.

Example measure B II 6.1: Waste-preventing integration of material streams in spatial context (industrial parks)	
Objective	Directly using “by-product” material flows as input material in neighbouring facilities is to prevent waste generation, and is to reach environmental relief particularly by substitution of primary input materials.
Characterisation	Supporting systematic analyses of input and output flows of companies settled or are willing to settle in an industrial park, will identify possibilities of networking.
Link to measures set out in Study I	(125) Waste prevention industrial park (Switzerland, Canton Basel)

¹⁹²

Experiences from precursor projects show this very clearly.

Example measure B II 6.1: Waste-preventing integration of material streams in spatial context (industrial parks)	
Link to Annex IV WFD	9. The use of voluntary agreements, consumer/producer panels or sectoral negotiations in order that the relevant businesses or industrial sectors
Instrumental character	Support of cooperation's
Initiators	Governmental and municipal departments
Addressees	Companies settled or willing to settle in an industrial park
Waste prevention potential	Not generally to be estimated, strongly dependent on individual "connectivity" of the material flows of the settled companies.
Environmental impacts	Environmentally relieving through prevented primary input materials and the reduced logistical effort.
Indicators	Volume and level of the linkages for further utilisation (statistically almost not to be figured).
Social impacts	Positive, location-securing effects: direct through advantages of material interactions indirectly through initiation effect for further cooperative activities on site.
Economic impacts	Direct cost relieving for network partners, but as well necessary expenditures for basic analyses, and permanent promotion of collaborations.
Conclusion	In theory effective waste-preventing effects can result from the measure. The present pilot experiences indicate, however, that realistic potentials depend strongly on specific (occasional) structures of the corresponding locations. Regardless this estimation it can, however, be very useful in specific cases, e.g. in structuring new industrial settlements, to implement this waste prevention measure.
Recommendation	The measure is recommended by the experts under the condition that an up-dated information basis has to present a relevant waste prevention potential.

7.2.6.2 Example measure B II 6.2: Waste-preventing cooperation in value chains

Background

In realistic supply chains "latent" interface problems are often "bridged over" in manner that causes waste generation.

In the following some practical example:

- Manufacturing "over-qualities"

An example are machinery or plant components, where partly surfaces are treated with corresponding high effort (filling, grinding, varnishing), although in later manufacturing steps necessary connections regularly need polishing or machining.

- Immoderate transport protection

An example is the coating of components with corrosion protection oil that have to be treated on any rate before further processing by acid cleaning to remove oxidation layers.

- Logistical surpluses

On purpose quantities above the announced demand in order to ensure a 100 % availability at the point-of-sale, although there would e.g. be a timely flexibility for a tightly focussed repeat order, or other adjustment measures.

Through improved coordination among the participating stakeholders in the supply chains waste-preventing effects can principally be met at these points.

Beside the interface optimisation well-functioning collaborations within the value-added chains can also lead to identification and implementation of even more radical optimisation options within the product system¹⁹³. Examples are agreements on waste-preventing reusable packaging solutions¹⁹⁴, or (partly) dematerialisation of the actual service of the product based on the substitution by corresponding services.

The approach of collaboration within value-added chains is particularly helpful for such further reaching measures, because here a basic common interest, to optimise the complete chain can be presupposed.¹⁹⁵

In the following this waste prevention approach will be described and evaluated for orientation. Thereby it will be taken a recourse to referring experiences of running activities of the Federal State Schleswig-Holstein, where the foundation for a relevant measure was developed on behalf of the Ministry for Environment (Dehoust, Jepsen, Wilts 2011).

Objectives

Systematic cooperation among all partners of a value-added chain identifies potentials to reduce material losses that result from interface coordination, over specifications, or as well lacking specification, or from logistical requirements, and which could not be changed by individual actors “alone”.

Through coordinated action of the participants those waste prevention potentials are to be opened up.

Characterisation

In order to reach the outlined objectives the following steps are to be implemented, or rather to be initiated and supported by the Federation or the Federal State's administration:

- 1) Selection of value-added chains with possible prevention potentials.
- 2) Development of collaborations that are capable of acting among key-actors of the value-added chain.
- 3) Systematic analysis of material and product flows to identify interface problems.
- 4) Collaborative development of solution options for the identified interface problems.

¹⁹³ I.e. the full life-cycle/utilisation-cycle of the concerned products.

¹⁹⁴ E.g. the exchange of small plant components in transport containers instead of palette-wise and “shrunk”.

¹⁹⁵ Which divides collaboration in supply chains i.a. from (solely) local-spatial collaborations, where the inherent driver is often missing.

- 5) Implementation of corresponding measures with waste-preventing impact, and monitoring of the measure's implementation.

For illustration some complementary explanations based on referring experiences in implementing such approaches.

Regarding 1: A selection directly based on waste statistics is not possible in a useful manner, due to the variation of the generators to be considered, and the not in general fixed relevant waste fractions. For a reasonable selection of possibly relevant sectors/cluster the following accesses can be used “as substitutes”:

- (Regional) economic relevance

The optimisation in terms of waste of sectors/clusters with high economic relevance (added value, number of employees...) and a dynamic in the development suggests a higher overall significance¹⁹⁶.

- (Overall) material intensity of the sectors

For different economic sectors/production clusters linkages between economic activity and material flows indicated by the economy as a whole may be created through (macro-economic) input-output analysis (Acosta 2007). Because high (overall material flows) also suggest higher waste prevention potentials, evaluating such (regional) economic values of activity also delivers helpful information.

- Existing collaboration structures/cluster initiatives

Because the development of collaboration structures capable of acting are quite complex (as well as time consuming), linking the planned WP activities to already existing cooperation within the value-added chain lays at hand. Particularly in the field of regional knowledge/employment and innovation clusters, as well as in marketing initiatives, the field of existing networks is often broad.

Regarding 2: Developing collaborations capable of acting needs key-actors of each value-added chain to be won for the waste-preventing efforts. Key-actors are often the so-called “leaders of the system”, i.e. those enterprises shaping large parts of the value-added chain through their de facto power to make decisions¹⁹⁷. Together with such key-actors¹⁹⁸ first

¹⁹⁶ The “cautious” formulation is due to the fact that also economic sectors are of increasing relevance which create added value mainly in the non-material segment (banks, insurances, other services). However, more carefully considered, also those areas have a close indirect interaction with material flows (e.g. services around real estate investment, the building sector). Thus they are also related to waste prevention potentials (i.e. should not per se be excluded).

¹⁹⁷ A typical example in this connection would be a large brand producer in the food segment that “controls” more or less the whole life-cycle of a foodstuff from selecting raw material and contents, via procurement and processing, as well as the design of packaging as far as to the distribution and marketing activities.

Leaders of a system are also existent in the service area, e.g. health sector, where large hospital groups are central “players” in questions about designing medical or hygienic products though their purchase decisions, and control of internal processes.

¹⁹⁸ Besides the actual system leaders also many other stakeholders often have important functions within the “chains” (in the examples mentioned above, e.g. the food retail or the medical product manufacturers), which both should be included in the first exploratory arrangements.

“suspected cases” of waste-intensive interfaces, or other optimisation processes, are discussed and documented.¹⁹⁹

Regarding 3.: Key-actors can deliver first important hints for possible “suspected cases”. Really systematic and quantified analyses of material/product flows, and the generated waste quantities, are usually not available though.²⁰⁰ Through structured inventory in close cooperation of all stakeholders of the value-added chain, reliable data and facts are to be brought together.²⁰¹

Regarding 4.: To develop waste-preventing optimisation measures effectively, proposals for technological logistic solutions are to be developed. This can be carried out by selected experts. “Against” those proposals for solutions, their impacts on the different stakeholders of the value-added chain are to be discussed very carefully. As a result in most cases such changes also lead to a change in dispersion of the burdens²⁰². Acceptance and enforceability of the measures depend on whether these shifts of burdens will in future also be represented in the dispersion of financial responsibility.

Regarding 5.: As a matter of course changes in the inter-company areas have to be implemented in agreement. First of all it needs (model) testing of the new “technical” solution though. It is necessary also for this reason, to divide the additional burdens of the testing between the cooperation partners, respectively, to source these burdens out. Just as in any other waste-preventing measures, also here a long-term monitoring of the measure's success while implementing is useful. Even more as in the course of monitoring data can often be collected that is helpful/necessary for initiating further steps of optimisation within the value-added chain.

Initiators and addressees

Because company overarching waste prevention possibilities usually are not acknowledged by individual economic control systems, in most cases it needs initiating impulses.

This function can very suitable be taken by governmental departments of on the federal and states level. These can initiate the invitation of important stakeholders in the value-added chain to rounds of talks, and develop the necessary facts.

In order to prepare and accompany the rounds of talk and the networks, governmental departments can mandate communication experts as well as experts of the subject. Besides, also departments responsible for economic and/or innovation's promotion are suitable to stimulate these impulses, or to accompany measures of the environmental authorities.

Addressees are the individual economic stakeholders of the (regional) value-added chain.

¹⁹⁹ Such reasonable suspected cases are very important for the further design of the collaboration, because it helps to illustrate, and hence also explain, the target perspective, and the potentials of acting collaboratively.

²⁰⁰ This is immanent within the system, because in order to determine comprehensive potentials, it will need in turn the mentioned comprehensive collaboration.

²⁰¹ Focussing on two or three exemplary flows might be sensible, because collecting data on materials and products throughout the whole broad value-added and commercial chains is hardly possible without unreasonable efforts.

²⁰² Although it can very well lead to positive economic effects.

Waste prevention potential

Facing the width of existing value-added chains, and the variety of the optimisation possibilities that might be identified/addressed during the optimisation of the chains, naturally estimations on the prevention effects that might be met are not possible.

According to the experts, relevant waste prevention potentials can be revealed though, by collaborations on the level of supply chains, when logistical planning is optimised and amended in terms of waste. In some product segments, where the return rate is very high, like fashionable articles, magazines, or also foodstuff, saving effects in a double digit percentage range are possible.

Environmental impacts

The material/product quantity savings by optimising value-added/supply chains regularly are accompanied by corresponding environmental relief effect from not produced primary energy input masses. Optimisation solutions should beyond this regularly be examined, not only economically and in terms of contractual law, but also for environmental orientation, to exclude possible counterproductive effects within other environmental fields.

Indicators

The optimisation within value-added chains eludes external statistical control to the greatest extent. Therefore accompanying a measure's implementation monitoring is of high significance for comprehensive evaluation.

Social impacts

As in all measures that strengthen the collaboration of economic stakeholders substantially, also here it can be assumed that location securing and innovation supporting impacts with related positive employment effect are generated.

Economic impacts

It has to be assumed that by the interaction among economic stakeholders in the end measures will be selected and implemented that are economically self-sustaining.

Initiating and supporting cooperation's, in particular by accompanying the systematic "weak point" analysis, needs, however, additional (start off) financing. Thereby clearly cost decreasing synergies with networks/clusters stimulated differently can be met.

Conclusion

Company overarching optimisations in supply/value-added chains can "raise" (additional) waste prevention potentials which would not be accessible through individual economic measures.²⁰³

Above this, the necessary steps (and financial resources) to support the creation of collaborations, and the chain's analyses inherent are a clear synergy potential with other

²⁰³

Independent of the individual ecological measure is voluntary or regulatory.

activities of the economic support, so an overall good impact efficiency of the used public funds can be assumed.

Recommendation

The example measure is recommended for the implementation.

Example measure B II 6.2: Waste-preventing cooperation in value chains	
Objective	<p>Systematic cooperation among all partners of a value-added chain identifies potentials to reduce material losses that result from interface coordination, over specifications, or as well lacking specification, or from logistical requirements, and which could not be changed by individual actors "alone".</p> <p>Through coordinated action of the participants those waste prevention potentials are to be opened up.</p>
Characterisation	<p>The waste prevention measure comprises following steps:</p> <ol style="list-style-type: none"> 1. Selection of value-added chains with possible prevention potentials. 2. Development of cooperation's being capable of acting among key-actors of the value-added chain. 3. Systematic analysis of material and product flows to identify interface problems. 4. Collaborative development of solution options for the identified interface problems. 5. Implementation of corresponding measures with waste-preventing impact, and monitoring of the measure's implementation.
Link to measures set out in Study I	-
Link to Annex IV WFD	The use of voluntary agreements, consumer/producer panels or sectoral negotiations in order that the relevant businesses or industrial sectors
Instrumental character	Support of collaborations
Initiators	Governmental departments and institutions responsible for business development on the federal and states level.
Addressees	Individual stakeholders within the concerned value-added chain.
Waste prevention potential	Not generally to be estimated, strongly dependent on individual production and distribution conditions. In some fields high potential assumed.
Environmental impacts	Environmentally relieving through prevented primary input materials, and reduced logistical effort.
Indicators	Statistically not to be illustrated, therefore monitoring of success necessary.
Social impacts	Positive, innovation supporting effects, and therefore also securing site and jobs.
Economic impacts	Direct cost relieving for cooperation partners, but as well necessary expenditures for basic analyses, and the promotion of collaborations. Synergies with cluster initiatives on other objectives can increase the efficiency of the used financial resources.
Conclusion	Very suitable, systematically "additional" potentials are opened up; links to (other) activities of business promotion are possible.
Recommendation	The measure is recommended for the implementation.

7.2.7 Measure B II 7: Strengthening of corporate ownership of waste prevention efforts by means of integration into corporate controlling systems

From a perspective of individual economies, in many fields the prevention of production waste is directly useful, because a number of cost savings can be realised.

Those are the costs for the

- purchase
- operation (storage, transportation and where possible, also partial processing)
- disposal

of (premature) to waste transforming materials and pre-products.

For this reason it would be to assume that – as far as this is possible without over-proportional effort – in general those wastes are prevented. But in the operational reality this is by no means continuously the case.

Above all, the reasons are that

- the correlations between waste emergences are not questioned
- the (technical) options of waste prevention are unknown
- the (overall) level of costs related to the waste emergence is not recognisable for the operational decision-maker

The introduction of operational management concepts which allow systematically to identify such weaknesses, and the implementation of (controlling-) instruments supporting a (full) waste-cost-control, can make substantial contributions to develop both, economic and ecological potentials.

7.2.7.1 Example measure B II 7.1: Greater focus on waste prevention aspects when implementing ÖKOPROFIT activities

Background

The “ecological project for integrated environmental techniques” (Ökologische Projekt für integrierte Umwelt-Technik), running under the brand description ÖKOPROFIT, was developed in Graz and implemented for the first time in Germany within the course of the Munich Agenda 21. ÖKOPROFIT is a modularly composed advisory and qualification programme supporting companies (customised according to type and size) in the implementation of fundamental structures for the operational environmental management.

The costs for the thematic workshops as well as individual operational consultancies during an ÖKOPROFIT round are pro-rated by the individual companies and the relevant municipalities. At the end of each ÖKOPROFIT round the successful commitment of the companies will be honoured with the award “ÖKOPROFIT Company“. This award may be used by the companies in their external communications. It can be updated annually or over longer intervals.

By now 96 municipalities in Germany are licensees of ÖKOPROFIT and offer training courses on the subject.

The municipality of Munich continues to coordinate the ÖKOPROFIT activities in Germany and is the central contact for participating municipalities.

The operational waste management is an independent focus of the ÖKOPROFIT trainings. One of the altogether 10 workshop days is only dedicated to this topic. Beside that in information brochures and work materials there is specific “booklet about this unit” (see also ÖKOPROFIT 2011).

In the course of evaluating these measures at the end of each round as well as during comprehensive evaluations of the activities, continuously relevant reductions of waste quantity are reported.²⁰⁴

Based on the experience of the experts²⁰⁵, in most of the companies though to begin with, “simple” efforts to collect and keep waste separate are in the centre of the measures. This does lead to relevant reduction of quantities and costs of residual waste, but is not, in the sense of the WFD, a waste prevention.²⁰⁶

In the current information and work materials (ÖKOPROFIT 2011) in booklet no. 4. “waste“, the requirements and definitions et al. of the Waste Framework Directive (WFD) are described in full extent, correctly and with basic examples.

But what it lacks of, according the expert's opinion, are descriptions of a concrete and gradual approach to identify and evaluate waste prevention possibilities and the underlying of such an approach with illustrative examples. In particular this kind of operationalisation could help that a higher number of ÖKOPROFIT companies take the next step towards real waste prevention measures.

Objectives

Objectives are that, by the support of explicit practical routines for identification and evaluation of waste prevention possibilities, the high number of in ÖKOPROFIT activities participating companies not only build up a basic knowledge of the correlations between waste emergence and prevention, but moreover, take first practical actions for implementation of a waste prevention.

Characterisation

The WP measure consists in a systematic extension of the workshop documents in the block „waste“ of the information booklet no. 4 by ÖKOPROFIT (cf. ÖKOPROFIT 2011) on further descriptions of methods and instruments for the operational check of waste prevention measures. Furthermore the usability of these methods and instruments is to be „acted out“ in 1-3 case examples.

²⁰⁴ For North Rhine-Westphalia e.g., there is the information that until 2009 1.009 companies were participating in an ÖKOPROFIT project and more than 7.700 environmental protection measures were realised. Hereby et al. a reduction of the residual waste quantities of more than 40.000 tons per year were gained. Cf. <http://www.oekoprofit-nrw.de/>

²⁰⁵ Since 2004 Ökopol organises the ÖKOPROFIT activities in Hamburg and has since then accompanied the implementation in approx. 200 companies.

²⁰⁶ Still, this is of course a very useful and necessary activity which in fact is a precondition for further „real“ waste-preventing actions.

Besides that, the distribution of ÖKOPROFIT is to be supported.

Initiators and addressees

Currently the provincial capital Munich coordinates the ÖKOPROFIT activities of the German municipalities, and in particular also places the orders for revising/up-dating of the work and information material. Therefore it would appear necessary that on the federal and the provincial level the responsible administrations for the waste prevention approach the provincial capital Munich to discuss the implementation of the measure.

Since the financial resources for the overall actualisation of work material are very short, in this context a possible financial support for the implementation of the measures should be considered.

Addressees of the measure then are the ÖKOPROFIT activities in the approx. 100 participating German municipalities, as well as the, as the case may be in the course of the measure, additional municipalities, and finally the companies participating on a voluntary basis.

Waste prevention potential

ÖKOPROFIT is directed towards the whole range of commercial enterprises of all sizes. From this point of view a quantification of the prevention potential is excluded. But, based on the referring experience of the experts, in smaller and medium-sized producing enterprises (still) to date 10-30 % of the specific waste are preventable, if state-of-the-art technology is applied.

However, it has to be taken into consideration that ÖKOPROFIT is a voluntary activity, i.e. it has to be assumed that only measures that are economically neutral or at least do not lead to additional expenses, are feasible.

Thereby the potential focuses as well on WP activities that can be realised with low investment, and that lead comparably fast to prevention effects. Predominantly those are activities aiming at more careful handling with operating material and additives, and waste-optimised processing. Already through these measures, about 50 % of the overall prevention potential is accessible²⁰⁷.

Environmental impacts

Since in the course of ÖKOPROFIT an integrated consideration of the environment²⁰⁸ is aspired and implemented, serious controlling errors can be excluded in the normal case.

Indicators

A structural indicator is the annual number of in ÖKOPROFIT qualifications participating companies.

²⁰⁷ These estimations are based on a high number (approx. 350) of realised consultancies of individual companies by Ökopool in the past years in various work contexts. Nevertheless, naturally an utmost restraint about a scale-up of such data to the whole range of producing companies in Germany is demanded.

²⁰⁸ Where both, the emissions of different types (air emissions, waste water, noise) as well as the generation of waste and the use of resources, energy and transportation, are examined.

A material indicator would be the comprehensive evaluation of the real waste savings. Therefore both, mass effects caused by optimised separating and disposing solutions, as well as “real” waste prevention successes, should be reported in the implementation differentiated statements of the individual companies.

In addition to this it a nationwide implementation of a substantial comprehensive evaluation of the effects would be necessary. This does not exist by now, but could be very useful as an initial information campaign for ÖKOPROFIT.

Social impacts

ÖKOPROFIT aims on the implementation of good management rules and the related environmental cost reduction. This supports the security of company sites and employment. Above this, from the outside visible engagement of the participating companies, leads to an increase of employee motivation and satisfaction.

Economic impacts

As mentioned above, ÖKOPROFIT is a voluntary activity that, aims i.a. to the individual environmental costs.

For this reason, positive effects on the stakeholders of a market are to be expected.

For the ÖKOPROFIT municipalities the costs (grants for participants) would not change by the recommended WP measures.

For the implementation of the WP measure as recommended by the consultants, presumably a one-off funding for conception, development and realisation of the additional work material on waste prevention will be necessary.

The consultants estimate this funding around 50,000 Euro.

Conclusion

By the including the measure into a well-functioning environmental management system, high waste prevention successes can be achieved with low expenditures. Additionally the understanding and acceptance for waste prevention in SME will be increased.

Recommendation

The example measure is recommended for the implementation.

Example for Measure B II 7.1: Greater focus on waste prevention aspects when implementing ÖKOPROFIT activities	
Objectives:	Stimulation of concrete waste prevention measures among a high number of companies participating in ÖKOPROFIT activities.
Characterisation	Target-oriented supplementation of the qualification material of ÖKOPROFIT by descriptions of methods and instruments for the operational controlling of waste prevention measures (incl. 1-3 practical examples).
Link to measures set out in Study I	(214): Promotional programme environmental management, Saarland (222): ÖKOPROFIT
Link to Annex IV WFD	10. Promotion of creditable environmental management systems
Instrumental character	Informational instrument

Example for Measure B II 7.1: Greater focus on waste prevention aspects when implementing ÖKOPROFIT activities	
Initiators	Ministries or administrations of the individual Federal States
Addressees	Municipality Munich as ÖKOPROFIT promoters; in ÖKOPROFIT participating companies
Waste prevention potential	Preliminarily not to be quantified.
Environmental impacts	Negative interactions are not expected.
Indicators	Saved waste quantity (requires systematic overall evaluation)
Social impacts	No negative effects.
Economic impacts	Low input of public funds.
Conclusion	By the including the measure into a well-functioning environmental management system, high waste prevention successes can be achieved with low expenditures. Additionally the understanding and acceptance for waste prevention in SME will be increased.
Recommendation	The example measure is recommended for the implementation.

7.3 Measures in the point of leverage III: Waste-preventing production design

Different expert estimations assume that approx. 70-80 % of the environmental impacts of a product are already set in the development phase²⁰⁹.

In this stage of product's life-cycle its geometry and mass and its physical composition, and therefore the essential production methods as well, are established. Important parameters in the stage of utilisation, e.g. the consumption of energy and indirect material or the like, are defined. Consequently this phase has a major impact on important aspects of waste prevention. Beside a possible limitation of harmful substances/pollutants, in particular aspects of reparability & durability are important parameters defining the lifespan of a product.

The recognition of waste-preventing aspects during the process of product development can be accelerated on one hand by regulatory anchored minimum requirements on the product design²¹⁰. On the other hand product developers (development engineers and industry designers) can be put into the position, to develop and place on the market suitable product solutions on their own authority by making well understandable and practical information with good examples available.

Both of these different types of “pushing” (in regulatory terms classified as push concepts) of the product suppliers are described as separate WP measures in the following sections. In the practical implementation they can support and promote each other.

Above this, there is a close interplay of these measures with the activities striving to support the market demand for eco-friendly products, and thereby in turn give incentives to the producers (and the product developers) to place suitable products on the market (“market pull”). In particular there are the measures C VI 3: “Considering waste prevention in the

²⁰⁹ Cf. e.g. the “Greenbook for an Integrated Product Policy” of the EU Commission KOM (2001) 68 final Brussels, 07.Feb. 2001; http://eur-lex.europa.eu/LexUriServ/site/de/com/2001/com2001_0068de01.pdf

²¹⁰ In this case the fulfilment of corresponding minimum standards is the precondition for the market entrance.

meaningful eco-labelling of products“and C IV 5 and C IV 4: “Environment-orientated / waste-preventing procurement”.

7.3.1 Measure B III 1: Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive

Background

Authorisations for the regulatory requirements on the product design can be found in various environmental laws.

In this context § 23 “product responsibility” of the KrWG²¹¹ formulates in paragraph (1) a corresponding basic obligation for developers, producers, manufacturers and distributors of products to *“design these, if possible in a way that during their production and use the generation of waste will be reduced ...”*. Paragraph (2) substantiates 1 insofar that it includes, i.a. “the development, production and marketing of products that are suitable for multiple use, that are technically durable and after use suitable for proper and safe and qualitatively high recovery, and environmentally compatible disposal”²¹². For a generally binding specification of the requirements of § 23 KrWG beyond the basic obligation the statutory instrument according § 24 KrWG are possible.

According to a legal commentary of Lersner et al. (2009) regarding the regulations of § 23 KrW-/AbfG, which is identical in wording to § 24 KrWG, this authorisation was rarely used by now, because the impact on the freedom of trade is relatively sharp and within the common European market hard to enforce a national basis.

An alternative is the decree of product specific implementation measures (mostly in the form of directly effective EU directives) below the EU ecodesign directive (2009/125/EC).²¹³ Relevant implementation measures are (by now) issued as EU regulations. Hence, a binding EU-wide effect unfolds directly.²¹⁴

To date, such implementation regulations were established exclusively for energy consuming products, so requirements concerning energy efficiency are clearly dominant.²¹⁵

²¹¹ Within the current legislation of KrW-/AbfG an (almost) identical formulation was to be found in Art. 22.

²¹² Translated from the German original

²¹³ DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND THE COUNCIL of 21. October 2009 for the creation of a framework for the setting of eco-design requirements for energy-using products

²¹⁴ More reasons for regulation authority can be found in the European Construction Products Regulation (CPR). But, as “New Approach” directive, the specification of the essential requirements, e.g. to the environmental protection and its performance, are made exclusively for the part of the sub-legal mandatory and voluntary standardisations. The complex and in sometimes parallel running work processes, which have to be considered, when waste-preventing aspects, i.a. driven by norms, are supposed to have more influence on product design demand both, the plain characterisation, as well as the de facto influence on the realisation of a WP measure. But facing how volume-related many construction waste are, an extended analysis of effective implementation options seems to be useful according to the experts.

²¹⁵ An overview of the current status of the enacted implementing regulations, and further regulatory drafts in discussion or preparation, can be found on the website of the topic-related network www.eup-netzwerk.de

But even when energy relevant concerns have no clear priority, Art. 1 paragraph 2 of the Eco-Design Directive, however, reveals that environmental impacts of products are addressed beyond this:

“(2) This Directive provides for the setting of stipulations which the energy using products covered by implementing measures must fulfil in order for them to be placed on the market and/or put into service. It contributes to sustainable development by increasing energy efficiency and the level of protection of the environment, while at the same time increasing the security of the energy supply.”

Other recitals, like here no. 10, point this out as well.

“Improving the energy and resource efficiency of products contributes to the security of the energy supply and to the reduction of the demand on natural resources, which are preconditions of sound economic activity and therefore of sustainable development.”

In recital 13 there is an additional link to EU resources strategy.

“Considering at the design stage a product's environmental impact throughout its whole life cycle has a high potential to facilitate improved environmental performance in a cost-effective way, including in terms of resource and material efficiency, and thereby to contribute to achieving the objectives of the Thematic Strategy on the Sustainable Use of Resources.”

Annex I then mentions environmental aspects, which are supposed to be improved by either general (according to methods of annex I) or specific (according to methods of annex II) requirements on the ecodesign:

- a) predicted consumption of materials, of energy and of other resources such as fresh water;*
- b) anticipated emissions to air, water or soil;*
- c) anticipated pollution through physical effects such as noise, vibration, radiation, electromagnetic fields;*
- d) expected generation of waste material;*
- e) possibilities for reuse, recycling and recovery of materials and/or of energy, taking into account Directive 2002/96/EC.*

Considering the proposed regulatory framework, it is beyond dispute among the participating circles that in the course of the implementing measures (implementing regulations) generally binding stipulations for not energy-related aspects can be formulated.²¹⁶

Nevertheless, during the current the implementation process, in (almost²¹⁷) none of the product groups, relevant binding minimum standards with waste-preventing effects, were

²¹⁶ According to law experts (Schomerus/Spengler 2011) the Eco-Design Directive can be interpreted this way that also implementing regulations are possible which exclusively formulate non-energy related eco-design requirements, e.g. requirements to the choice of material, the limitation of harmful substances and the durability.

²¹⁷ The requirements referring to the minimum duration for non-directional domestic lamps of the Regulation (EC) No. 244/2009 of the Commission of 18. March 2009 for the execution of Directive 2005/32/EC

formulated so far. According to the analyses of the consultants (Jepsen/Sprengler 2012) the reasons are as following:

- Aspects of energy efficiency are dominating within the quantified, political objectives, the discussions about the arrangements of the ecodesign requirements for different product groups.
- Regarding waste-preventing aspects, especially for energy-consuming electronic and electrical equipment, in the debates on implementation often the reference to the regulations WEEE²¹⁸ and RoHS²¹⁹ is made; without reflecting that beyond specific substance exclusions no operational regulation prevent waste are contained.
- The uniform method for analysing and evaluating ecodesign options (MEErP) has only a very limited potential to illustrate waste-preventing aspects to be useful for decision-making²²⁰

But now, in the current environmental debate on a strategy for efficiency of resources, the importance of product development for less resource-intensive and therefore often waste-preventing requirements on product design has been considerably strengthened. Accordingly the EU Commission formulates in the “route map for a resource efficient Europe”²²¹, published in September 2011, as a milestone in the field of activity “sustainability in production and consumption”²²²: *“In 2020 at the latest, with appropriate prise signals and clear environmental information, proper incentives will be offered to citizens and public authorities, so they can choose the most resource saving products and services. ... Minimum standards of environmental performance will be set, in order to take products with the worst resource efficiency which harms the environment most off the market.”*²²³

The Federation is sensitive to the relevance of product design as well and emphasises in the German resource efficiency programme (ProgRess)²²⁴ a particular approach: *“The realisation of ecodesign – in terms of the development of products suitable for both environment and market – as an worthwhile principle of product design, urgently requires regular consideration of impact on resources.”*²²⁵

of the European Parliament and the Council with regard to the definition of requirements on environmentally compatible design of non-directional household lamps, remain an exception.

²¹⁸ Directive 2002/96/EC of the European Parliament and the Council of 27. January 2003 on waste of electrical and electronic equipment

²¹⁹ Directive 2002/95/EC of the European Parliament and the Council of 27. January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

²²⁰ This also applies for the present consultative proposal for the further development of a uniform methodology which results of a current expertise for the EU Commission (cf. Kemna et al. 2011)

²²¹ KOM (2011) 571, Brussels, 20.09.2011

²²² Ibidem, p. 6

²²³ Translated from the German original

²²⁴ German resource efficiency programme (ProgRess): Programme for a sustainable use and the preservation of natural resources, decision of the German Federal Cabinet of 29. February 2012, S. 41

²²⁵ Translated from the German original

In terms of a “design for waste prevention” the regulation options, that already exist in principle, in combination with the current political emphasis of the topic can, according to the experts, very well be used for waste-preventing activities in the field of product design.

Specification of the WP measure

Currently there are two processes which are important for a stronger systematic integration of waste-preventing approaches into the product group-specific ecodesign requirements:

1. In the context of the preparation of future proposals for specific implementation measures according to product groups during the realisation of the EU Eco-Design Directive, but also for the next revisions of the referring implementing regulations, continually the question, how a greater account can be taken of resource-saving and waste-preventing aspects, will have to be raised.
2. Furthermore, in the course of the 2012 upcoming revision of the EU Eco-Design Directive, it has to be reviewed, if an extension of the jurisdiction on non-energy relevant products might not be useful as well.

In its implementation the WP measure “Introduction and Implementation of mandatory stipulations for a Waste-Preventing Product Design under Implementing Measures of the EU Eco-Design Directive” should support these two processes in a very practical manner. This can take place in particular by introducing corresponding objective arguments and facts to each working and decision process, whereby waste prevention will be strengthened.

7.3.1.1 Example measure B III 1.1: Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive (exemplified by inkjet printers)

Background

The Eco-Design Directive gives the opportunity to set EU-wide binding regulations for waste-preventing measures for specific product groups. This option has rarely been used yet. A relevant potential can be developed by improving the cooperation of the efforts to prevent waste, using the implementing processes below the Eco-Design Directive on two levels, for technical reasons as well as in the consideration of political objectives.

Objectives

Mandatory waste-preventing ecodesign requirements should be implemented for all kinds of products that are regulated under the EU Eco-Design Directive and that will be distributed on the European market.

Characterisation

For the product groups which are identified as relevant by each current work programme (according to Art. 16 of 2009/125/EC), the EU Commission initiates step-by-step the Directive's process the review and, when indicated, the definition for the specific product group. In this process Germany is involved as both, member of the consultation forum (according Art. 18, 2009/125/EC) as well as member of the regulation committee (according Art. 19, 2009/125/EC). The Federal Ministry for Economics and Technology (BMWi) directs

this process; on a work level the tasks will be performed as far as possible by the Federal Institute for Materials Research and Testing and the Federal Environment Agency (UBA) (supported/represented by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU))²²⁶.

The graphic below shows this process in a schematic overview:

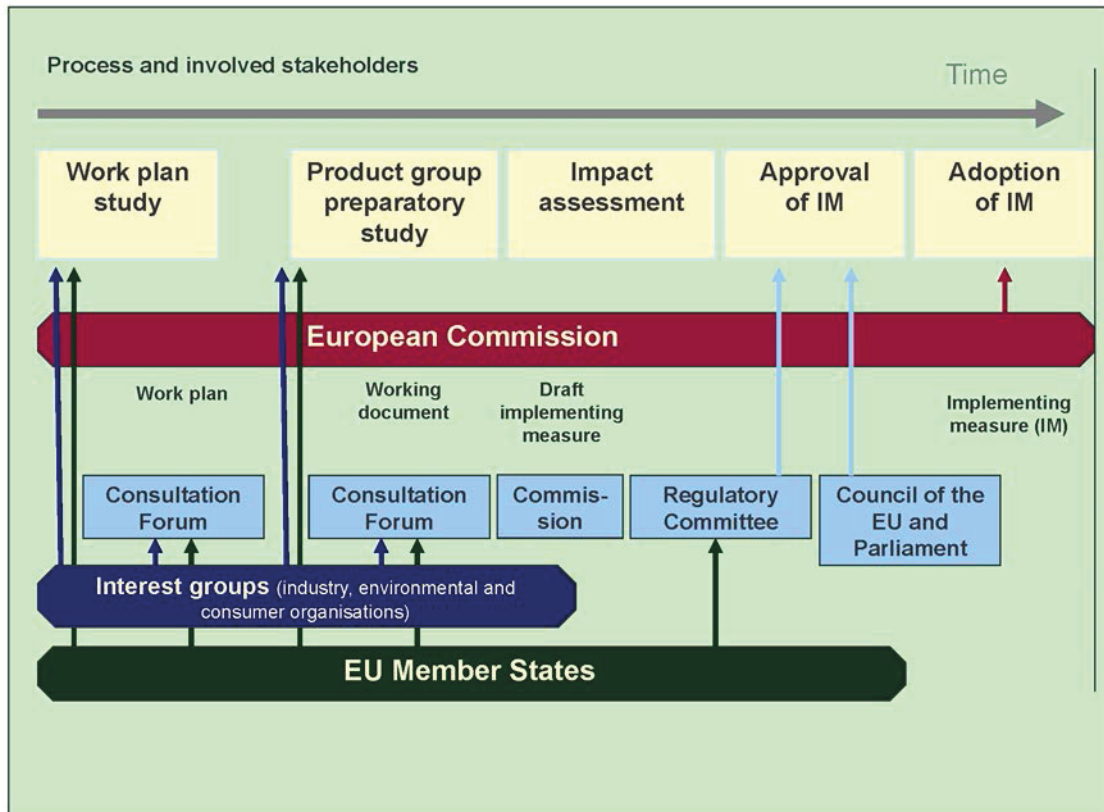


Figure 7-5 : Development and decision process of implementation measures to include the EU Eco-Design Directive (Oehme et al. 2009)

During the implementation of the measures proposed here, the waste departments/divisions of BMU/UBA participate actively in the review/discussion of:

- Each by the EU Commission assigned product group-specific preliminary study, respectively the hearing of stakeholders which will be conducted in this course.
- The working papers presented to the consultative forum by the EU Commission for the preparation of a possible regulation and
- the final draft of regulation (implementing regulation) presented to the (regulating) committee.

The waste departments will also actively introduce their suggestions on waste-preventing ecodesign options for each product group (here in the example of inkjet printers).

²²⁶

cf. the website of the BMU:

http://www.bmu.de/produkte_und_umwelt/oekodesign/oekodesign_richtlinie/doc/39037.php

Detailed information on processes and procedures can be found on the webpages of the EuP network:

<http://www.eup-network.de/de/hintergrund/oekodesign-richtlinie/>

Initiators and Addressees

The initiative for implementing the measure is to take place in coordination of the departments and divisions of the Federation responsible for waste-preventing activities, and those for the implementation of the Eco-Design Directive.

The addressee of the measure is in the first instance the EU Commission for its initiating function for proposals and decrees in the course of EU Eco-Design Directive.

Subsequently the implementing regulations aim at the distributors of the regulated products.

Waste Prevention Potential

To illustrate which waste prevention potential can be developed by the example measure, specific waste-preventing ecodesign options existing for the product group will be outlined and evaluated in the following.

Therefore it will be assumed that for on the European market distributed inkjet printers the following minimum standards are required²²⁷:

Requirements on the intensification of the utilisation/lifespan prolongation:

- All devices have the option for duplex printing; this function is activated at the time of delivery.
- Appropriately designed components (push-buttons, micro pumps and transport rollers) increase the technical lifespan (by approx. 20 %).
- The devices will be sold (optionally) without external power supply unit, so standardised power suppliers can be (re-)used for commonly used devices.
- The devices are equipped with rechargeable ink cartridges²²⁸ which enable minimum 10 refills.

Requirements on the reduced consumption of material / and waste

- The manufacturers ensure that the devices are able to work with recycling paper and papers with a grammage of 60g/m².
- The collection devise for drip losses/residues of print head cleaning are designed for easy cleaning with low material costs.

In Germany annually approx. 5.8 million inkjet printers are sold²²⁹ (Graulich 2007), each of them printing a little more than 5 kg of paper per year.

²²⁷ A great part of these eco-design options was already proposed in a preliminary study by the consultants (Stobbe 2007). Further options can be found in the documents for the voluntary self-obligation of a sector's participants „Imaging Voluntary Agreement (v3.5).”

²²⁸ In the arrangement of appropriate regulation it is also necessary to take the current knowledge/experience of different types and qualities of refillable cartridges into account, like they are i.a. offered by the Federal Environmental Agency at <http://www.umweltbundesamt.de/produkte/beschaffung/buero/bueromaterial/toner.html>

²²⁹ At a stock of approx. 22.9 Million pieces.

Facing these high quantities, the implementation of the outlined ecodesign options offers relevant waste prevention effects. At an average weight of 4-5 kg per device, a lifespan prolongation of about 20 % would already lead to a reduction²³⁰ of 5,200 t/a. And if the (simplified) possibilities for duplex print increase the use of this option only by 30 %, this measure will lead to a reduction of paper consumption up to 18,000 t/a, respectively, less waste paper.

Environmental impacts

The environmental effects of a generally binding implementation of the waste-preventing ecodesign options can be estimated by comparing the ecodesign scenario with a benchmark case basing on a standard device. A “BaseCase” description, extracted from the preliminary study of the EU Commission (Stobbe 2007) is used for this benchmark case. In reference to the ecodesign options corresponding assumptions are made for their practical application²³¹. Consequently there result the following environmental benefits.

Table 7-18: Annual environmental pollution in connection with printer and paper production and annual saving potential with optimum variants

Parameter	Source (reference data)	CED (GJ/a)	GWP (t CO ₂ -eq/a)
Benchmark case			
Annually distributed printers and consumables	Stobbe 2007	10,328,624	497,265
Saving potential through ecodesign options			
partly no new power supply necessary	EI 2.2	-106,487**	-6,526,041
Cartridge partly refilled*	EI 2.2	-148,950**	-8,670,393
Paper partly duplex printed	Stobbe 2007	-359,362	-5,183,100
Paper partly of low grammage	Stobbe 2007	-299,468	-4,319,250
Lifespan prolongation from 4 to 5 years	Stobbe 2007	-1,759,950	-92,144,000

* only figured as raw material: simplified to 0.02 kg PET and 0.004 kg circuit board (composition of Ord & DiCorcia 2005); without ink

** based on upper calorific value

Combining the prolongation of lifespan and the reduction of paper consumption, annually approx. 100,000 t CO₂-eq will be avoided. The increased production costs for the “more durable” devices and the (logistical) effort for refillable cartridges and standardised power supplies was not taken into account for this calculation. However, relevant opposite/counter-productive ecological effects can be excluded according to estimations of the consultants.

Even if this exploratory assessment might estimate the saving effects a bit too high – because certainly improved devices will reach a greater market share in the course of time, even

²³⁰ Of new devices and with a corresponding delay also of disposable devices.

²³¹ Beside the already mentioned increase of the number of duplex instead of single-sides printed pages of 30 %, it is the assumption that because the standardisation, approx. 30 % of the devices will be sold without new (external) power supply and 50 % of the users take the opportunity to refill the printer cartridges.

without regulating interventions, as well as it will not be to full extent preventable that, e.g. (non-compliant) importers bring unqualified devices on the market – still the estimations remain in a relevant magnitude.

At the same time it has to be noted that inkjet printers here are only a substitution for a much broader product portfolio of the product groups mentioned in the EU Eco-Design Directive. Therefore the waste-preventing/environmental relief effects can be estimated significantly higher²³².

Indicators

As a (meta) indicator concerning the effectiveness of the overall measure, the number of product groups and devices that are covered by the ecodesign requirements, can be taken into account very well.

On a material level the quantitative developments of the different waste product flows (and, if necessary, like in the illustrated case, of the additional components) would have to be observed.

For a proper interpretation of these development, it could be necessary, to consider correction factors for the equalisation of effects based on comprehensive changes in the consumption pattern (in the economic situation) which are not linked to the tightened ecodesign requirements under the implementation of the WP measure.

Another indicator is the course of time of the average lifespan of certain example products. But this would make a specific survey necessary.

Social Effects

Article 15 (5) of the EU Eco-Design Directive (2009/125/EC) includes a number of examination of requirements referring to the proportionality of additional burdens which have to be considered in the course of development and adoption of an implementing measure. Concretely it formulates:

Implementing measures shall meet all the following criteria:

(a) there shall be no significant negative impact on the functionality of the product, from the perspective of the user; (b) health, safety and the environment shall not be adversely affected; (c) there shall be no significant negative impact on consumers in particular as regards the affordability and the life cycle cost of the product; (d) there shall be no significant negative impact on industry's competitiveness;

Through the mandatory recognition of this regulation negative social effects as a side effect of implementing the measure are prevented.

Economic effects

Negative economic effects on the market players and the consumers can be excluded as far as the above mentioned requirements of the Eco-Design Directive on the proportionality of the implementing measure are met.

²³²

Cf. this purpose also the ecological effects of a prolongation of lifespan as explained in the context of the example measure B III 3.3.

For an implementation of the measure there are, of course, certain expenditures for the consultancy of the development (by waste (-avoiding) experts) to be expected. Information quantifying the corresponding expenditures in the environmental administration is not available for the consultants. But in relation to other individual regulations planned, these expenditures should be quite low, because they (only) occur for a consultative support of a running process (not for an initial implementation).²³³

Conclusion

In the view of both, the perspectives to open up synergies of the waste-preventing attempts with specific examination and regulatory processes, as well as the overall rather positive experience of the participating circles while preparing concrete implementation measures (cf. CSES 2011), the implementation of the measure is recommended from a regulatory point of view.

The exemplary assessment of the potential for a product group example confirms that, presumably, relevant waste prevention effects will be achieved by its implementation. Therefore the realisation of the measure is recommended from a material point of view as well.

Recommendation

The example measure is recommended for the implementation.

Example measure B III 1.1: Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive (exemplified by inkjet printers)	
Objectives:	Products not meeting the generally binding requirements on their waste-preventing (resource-saving) design are not allowed to enter the markets. Typical stipulations can be guaranteed minimum lifespan, regulations to limit the use of components or as well guidelines for the reparability of the devices. If quantity-relevant products are regulated, relevant quantities of waste products and other waste-related to the product can be effectively avoided on an EU-wide level.
Characterisation	Support in the determination and implementation of waste-preventing ecodesign requirements for products that will be regulated under the EU Eco-Design Directive → specific example: inkjet printers
Link to measures set out in Study I	(286) Resource Top Runner (FFU Berlin)
Link to Annex IV WFD	4. Promotion of ecodesign
Instrumental character	Regulatory law (directly acting EU regulation)
Initiators	Relevant competent departments and divisions of the Federal authorities.
Addressees	EU Commission → distributors of products
Waste prevention potential	In the case example inkjet printers by a lifespan prolonging design 20 %; 5,200 t/a printer scrap in DE. By an increase on duplex printing of 30 %; 18,000 t/a waste paper in DE.

²³³

The discussion process over the proper arrangement of implementing measures and activities involved does not have to lead in any case to a generally mandatory implementing regulation. The Eco-Design Directive explicitly provides the alternative of self-regulating initiatives as the preferable approach of regulation with the same material effect.

Example measure B III 1.1: Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive (exemplified by inkjet printers)	
Environmental impacts	In the case example inkjet printers by a design prolonging the lifespan 20 % and a 30 % increase of duplex printing up to 100,000 t/a less CO ₂ -eq/a greenhouse effect in DE.
Indicators	Number of product groups that are (beside others) recorded by the waste-preventing implementation measure of the EU Eco-Design Directive. Waste product mass flow rates. Lifespan of products.
Social impacts	No negative social effects.
Economic impacts	Process of determination of implementation measures of Eco-Design Directive guarantee proportionality of measure.
Conclusion	Recommendation from both, systematic regulative perspective, as well as on the basis of quantity potentials that can be opened up.
Recommendation	The example measure is recommended for implementation.

7.3.1.2 Example measure B III 1.2: Support for expansion of the EU Ecodesign Directive to further product groups that have waste-preventing potential (exemplified by upholstered furniture)

Background

In its current form the ecodesign directive is restricted to energy-related products²³⁴ which are distributed in larger quantities on the European market. But already in the course of the discussions on expanding the scope of application from energy-using towards the energy consumption-related products in 2008/2009, some of the Member States and other participating circles demanded that the (regulating authority of the) directive should be extended on all products.

On this account, the following recital was integrated into the 2009/125/EC:

(39) The Commission should, based on the experience gained from applying this Directive, Directive 2005/32/EC and implementing measures, review the operation, methods and effectiveness of this Directive and assess the appropriateness of extending its scope beyond energy-related products. Within that review, the Commission should consult Member States' representatives as well as concerned interested parties.

In preparation of the discussion coming up in 2012/2013 on the (renewed) revision of the Eco-Design Directive, the EU Commission has commissioned a corresponding evaluation study (CSES 2011). In this study a possible extension of applicability was analysed.

As a result, i.a. a row of product areas and groups being quantity-relevant were identified that presumably have a significant potential of environmental relief by redesigned products²³⁵ and that are not covered by scope of the Eco-Design Directive, yet.

²³⁴ Article 2 "Definitions" of the 2009/125/EC defines: 'Energy-related product', (a 'product'), means any good that has an impact on energy consumption during use which is placed on the market and/or put into service, and includes parts intended to be incorporated into energy-related products covered by this Directive which are placed on the market and/or put into service as individual parts for end-users and of which the environmental performance can be assessed independently.

²³⁵ As an indicator i.a. the question was used, whether ecolabel requirements exist for the particular product.

Table 7-19: For an expansion of the EU Eco-Design Directive relevant product areas/groups (CSES 2011)

Product areas	Relevant product groups
Food	All types of food products (e.g. dairy products, meat products, frozen food products, ...)
Consumer products	Clothing and shoes, furniture, home textiles, tools, paper products, sport equipment,... and a row of sanitary and hygienic products
construction products	Wallpapers and carpets from wood, ceramics and other (textile) materials as well as colours, glue and sealants
Commercial (primary) products	Paper materials, textile primary products, primary products of metal and/or synthetics, tools and chemical products
Mobility products	Cars, trucks, wagons and locomotives, air-planes and ships as well as (spare) parts of these products

For five selected product groups²³⁶ the effects of possible ecodesign measures were analysed in detail. Thereby virtually non-stop a relevant potential of environmental relief was stated so that the issue of generally binding ecodesign requirements was estimated as a comparably efficient and very effective regulatory concept for the development of this potential. Still, the consultants of CSES see an overlapping with existing environmental standards and regulations so that they do not give an explicit vote for an expansion of the scope at the end of their analysis.

But a detailed consideration (Jepsen, Spengler 2012) shows that the presumed double-regulations are based on the lack of detailed knowledge of scope and/or matter of regulation of other environmental standards.²³⁷ This means that from a professional point of view there definitely is the opportunity/necessity for (complementary) ecodesign activities.

Regarding this, in the next months the discussion on chances and/or risks of further expanding the regulatory authorisation of the EU Eco-Design Directive will have to be lead in Germany as well as in Brussels.

In the framework of the proposed WP measures, those who are responsible for the coordination of the German waste prevention activities should review, whether and how this process can be supported with professional arguments and facts. In the following it will be illustrated on the example of upholstered furniture, which aspects and effects would result for this product group from expanding this regulation under reservation.

Objectives

After an expansion of the regulating authority of the EU Eco-Design Directive, waste-preventing ecodesign requirements can be formulated for other product groups – like e.g. for upholstered furniture. As a result, these ecodesign requirements should be implemented for every devices placed on the European market. With this wide impact, noticeable waste-preventing and environmentally relieving effects shall be gained.

²³⁶ Examined were sausages, clothing, different floor coverings, all-purpose cleaners and passenger cars

²³⁷ This was already presented towards the EU Commission in this form in a joint subjective statement of BAM and UBA.

Characterisation

The WP measure is that the Federal government actively examines how the specific regulative opportunities given by the EU Eco-Design Directive (keywords: product-specific approach, systematic professional-technical consideration process in exchange with the market players, option on differentiated choice of regulation instruments [mandatory minimum standards, self-regulation, labelling] and direct EU-wide binding effect) can be integrated into comprehensive efforts/planning for to prevent waste.

In case of a positive examination result²³⁸, the expansion of the regulatory authorisation of the Eco-Design Directive will be supported by concrete facts and examples, which will be fed into the corresponding coordination processes.

For upholstered furniture such an example could be outlined as the following:

In Germany annually approx. 10 Million upholstered pieces of furniture are distributed²³⁹. This product group is (not yet) addressed by specific product-related regulations.

A possible measure during the implementation of an extended EU Eco-Design Directive could formulate the following minimum standards for upholstered furniture distributed on the European market:

Requirements on intensifying the prolongation of lifespan/usability (reduction of waste quantities):

- The upholstered furniture has to be designed in a way that the exchange of covers is easy to handle.

Requirements on the maximum contents of pollutants (depollution):

- The upholstered furniture brought on the market may not contain SVHC listed in the candidate list of REACH.
- The distributed upholstered furniture may not contain high-polish chrome-plated components.

Requirements on the reduction of environmental burdens during the disposal:

- Wooden frames or similar wooden components have to be designed in such a way that they can be separated from the rest of components during the pre-treatment.
- The wooden parts of distributed upholstered furniture have to be free of substances which affect the wood recycling.
- Except from defined functions, the components of the distributed upholstered furniture have to be free of halogenated organic compounds (e.g. organ chlorinated carriers in textiles).

²³⁸ This is to be expected according to the experts' estimation.

²³⁹ Due to missing reliable market analysis, this is a conservative estimation based on corresponding survey of market players (KEMI 2009)

Initiators and addressees

The initiative for the implementation of the measure should be taken by the departments and divisions of the Federation responsible for the implementation of waste prevention activities, in coordination with those responsible for accompanying the implementation of the EU Eco-Design Directive.

In the first instance addressees are the EU Commission and the EU Parliament in the course of the agreement on an expansion of the regulating authority of the Eco-Design Directive.

Thereafter the EU Commission in its function of proposing suggestions and decrees of implementing regulations in the framework of the EU Eco-Design Directive.

In the end, addressees of the mentioned implementing regulations will be manufacturers of upholstered furniture and here especially importers as the “distributors” of the regulated products.

Waste prevention potential

Some of the outlined ecodesign measures support the potential extension of the average lifespan/durability of upholstered furniture by:

- increasing the maintainability/reparability of essential components – in the specific case the option to exchange (or e.g. wash) the upholstery's covers easily (e.g. with suitable zip, or hook and loop fasteners).
- providing replacement options for potential wear parts – in the specific case e.g. for the legs of the upholstered furniture.
- supporting/demanding a selection of solid and lasting basic components – in the specific case, e.g. by suitable size and selection of connecting parts of the base frames of the furniture.

Achieving through this measure that the average durability of upholstered furniture is extended by only 10 %, with the average weight of 60 to 65 kg, the waste-reducing effect would ²⁴⁰ be 12,500 t/a.

Under the assumption that in a part of the distributed products, especially in the foam of the upholstery, particularly alarming substances (SVHC) are deployed²⁴¹, corresponding estimations²⁴² result in a possible depollution of approx. 1,000 t/a.

Further waste-preventing effects would result from the other outlined ecodesign requirements (e.g. the avoidance of harmful substances in hazardous waste from chrome-plating processes). But in the course of exploratory estimation, these effects can only be quantified insufficiently.

²⁴⁰ Or rather it is assumed that only for 10 % of the products the lifespan is extended by the reparability.

²⁴¹ This is especially in the area of flame retardant (e.g. in reference to HBCDD the case), since in some regions of the world (and in specific applications as well in some EU state, e.g. UK) corresponding requirements on the flame retardants of upholstered furniture are demanded.

²⁴² Estimation over 5-10 % m/m in the foam of approx. 25% of the merchandised products which is reduces on 0 % m/m by the implementation

Environmental impacts

For the orientating quantification of environmental impacts, an average standard upholstered furniture as referring case is assumed, and arithmetically compared with a product that is optimised in terms of waste prevention by the implementation of the ecodesign requirements.

The standard upholstered furniture²⁴³ of an average weight of 62.3 kg consists of the following: wooden frame 70 %, steel springs 5 %, polyurethane foam filling 20 %, polyester wadding 3 % and cover 2 %.²⁴⁴

The environmental impacts result like outlined in table 7-20.

Table 7-20: Annual environmental burdens in connection with the sofa production and annual saving potentials with an optimised variation

	Upholstered furniture [piece/a]	CED [MJ/a]	GWP [kg CO₂-eq]
Standard upholstered furniture			
Burdens from production and disposal of the annually sold sofas	4.000.000	7.881.366.183	325.893.095
Optimised upholstered furniture			
Burdens from production and disposal of the annually sold sofas	3.800.000	7.566.733.175	315.420.897
Saving potential annually		314.633.009	10.472.198

* based on upper calorific value

Optimising the design saves annually 0.3 Million GJ primary energy and 10,000 t CO₂-eq, because, due to prolonging the lifespan (e.g. by the demanded option of replaceable cushions), annually approx. 200,000 upholstered furniture less are distributed and therefore not have to be disposed.²⁴⁵

Further effects - like outlined before - cannot definitively be quantified, because the development of their prevention and/or relief effects also depends on how far recording and treatment structures for waste furniture can be adjusted to the altered composition of the products.

²⁴³ Modelled as typical two-seater sofa by IFEU

²⁴⁴ The materials are approximated with modules from the Ecoinvent database (2012). Solely the cover is modelled according to an IFEU data record. The environmental impacts for constructing the sofa with these individual materials is not contained though they should be of no consequences in relation to the materials. The burden of the disposal is approximated by the Ecoinvent modules. Since Ecoinvent gives no credits for electricity and heating generated by incineration, the credits are also modelled according to the caloric value of IFEU.

²⁴⁵ The exchange of upholstery is considered in 10 % of the sofas. However, this is an optimistic estimation, because on one hand, also present sofas could have replaceable upholstery, and on the other hand, because prolonging the lifespan will only then come to full effect, when the market is saturated.

By a design that allows a material recovery of the wooden frames in the sofas, the resource wood, e.g., would be protected. Not recovered quantities of wood could, because of their low concentration of pollutants, for instance be directed towards an efficient utilisation. By now, the wooden parts of sofas usually are burned in the waste incineration plant, so only a less efficient utilisation of the energy stored in wood takes place.

Decreased halogen intakes in general reduce the flue gas purification demand in the thermal disposal plants, but here as well, a direct causal chain from upholstered furniture design to environmental relief is only possible by complex assumptions and system analysis.

Indicators

As (meta) indicators for the effectiveness of the overall measure the number of product groups and devices that are covered by pertinent waste-preventing ecodesign requirements, can surely be taken into account.

On a material level the quantity development of each waste product flow has to be observed.

For a proper interpretation of these development, it could be necessary, to consider correction factors for the equalisation of effects based on comprehensive changes in the consumption pattern (in the economic situation) which are not linked to the tightened ecodesign requirements under the implementation of the waste prevention measure.

Another indicator, though it would have to be collected specifically, is the course of time of the average lifespan of certain example products.

Social impacts

Article 15 (5) of the EU Eco-Design Directive (2009/125/EC) includes a number of examination requirements referring to the proportionality of additional burdens which have to be considered in the course of development and adoption of an implementing measure. Concretely it formulates:

Through the mandatory recognition of this regulation negative social effects as a side effect of implementing the measure are prevented.

Economic impacts

Negative economic effects on the market players and the consumers can be excluded as far as the above mentioned requirements of the Eco-Design Directive, on the proportionality of the implementing measure, are met.

For an implementation of the measure there are, of course, certain expenditures for the consultancy of the development (by waste (-avoiding) experts) to be expected.

In the current analysis of a potential expansion of reserving the regulation to the Eco-Design Directive, the necessary additional resource expenditures on all levels of the administration (from EU Commission via the ministries of the participating countries to the market surveillance) as well as for the involved stakeholders of a market, is discussed as an important obstacle to such an implementation (cf. CSES 2011).

According to the estimations of the consultants such a resource discussion, referring solely on the efforts for a single regulation instrument (here: the existing Eco-Design Directive), is

not broad enough. If waste prevention shall be implemented effectively, the possibilities of a much targeted regulatory intervention on the product design cannot be given up. For this, on any rate, there will be an appropriate (administrative) effort necessary. This effort will definitely be less, if the additional task are integrated into existing instruments and established procedures and as if, for example in a more narrow field like the regulations of the waste legislation, new (and unavoidably in many cases parallel) instruments and procedures would have to be created and maintained.

Information for quantifying the corresponding expenditures in the environmental administration, are not available for the consultants.

Conclusion

In consideration of the possible perspectives, to develop synergies between the waste-preventing attempts and concrete running examination and regulatory processes of the product policy and, because of the overall rather positive experience of the participating circles while preparing concrete implementation measures (cf. CSES 2011), the implementation of the measure is recommended from a regulatory point of view.

The exemplary assessment of the potential for the product group example of upholstered furniture confirms that, presumably, relevant waste prevention effects will be gained by its implementation. Therefore the realisation of the measure is recommended from a material point of view as well.

Recommendation

The example measure is recommended for the implementation.

Example measure B III 1.2: Support for expansion of the EU Ecodesign Directive to further product groups that have waste-preventing potential (exemplified by upholstered furniture)	
Objectives:	By an expansion of the regulating authority of the EU Eco-Design Directive, waste-preventing (resource saving) ecodesign requirements can be formulated for other product groups. Products that cannot meet these requirements may not be distributed. If quantity-related products can be regulated this way, EU-wide relevant waste product volume and other waste linked to the product can be prevented effectively.
Characterisation	Support of the expansion of regulating authority of the EU Eco-Design Directive on all products and formulation of waste-preventing ecodesign requirements on volume of waste of relevant product groups specific example: upholstered furniture
Link to measures set out in Study I	(286) Resource Top Runner (FFU Berlin)
Link to Annex IV WFD	4. Promotion of ecodesign
Instrumental character	Regulatory law (directly acting EU regulation)
Initiators	Related competent departments and divisions of the Federal authorities
Addressees	EU Commission → distributors of products
Waste prevention potential	In the case example upholstered furniture by a design prolonging the lifespan 10 %, 12,500 t/a in DE. By depolluting upholstered furniture from particularly alarming substances of approx. 1000 t/a.

Example measure B III 1.2: Support for expansion of the EU Ecodesign Directive to further product groups that have waste-preventing potential (exemplified by upholstered furniture)	
Environmental impacts	In the case example upholstered furniture by a prolongation of lifespan up to 10,000 t/a less CO ₂ -eq/a in DE.
Indicators	Number of product groups that are (beside others) recorded by the waste-preventing implementation measure of the EU Eco-Design Directive. Waste product mass flow rates. Lifespan of products.
Social impacts	No negative social effects.
Economic impacts	Process of determination of implementation measures of Eco-Design Directive guarantee proportionality of measure.
Conclusion	With the measure the regulating authority for examination and implementation of mandatory waste prevention measures can be extended on other relevant product groups. Hereby a regulative instrument for the entire width of products would be available.
Recommendation	The example measure is recommended for the implementation.

7.3.2 Measure B III 2: Information dissemination and awareness-raising for waste-preventing product design

The process of development of products is very complex, as there has to be a multitude of different and partly contradictory stipulations on the future product, such as

cost aspects, conversion of the technical production, functionality, shape language, availability of components et al.

that have to be considered and transformed to a sustainable solution.

The consideration of environmental aspects in general and waste prevention aspects in particular, is therefore only one of many requirements. Although these requirements today appear more often in the related catalogues of the product development specifications, but the practitioners report repetitively²⁴⁶ that in the daily routine of product development, they are still on a secondary level and therefore often not considered systematically in the course of the (necessary) reduction of complexity.

Beside the corresponding setting of priorities by the clients, this is also due to the (still in many cases) insufficient knowledge of constructionists and development engineers, about which concepts and instruments are available, to make quick decisions in the right direction that meet the environmental requirements.

For other typical decision problems during the conception and development process of complex technical products (e.g. the optimisation of installation space), the development engineers have methodical concepts and acquired instruments, so that they can be worked out “easier” and with priority.

Measure to strengthen the integration of waste prevention aspects into the autonomously directed product development processes of companies, should take the identified difficulties in account in and offer appropriate solutions.

²⁴⁶ Personal contributions of industry designers in frame of the network-meetings “Umweltfreundliche Produktentwicklung Hamburg” [environment-friendly product design Hamburg] (IPP Hamburg 2012)

7.3.2.1 Example measure B III 2.1: Dissemination of information on waste-preventing product development

Background

For the waste-preventing design of everyday products “simple” solutions rarely exist. Moreover, the desired characteristics of product like durability, reparability, upgradability or as well reduction of the variety of material and harmful substances, are in conflict with other development targets. Partly, even the waste-preventing and often contrary stipulations have to be balanced out.

Waste prevention therefore has to be “present” during the whole development process, if it shall not be “dropped” from the result of the various consideration processes for different design options. For this reason, all attempts to implement the environment-friendly/waste-preventing product design as a further step of the process, will have little prospect of success.

To be anchored “in the middle” of the development process, the waste prevention aspects therefore have to be implemented by persons who are involved into the “normal” development process.

The development engineers will need clear concepts for this and simple guidance that connects directly to their usual approach. Such supporting material cannot solely be developed by “external” environmental experts, rather only in close cooperation with the various domain experts²⁴⁷. Above this instruments and concepts normally should never be developed in a way that they could be implemented without a further feedback from the practitioners²⁴⁸.

In the result this means that for an effective support of the operational practitioners it is necessary to build up intense cooperation's with environmental and waste prevention experts, so stable, practicable and sustainable solutions for a waste-preventing product design can be established.

Objectives

With an effective support of the operational practice, the possibilities of autonomous implementation of waste-preventing product concepts shall be spread so that corresponding options can be realised and examined as routine in all “normal” development processes. In this way an enormous broad effect of the measure can be met.

Characterisation

In the course of the measure governmental authorities should initiate and support the cooperative preparation and implementation of practical concepts and guidance for a waste-preventing product design which is supposed to be developed in collaboration between waste-preventing experts and product designers.

How this could appear can be illustrated in practical examples.

²⁴⁷ I.e. specifically of constructionists and industry designers and environmental scientist

²⁴⁸ This practical experience of management consultancies can largely be adopted, regardless the matter of topic

In particular the activities on the Integrated Product Policy (IPP) in the Federal States Bavaria and Hamburg can be named as an example.

While IPP Bavaria, as an activity of the Environmental Pact Bavaria (Umweltpakt Bayern) following the concept of the IPP, includes a wide range of different activities on the product-life-circle and above this, is constituted particularly through various operational pilot schemes²⁴⁹, the current implementing project environment-friendly Product Design [Netzwerk Umweltfreundliche Produktentwicklung (IPP Hamburg)] focuses, as the name suggests, very practical on the stage of product development.

The Hamburg project is composed of a number of interacting activities:

- To qualify, consulting industry designers and development engineers, but also developers of companies from Hamburg have the opportunity to participate for several days and free of charge in information events. In the information workshops, concepts and instruments of the ecological product evaluation will be explained and possibilities for an integration of these tools into the daily routine of development are subject of discussion.
- Companies using the consultative service of the qualified designers and product developers get up to 2/3 of the originating cost refunded by the municipality. The collaboratively performed analysis, planning and realisations are documented.
- During the narrowly clocked work meetings and workshops on the subject, but also in between these meetings, the consultants and the responsible decision makers have the opportunity, to exchange their questions and to get a feedback from specialised experts for environmental evaluation and science.

In addition, incentives are given to companies with big events for public relation purposes and a design competition, to access the grown competence of the local developers and designers for their further implementation projects.

The experiences to date show that, in particular by the integration of the (consulting) Industry designers and construction engineers who understand the additional competences on environment-friendly/waste-preventing product development as an enlargement of their scope of action, a self-directed process is created. During this process those core stakeholders manage the highly important transfer between scientific concepts and practical, operational implementation.

Initiators and addressees

The initiative comes from governmental authorities (in the mentioned cases on the federal level) in interaction with corresponding comprehensive cooperation activities in partnerships with the economy (in Bavaria through the Environmental Pact, in Hamburg through the Environmental Partnership). This ensures an acceptance and credibility.

As explained, the addressees are not solely the companies, but also the domain experts supporting the companies in the day-to-day business plus the domain experts, scientists and

²⁴⁹

cf. <http://www.ipp-bayern.de/content/content2.php?CatID=1&NewsID=65&lang=de>

other multipliers²⁵⁰.

Waste prevention potential

Since in the first instance the measure aims on an implementation of the cooperatively developed concepts and instruments for the day-to-day procedures, and not on single, temporary implementation activities, naturally a quantification of the waste prevention potential cannot be carried out. But in principle, possible potentials can be disclosed by the activities on a large scale. If they will be implemented into the daily operational routine in the autonomy of the market players, will, last but not least, depend on the status of the waste prevention as an optimisation target compared to other possibly competing targets.

To transform the “latent” potential which grows on the training of the practitioners into a realistic potential, it will be necessary to generate both, an appropriate “push”, e.g. by generally binding stipulations or clear price signals, as well a “pull” by, i.a. induced stimulation on the demand (environmental labels, public procurement, promotion).

Environmental impacts

Since, like outlined, currently the competence for identification of possible environmental impacts and consideration of counterproductive effects that might occur is taught, a fundamental malfunction with overall negative effects can be excluded.

Naturally unbalanced and counterproductive decisions of autonomous economic stakeholders could be made. But by implementing the measure, the risk is diminished, not increased.

Indicators

The success of such broadly effecting activities carried out in the autonomy of the market players can naturally only insufficiently be surveyed with simple indicators. Therefore it is even more important that a consulting, but in particular a follow-up evaluation of such programmes becomes a constant part of all promotional and support activities. Specifically the operational consultancy/implementation reports, e.g., would have to be evaluated. Also, in intervals of some years, the status of implementation would have to be sought. Additionally it would be necessary to interview the participating actors over the course of time about their practical experience.²⁵¹

Social impacts

In general it can be assumed that such networking and qualifying activities strengthen the innovation and cooperation abilities of all participants in a way that effects on employment are to be expected.

Many people experience strong contradictions between the production pattern of their working environment, sensed as environment damaging, and the values of their private life.

²⁵⁰ I.e. the representatives of chambers, trade and professional associations and other self-organisations of the economy

²⁵¹ Hereby particularly “unexpected” transfers in totally different regions or branches and the reasons for a possible failure would have to be asked in open questions.

The opportunities, which are created with this measure to bridge this gap, are recognised as very positive and therefore increase the job satisfaction.

Economic impacts

The effects of such autonomously implementable measures supporting the innovation ability on individual economies can, however, be estimated as positive.

The question about the impact efficiency of the invested public funding is difficult to evaluate across-the-board. It will surely increase the efficiency, if various elements (like e.g. in the outlined project in Hamburg) are combined, so the individual concerns of the stakeholders are stimulated, and self-supporting processes can be installed. However, it may not be ignored that the development and care of stable and effective cooperation structures usually need the function of the network promoters over a longer period. The work of the network promoters has to be (co-) financed by public funds.

Conclusion

Since autonomous and qualified activities towards waste-preventing, environment-friendly product innovations are indispensable to reach the greater targets, the further and reinforced initiation and support of the outlined cooperative activities of qualification, development and transfer are recommended by the consultants.

As outlined, it has to be particularly taken care that clear controlling impulses are given by additional (higher-ranking) parallel running measures in order to make the realisation of waste-preventing options in their product development comprehensible for the individual market players.

It has to be added that currently on the federal level virtually no structures or initiatives exist being capable of supporting the information and experience exchange on waste related product optimisation. The existing structures address either mainly to the demand („sustainable consumption“), the optimisation of the manufacturing procedures (material efficiency agencies and related measures), or they are focussed on optimising the energy efficiency of products.²⁵²

Cooperative activities surely are anchored correctly on the regional level, comprehensive support is necessary for the preparation, the exchange of experience and the publication of successful concepts.

Recommendation

The example measure is recommended for the implementation.

²⁵²

In the formulation of this observation the consultants do not misconceive the circumstance that many promotional activities (e.g. in the field of the BMU Environmental Innovation Programmes or in the field of material and resource efficiency activities) are absolutely open for product innovations. But inside these structures in actuality it is lacking of a “thematic care-taker” with the view for the characteristics of a situation.

Example measure B III 2.1: Dissemination of information on waste-preventing product development	
Objectives:	The presentation of options of economic and ecological advantages shall give incentives to the market players to implement more waste-preventing product design on their own responsibility. In particular the description of a specific, systematic approach in the analysis of the current situation and in the decision for possible improvement measures, the implementation, because inside each of the commercial enterprises / trade store or supply chains, a larger number of decision-makers have to be coordinated.
Characterisation	Governmental administrations initiate and promote the creation of basic information and/or concrete functional presentations of the potentials, the opportunities and the specific implementation of a waste-preventing product design.
Link to measures set out in Study I	(182): Consulting Programme for Ecodesign (Hamburg) (227): Cradle to Cradle
Link to Annex IV WFD	4. Promotion of ecodesign
Instrumental character	Promotion
Initiators	Governmental administrations in collaboration with cooperation activities of the economy.
Addressees	Product designers, producers and trade store chains.
Waste prevention potential	Because of the large scale of the measure, not to be estimated, but potentially great broad effects.
Environmental impacts	No negative environmental impacts expected.
Indicators	No direct indicator. Evaluation through consulting reports and status quo of the implementation (number of spread/retrieved information, degree of concretion of the information)
Social impacts	Promotes the innovation and cooperation. Promotes, as the case may be, the reduction of contradictions between job and private values.
Economic impacts	Develops new markets, supports impulses for innovation
Conclusion	Autonomous and qualified activities are indispensable to reach the greater targets; additional and stronger initiation and promotion of the outlined collaborative qualification, development and transfer activities are recommended. Additional parallel implemented measures as controlling impulses are necessary.
Recommendation	The example measure is recommendable for the implementation.

7.3.2.2 Example measure B III 2.2: Efforts to raise awareness of waste-preventing product innovations by means of public awareness activities (competitions, awards)

Background

Like outlined in the example measure B III 2.1, it is important to give suitable incentives to stimulate economic stakeholders to an autonomous implementation of activities.

Especially an “officially” recognised environmental “front-runner” status is for many companies today of high value. It helps them to communicate the environmental commitment that is (at least latently) claimed by the consumers.

Above this “good examples” extent the possibilities for as feasible accepted measures and therefore the room for manoeuvre for suggestions of optimisation in similarly positioned product areas.

Objectives

With the offer of public relation activities like competitions of award environment-friendly/waste-preventing product designs the following objects shall be achieved:

- visualize good (environment-friendly/waste-preventing) product solutions at the market, and therefore set a new scale of values for the usual market offer,
- increase the creativity potential in the development departments of the enterprises and/or their advising industry designers in respect of “clever” future-oriented product solutions
- encourage the persons responsible for products within the enterprises to „think“ about possible modification of the product range,
- sensitise procurement managers of the commercial trade business, but also of the public sector and/or in large-scale enterprises.

Finally in this way both, the supply as well as the demand shall be supported by waste-preventing/environment-friendly product solutions.

Characterisation

In the course of this measure governmental administrations should organise public invitations for competitions in which especially (innovative) environment-friendly, in particular waste-preventing product developments will be awarded.

A measure like this can be realised in the context of regional collaboration and support measures (cf. BIII 2.1). Such is e.g. the case in the Hamburg network for environment-friendly Product Design (IPP Hamburg).

But it can also happen on an overarching (federal) level. The Federal Award for Ecodesign²⁵³ can be raised as a good example here.

With the funds of the Environmental Research Plan, the BMU has, supported by the UBA, worked out the basic conception for this competition that was held for the first time in 2012 and that has the following target:²⁵⁴

“It is the aim to promote innovations and support the market launch and diffusion of ecological products with a publicly recognised award. On the side of the consumers the acceptance of ecological design will be promoted and the ability to make decisions and take actions will be increased.

The Federal Award Ecodesign wants to contribute to free ecological products from their niche existence and establish ecological design in the everyday culture. Above this a space for discussion on and general understanding of ecological design in its various manifestations shall be created plus the topic positioned stronger in the public.”

The competition follows an open approach after which, beside practical products, also concept studies and prototypes can be submitted. Immaterial services and systems providing e.g. the same utility as material goods can also be submitted.

²⁵³ Cf. <http://www.bundespreis-ecodesign.de/de/ecodesign.html>

²⁵⁴ Extract of announcement from the internet presence

Rating the participant's contributions a criteria matrix is applied, which specifies requirements on environmental protection and sustainability for the different steps of a life cycle of a product. The central options of a waste-preventing product design (from miniaturisation over modularisation / reparability up to the prevention of waste during the distribution and usage phase) are, besides other aspects, included in this matrix.

A given weighing of the different target dimensions is disregarded, but it is expected that the participants of the competition define their thoughts on solutions for possible time conflicts in the application documents.²⁵⁵

The award is given by a jury of professional experts and the public ceremony takes place in autumn 2012 at Berlin.

Above this, all awarded competition contributions will be presented in an online exhibition on the website. Subsequent to the award ceremony an additional a touring exhibition accompanied by a publication is planned. In the competition announcement this is explained more detailed²⁵⁶:

“The exhibition and the publication will present the awarded competition contributions, but above this explain ecodesign as a design approach more detailed.

The exhibition is supposed to be presented in cooperation with various institutions on the level of the individual Federal States over the period of one year in the public throughout the whole federal territory. Accompanied is the exhibition by events that deal with the subject of ecodesign.”

Currently it is in planning to repeat the competition activities in the year 2013. If and in which way a prolongation is possible after that, is not decided, yet.

Initiators and addressees

The initiative for such public (competition) activities should come from governmental administrations, because the independence from (individual) economic concerns is a major factor regarding the credibility.

Addressees are product manufacturers as well as free-lancing product designers, who contribute to the competition with their concepts and implemented projects.

Waste prevention potential

According to the consultants the measure, like defined preliminary, has to be understood in particular as an accompanying support activity and therefore addresses a waste prevention potential which apparently exceeds the possible effects of the practical competition contributions.

The extent of the overall potential cannot be indicated precisely. Whether this potential can be “increased” or not, will, beside the effectiveness of the “merchandising” of the competition, in particular decide on the success of the combination with other activities for a waste-preventing product design.

²⁵⁵ Here is a close link to the qualification activities of example measure B III 2.1

²⁵⁶ Cf. <http://www.bundespreis-ecodesign.de/de/ausstellung.html>

But in general, it will have to be observed, which status the waste-preventing design options achieve in the contributions for the competition at all. Facing the currently great attention on energy efficiency and resource/material efficiency in the public environment discussion, it is just as well likely that other ways of optimisation will come to the fore.

Against the background of the last-mentioned question, from the consultative point of view, it seems to be worth considering, whether or not there should be a special valuation inserted in the next competition announcements for specifically waste-preventing contributions under referring to the national intentions of waste prevention (waste prevention programme).

This would allow to focus the attention on this mainstream subject and to present “good examples” for the solution of possible conflicts of objectives²⁵⁷.

Environmental impacts

Since, like outlined, especially the consideration of counterproductive effects that might occur will be matter of the assessment of the participant's contributions, a fundamental malfunction with overall negative effects can be excluded.

Indicators

The success of such a competition for a short term is certainly measured by the number and the quality of the submitted contributions and, if so, further related indicators like the media presence that is achieved.

On the other hand, the more relevant “indirect” effect by the spill over of the competition on other activities for a stimulation of self-supporting activities for waste-preventing product design and purchasing decisions is almost impossible to calculate.

Social impacts

In general it has to be assumed that such an activity, which is build on the rewarding creativity and aims on product innovations and the diffusion of markets, has only positive social effects.

Economic impacts

Despite the efforts involved, the effects on the stakeholders of the individual economies who participate in such public (competition) activities are estimated to be positive. The involved efforts are accomplished by internal, possibly new developed, innovation potentials. Besides that, because of the public attention for the topic (of the competition), on one hand the merchandising of the innovative products will be supported, and on the other hand the brand name will be linked to a topic, which is connected to a positive image (brand-image-forming).

The question about the impact efficiency of the invested public funds again is difficult to be evaluated across-the-board.

²⁵⁷

In fact and then again, the waste-preventing product design is a high number of possible directions for optimisation which have to be balanced out on each other; e.g. lightweight construction, material savings vs. avoidance of harmful substances

With a professional implementation and “merchandising” such a competition related to the invested public funds can present a very positive cost-benefit ratio. In the end this will decide over the leverage effect of the invested funds, i.e. with which amount of initiating and execution effort for the competition can how many companies be activated to start own activities and, if appropriate, bring them into the competition?

Conclusion

The implementation of such public (competition) activities that, above all, support other waste prevention activities, is in the opinion of the consultants on any rate conducive. But it is necessary that funding for a professional “production” is provided adequately and/or made “available”, as the support effect depends to a great extent on the external effect of the activity.

According to the consultant's estimation, above this it is recommended to examine, whether the waste prevention receives additional weight in the framework of the evaluation criteria and/or in the course of a “special” rating. Above this, a possibility for continuation would have to be found. Because in the context of a medium-term waste prevention programme, also for such supporting/consulting activities, a little “longer wind” seems to be necessary, if an interaction of diverse waste prevention measures is supposed to work well.

Recommendation

The example measure is recommended for implementation.

Example measure B III 2.2: Efforts to raise awareness of waste-preventing product innovations by means of public awareness activities (competitions, awards)	
Objectives:	The competition gives incentives for a further implementation of the waste-preventing product design in the individual responsibility of the market players. If the developed product solutions are integrated in the merchandised products by subsequent steps of the companies, corresponding waste prevention (environmental relief) effects result.
Characterisation	Governmental administrations initiate (where necessary in cooperation with economy organisations) and promote the realisation of ideas and implementation competitions for a waste-reduced, pollution-less and/or resource-saving product design.
Link to measures set out in Study I	(93): Award Recycling Design
Link to Annex IV WFD	4. Promotion of ecodesign
Instrumental character	Promotion
Initiators	Governmental administrations, autarchic
Addressees	Product manufacturer, free-lance product designers.
Waste prevention potential	For the overall measure, not to be estimated. Gives rather impulses in the way of consulting, supporting activity. Aims in the first instance not directly on waste prevention
Environmental impacts	For the overall measure, not to be estimated. Benefit for corresponding activities by means of public relation.
Indicators	Quality of the submitted contributions, media presence. Possible indicators for the actual intended effect (degree of innovation incentives, number of imitations et al.) are hardly practicable.

Example measure B III 2.2: Efforts to raise awareness of waste-preventing product innovations by means of public awareness activities (competitions, awards)	
Social impacts	Promotes the innovation and collaboration. Promotes, as the case may be, the reduction of contradictions between job and private values.
Economic impacts	Develops new markets, supports impulses for innovation
Conclusion	Conductive, provided that “professional production” is performed. Waste prevention should be awarded additionally in the framework of the waste prevention programmes
Recommendation	The example measure is recommended for the implementation.

7.3.3 Measure B III 3: Adoption of (sub-statutory) rules and regulations in support of waste-preventing or resource-conserving product design

Background

In the phase of product design it is essential to set the course for the further product life and the lifespan. The waste volumes that result from production and consume can effectively be reduced by certain quality requirements. At the same time by quality requirements the material, resource and energy efficiency of products can be decisively improved. Thereby, in an interaction of further measures on prolongation of lifespan and/or utilisation intensity (e.g. extension of warranty, product resource tax, support of inexpensive repair options), waste prevention potentials can be developed. These measures are even more effective, the more the technical functionality of the device is increased, the less fashion aspects are considered.

For devices like mobile phones, of which some versions of the low and medium price range almost became objects of consumption as addition to the contract in the framework of charging conditions of the telephone companies, further measures have to regulate the frame conditions. Modifying contracts for mobile phones though, need to be assessable according to the sub-statutory regulations of Art. 2 I GG. It has to be reviewed here, whether the measures would harm the general freedom of contractual design in terms of the principles of autonomy of individuals.

Above this, the currently existing measures in the field of social projects for the recovery of such devices in developing countries and for the preparation of a high quality recycling, will be of increasing importance for such products. High priced smart phones, which are advertised as fashion products with high identification value though, today are already objects of consumption in the sale offers of the mobile telephone companies or are dealt on internet market places.

By quantitative requirements for upgrading, recycling ability and reuse, as well as reparability, the lifespan of products can be addressed directly. This has an impact on the primary and secondary product-life-cycle. Through higher requirements on the product quality which address in particular – but not exceptional – the waste prevention aspects, an increase on the resource and energy efficiency will be achieved. These efficiency improvements have an impact on the overall life-cycle costs. The waste volumes, in particular of complex goods, like electronic articles, IT products, cars et al., but also simple

products like furniture, could thereby crucially be reduced²⁵⁸, which is due to both, a longer and more intensive use of the devices by their first users, as well as by a higher chance for a “second life” of the products²⁵⁹.

Besides, product design is crucial for the recycling and reuse options with or without preparation measures. The product design and the way of construction, e.g. by means of modular construction and the availability of replacement parts essential for a later option of upgrading and repair.

Another central aspect having an effect on the lifespan is the so called planned obsolescence. Thereby intentional weak points and predetermined breaking points are built in, preventing a further use after a certain period of time, or make it uneconomical. In this context also the ways of construction are discussed, where repairing is unprofitable, because of the high follow-up cost (cf. for this chapter Measure C VIII 6: Supporting research and development of measures to increase the utilisation intensity).

Waste-preventing regulations, laws and standards

Waste prevention measures by laws and regulations which start already in the phase of product design can help to prevent potentially waste quantities at a later time. Relevant measures in this field by legal guidelines on one hand direct the obligation of warranty of the producers/retailers in a way that in the result the product-life-cycle is extended and at the same time give incentives to the manufacturers/retailers to avoid products of low-grade quality from the start.

On the other hand measures are suggested that create certain qualitative and quantitative standards and guidelines (e.g. extension of the minimum durability, modular construction et al.) on products. These standards display direct references to the EC Eco-Design Directive and shall by the EU-Top-Runner-Approach be complemented. In addition to this the regulations for binding return and repair options shall support this measure.

The target waste which should be avoided in relation with this measure refers on one hand to waste on the production side as well as on the reduction of waste on the consumer side (waste-products). These measures shall contribute to extend the product-life-cycle respectively to enable a second life-cycle through repair and second-hand markets. The desired effects of these measures can be flanked by further measures in the social-political field respectively by qualification measures on the labour market (e.g. promotion of repair centres et al.)

Measures to be taken are

- extension of the legal warranty period by the liability for material defects;
- strengthening of aspects of waste prevention in the assessment of quality standards for products.

²⁵⁸ Compare for this as well chapter Waste prevention potentials and environmental effects of lifespan prolonging measures.

²⁵⁹ Cf. for example also chapter Measure C VIII 2: Support of private and non-profit markets for waste product and Measure C VIII 3: Support of reprocessing structures

7.3.3.1 Example measure B III 3.1: Extension of statutory warranty periods or of liability for defects

Background

With the Act to Modernise the Law of Obligations fundamental changes in the law of purchase, in particular for the purchase of second-hand goods, were made. With the changes in the law, commercial sellers of second-hand goods can be made liable for minimum twelve month in the case of material defects. Basis for the determination of the matter is the sales contract in which the characteristics of the matter at hand have to be made explicit. Also wear parts cannot be excluded from the liability for material defects (Willand/Neuser 2003). For new products a warranty of minimum two years was defined (Directive 1999/44/EC). The liability for material defects is generally applied for all consumption goods.

For some products already today extensions of the producer guaranties are offered on a voluntary basis (e.g. for motor vehicles up to seven years²⁶⁰).

Just as in these voluntary offerings of long guaranty periods, also for the product-defined guidelines on longer periods for the liability for material defects, it has to be reviewed, if certain “expendable components” have to be kept excluded from the extension. But at the same time it shall be ensured in regard of the Eco-Design Directive that expendable components are designed in a way not diminishing the product characteristics in view of the lifespan (cf. chapter Measures B III 1: Introduction and implementation of binding stipulations towards a waste-preventing product design within the context of implementation measures under the EU Eco-Design Directive).

Objectives

With this present measure it is intended to extend the legal warranty in the sense of liability for material defects by legal guidelines. At the same time it is supposed to work towards prolongation of lifespan. Targeted is also the increase of product quality, and to complicate the planned obsolescence of products, or rather to make it unprofitable. A harmonisation on European level shall be achieved.

By the extension and expansion of the liability for material defects an incentive for manufacturers and retailers shall be created, to avoid producing, or rather distributing low-grade quality.

Characterisation

The legislator will extend the liability for material defects of new products by a change of law (according to §§ 434, 437, 476 BGB and §§ 459 ff. BGB). The legal warranty period for material defects is supposed to last minimum 3 years. Additionally the existing burden of proof that material and parts are free of defects for the manufacturers is expanded from today 6 up to 12 months.

An expansion of the liability for material defects on the medium duration takes place, when the weighing between each environmental burden of use and production stages

²⁶⁰ Compare here as well chapter Waste prevention potentials and environmental impacts of lifespan prolonging measures.

recommends this. If in relation particular high ecological burdens appear in the phase of production, an extended using phase according to the measure would be related to positive ecological effects.

Recommended is as well to change the law, so the liability for material defects takes effect beyond the limitation period in cases of verifiable existing planned obsolescence, by either intentional weak points or uneconomic repair options. The identification and differentiation from usual wear is still rarely known and should be researched more detailed (cf. also chapter Measure C VIII 6: Support for research and development of measures to increase utilisation intensity).

Initiators and addressees

The measure is initiated by the legislation authority (on the federal level) and aims on producers and retailers and should be harmonised on European level.

Waste prevention potential and environmental impacts

The overall waste prevention potential of this measure as well as the thereby released environmental impacts of the extension of the warranty period up to minimum three years cannot be precisely indicated. The reasons are that:

- various products and product groups are affected,
- the period of the actual prolongation of lifespan, plus
- the possible economisation effects per time unit considerably vary from product to product and above this
- even the estimation for single products only roughly can be carried out.

To present the possible waste prevention potential and environmental impacts by the prolongation of the lifespan on an example, however, estimations and calculations will be made for some products (laptop, printer, washing machine and motor vehicles), revealing that the overall waste prevention potentials and environmental impacts will be very relevant. See for this excursus chapter *Waste prevention potential and environmental impacts of lifespan prolonging measures*. In Austria estimations for the field of electronic devices revealed that an extension of the liability for material defects for large appliances up to 20 years, respectively for small appliances up to 10 years, lead to a prevention of waste adding up to 14,000 t per year (cf. Salhofer 2000).

The full extent of these potentials can only be successfully be implemented by the interaction of the various mentioned measures. How high the contributions of the individual measures will be in the end, cannot be prognosticated in advance and not be determined afterwards.

Indicators

As indicator to control the success of the measure on a short-term basis the de-facto implementation of the - in opposite to the present form – extended warranty periods be used.

As a medium and long-term success control the medium lifespan is to be surveyed according to standardised guidelines at the example of some selected indicator products at the start of

the measure and then annually (or else every second year). The examples of chapter “waste prevention potentials and environmental impacts of lifespan prolonging measures” should necessarily be part of it. As an indicator it would be favourable to use the chronological sequence of the medium lifespan of these example products.

Social impacts

With the measure a broad consumer protection is connected, which on one hand increases the quality of products, and on the other hand, improves the penalisation options for planned obsolescence beyond the limitation period of liabilities for material defects.

Economic impacts

By the extension of the period for liabilities for material defects new impulses for the innovations in the product quality are given, and offers of low-grade quality are displaced for the market. This stimulates the development of high-quality product capacities, which in this case leads to positive labour market effects. Accordingly negative effects and sectoral changes in the segment of cheap products are to be expected. A tendency to increase purchase prices for some products is to be expected. But, throughout a full life-cycle, rather equal costs and for some product even lower prices are likely.

Recommendation

The example measure is recommended for the implementation.

Example measure B III 3.1: Extension of statutory warranty periods or of liability for defects	
Objectives:	The extended warranty and/or guarantee periods shall increase the quality and therefore support a longer lifespan. Planned obsolescence shall be complicated and made unprofitable.
Characterisation	<p>The legislator expands by a change in law the liability for material defects of new products (accord. §§ 434, 437, 476 BGB and §§ 459 ff. BGB). The legal warranty period for material defects has to be minimum 3 years. In addition to the existing burden of proof that material and parts are free of defects for the manufacturers is expanded from today 6 up to 12 months.</p> <p>An expansion of the liability for material defects on the medium lifespan takes place, when balancing each environmental burden of use and production stages recommends this.</p> <p>It is also recommended to change of law, so the liability for material defects takes effect beyond the limitation period in case of verifiable existing planned obsolescence, by either intentional weak points or uneconomic repair options.</p>
Link to measures set out in Study I	(285): Extension of the warranty period
Link to Annex IV WFD	Legislation was mentioned in Annex IV of the WFD
Instrumental character	Law
Initiators	Legislator, EU
Addressees	Product manufacturer, retailers
Waste prevention potential	For the overall measure, not to be estimated. On some selected product examples material savings were estimated due to their prolonged lifespan (cf. chapter “waste prevention potentials and environmental impacts of lifespan prolonging measures”)

Example measure B III 3.1: Extension of statutory warranty periods or of liability for defects	
Environmental impacts	For the overall measure, not to be estimated. On some selected product examples greenhouse gas emissions savings were estimated due to their prolonged lifespan (cf. chapter “waste prevention potentials and environmental impacts of lifespan prolonging measures”)
Indicators	Short-term de-facto implementation of the extended warranty period Medium and long-term: chronological sequence of the medium durability of these example products
Social impacts	Improved consumer protection
Economic impacts	Impulses for innovation, displacement of low quality from the market
Conclusion	Incentive for manufacturer and retailers for higher quality and longer lifespan, planned obsolescence will be unprofitable and complicated.
Recommendation	The example measure is recommended for the implementation.

7.3.3.2 Example measure B III 3.2: Giving greater attention to waste prevention aspects when setting quality standards for products

Background

With standards on a sub-legal level uniform rules can be appointed and coordination processes can be simplified and accelerated to be implemented in the form of voluntary (self-) obligations or mandatory rules. This concerns in particular the freeing of laws from technical detail regulations. By this way the bureaucratic effort to implement certain measures will be reduced. Quality standards for products, like CEN, DIN, EN, ISO etc. contain beside economic, social and ecological aspects regulations on health protection and safety.

From the understanding that environmental viewpoints rarely come into consideration under the process of defining standards, by the end of the 1980s the “Koordinierungsstelle Umwelt, KU” (coordinating authority environmental protection”) at the DIN – Deutsches Institut for Normung (German Institute for Standards) was founded. During many standardisation processes economic aspects carry more weight than environmental interests. Particularly aspects of waste prevention are often unconsidered or ineffective. Over specific quality standards for products, significant potentials can be developed that support the prolongation of the durability to prevent waste. This concerns aspects of the technical usability (i.e. the potential lifespan), but also of quality or the question whether products are upgradable that concern the actual lifespan for the consumer.

Specific examples are **laptops**. For these devices special requirements on the durability were developed for the environmental label “Blue Angel” (Blauer Engel). The ElektroG already gives guidelines for the conception of products, but they stay within the limit of maximum level of certain contents in the § 5²⁶¹, on the dismantling options²⁶² and beside that on unclear information obligations²⁶³.

²⁶¹ By which an exemplary measure for the qualitatively waste prevention is given EU-wide. The measures described in this connection aims rather on the improvement of the product quality in combination with a prolongation of lifespan.

According to surveys of the Öko-Institut for the durability of laptops beside the guarantee period, two other aspects are play a decisive role (cf. Prakash et al. 2010): upgrading options of working memories (RAM), processors (CPU), hard disk, graphic board, drives (without much difficulties and repair options.

In the requirements of the Blue Angel these aspects are realised by the following product standards (cf. RAL 2011, chapter 3.4):

“3.4.1 Reparability

The commits to take care that for the repair of the devices the spare part supply is guaranteed for minimum 5 years from production end on. Spare parts are understood as such parts that could typically fail during the normal use of a product. Other components or parts which routinely outlast the average lifespan of the product are not too be seen as replacement parts. In particular accumulators have to available up to 5 years after production end. The product documents have to hold information about the mentioned requirements.

3.4.2 Expansion of the capability

Portable computers need to offer the following expansion options:

- *Option to exchange or expand the working memory (RAM) to the standard configuration Energy Star 5.0.*
- *Presence of minimum three USB ports as well as a port for an external monitor.”*

For more durable products like machines, the Blue Angel even requires the availability of spare parts for a period of 10 years (cf. RAL 2009).

Criteria for environment and waste prevention orientated standards can either be developed or established by experts and scientists, or else are found by dynamic and market-orientated competition processes, like the variation of the Japanese Top-Runner approach.

With the Top-Runner approach the energy efficiency of the best products becomes minimum standard for the next (e.g. three or five) years, whereby then again the present best quality establishes the future minimum standard (The Swedish Environmental Protection Agency 2005).

Objectives

The measure aims to expand and bindingly regulate standards in technical obligations or voluntary obligations on aspects of waste prevention. This target can be met by definitions on prolongation of lifespan (durability), recycling and reuse, upgrading and reparability, but as well by high requirements on quality and functionality of the products in the

²⁶² “If possible, electrical and electronic devices have to be designed in a way that dismantling and utilisation, in particular the recycling of end-of-life-products, their components and parts is taken in account and facilitated.” (§4 ElektroG)

²⁶³ “Each producer shall provide reuse facilities, treatment facilities and recycling facilities with information, in the form of a handbook or in data form, on reuse and treatment for each type of new electrical and electronic equipment within a year of its placement on the market.” (³ 13, 6, ElektroG)

standardisation processes. Another target that is connected to this is, to strengthen the market penetration of products that meet these standards.

Characterisation

With this measure will be developed in a way that in the course of defining new product and industry standards the aspects of waste prevention are stronger taken into account and are bindingly formulated. At the same time a programme will be initiated in which existing standards are examined for these aspects.

Important aspects for waste prevention should be specified by defined criteria. Essential aspects for waste prevention, like prolongation of lifespan by quality improvement and the reparability by standardised modular construction and secured supply with spare parts, are not sufficiently considered, yet. These criteria should as well prevent the planned obsolescence of products or at least complicate it.

On way of implementing the measure could as well be a variation of the Top-Runner approach. It could also be applied analogue for a competitive search for the most innovative development of waste-preventing product standards. This way ecological market innovations will be effectively be released by competitive processes and innovations and promote the market penetration of products that emit lower environmental burdens and create waste-preventing innovations.

Initiators and addressees

The Federation (e.g. BMU and UBA) in collaboration with the German Institute for Standards (Deutsches Institut für Normung) promotes the inclusion of waste prevention criteria into standardisation processes, and/or the ministry of economics initiates through a competitive procedure an economic selection process in which the best products of classes defined by waste management criteria, set the standard for the next five years.

Waste prevention potential

Analogue to the reasons described in B III 3.1, the general waste prevention potential of the measure can neither be directly defined, nor estimated qualitatively.

Exemplary estimations for individual products can be found in the excursus of chapter waste prevention potentials and environmental impacts of measures prolonging the lifespan.

Environmental impacts

The same applies for the environmental impacts of the measure which in addition are particularly product specific. Especially for the field of laptops, various studies on environmental burdens during the life-cycle reveal with all clearness that through an extension of the lifespan of the respective devices, massive reduction potentials of environmental burdens develop. The reason for this is that for computers in opposite to many other products, the production stage weights almost as much as the user stage (cf. Prakash et al. 2010).

Indicators

Since both, the extended warranty, as well as the standardisation aim at waste prevention by durability extension, it seems appropriate here, to insert uniform standards for the average lifespan. As an indicator the chronological sequence of the average life should serve.

Social impacts

Qualitatively unsatisfying products will by standards be displaced from the market, so structural and capacity-related adjustments of the concerned companies and sectors will be released. A certain pressure, particularly on the suppliers of bad qualities, can therefore not be excluded.

Since by this measure the repair and upgrading of used devices becomes competitive with the new production, from an overall point of view the effects on the labour market positive effects can be estimated, because usually repairs are more work intensive than new production.

Economic impacts

From the perspective of consumers with references to the chosen case example of laptops it can be assumed that the measure would lead, at least during the current duration of use, to a significant reduction of the average repair costs. Studies on portable computers by now assume that during the overall life-cycle of a portable computer, repair costs amount to approx. 125 Euro for the hardware plus upgrade and other costs for the software up to approx. 75 Euro. So therefore costs summarise to 200 Euro; in references to the estimated average lifespan of 5 to 6 years, this means that almost 36 Euro per year (cf. Prakash et al 2010). By now these comparatively high costs rather lead to the consumer's decision to dispose the defect equipment and to purchase a new product which reduces the possible lifespan of devices.

Conclusion

Through this measure waste prevention criteria will be anchored in standards that are to be identified by recommendations of experts, respectively by competition processes. From the consultative point of view the measure is indicated in particular for such product groups where specific standards not only lead to environmental benefits, but also to an improvement of overall quality and functionality. At the same time, the criteria defined under this measure, need to be reviewed frequently.

Recommendation

The example measure is recommended for the implementation.

Example measure B III 3.2: Giving greater attention to waste prevention aspects when setting quality standards for products	
Objectives:	Strengthening the waste prevention by anchoring in standards for products, increasing their market penetration
Characterisation	Revision respectively reviews of existing standards on aspects of waste prevention (in particular extension of lifespan, reparability, upgrading, recycling, and reuse). Processes of identification of standards will be initiated and supported by experts and competitive methods (Top-Runner Programme).
Link to measures set out in Study I	(90) Introduction of minimum standards for products; UK
Link to Annex IV WFD	13. Promotion of credible eco-labels 4. Promotion of ecodesign
Instrumental character	Sub-legal regulation
Initiators	Environmental policy institutions (UBA, BMU etc.)
Addressees	Producers
Waste prevention potential	Not to be estimated for the overall measure.
Environmental impacts	Only product specifically calculable – particularly high for products where production stage in relation to the usage stage is connected with high environmental impacts.
Indicators	Medium and long-term: chronological sequence of the medium durability of these example products
Social impacts	No negative effects expected. Since repair is supposed to become competitive to new production, overall positive effects on the labour market are expected, because repairs usually are more work intensive than new production.
Economic impacts	Sectoral change and adjustment processes will be initiated.
Conclusion	Waste prevention criteria will be anchored in standards
Recommendation	The example measure is recommended for the implementation.

7.4 Measures in the point of leverage IV: Waste-preventing logistics

7.4.1 Measure B IV 1: Agreements on voluntary measures of to reduce “logistic waste”

Background

According to the current state of knowledge, like in the following section briefly described, for some product groups, because of their supply chain, dispose products accrue to a quite substantial extent. In the broad public know and discussed it this currently on the example of foods. But as well for paper products, textiles and possibly in general for brand name products, in certain areas of trading an oversupply is described.

In the retail of newspapers a return share of almost 20 to 30 % is standard (Pürer, Raabe 2007). The losses are taken for prestige reasons. For magazines the return share is around 24 %. For 810,000 t of printed German magazine covers per year (MARESS 2010) this amounts to 194,400 t. It stay questionable, how much of this will be merchandised on secondary distribution channels (MARESS 2010).

In the food section bakeries are in particular in the discussion that, due to their strategy of offering the whole range of goods throughout the day as long as possible, have to dispose

around 10-20 % of their daily production. This correlates annually 500,000 t of bread (Dradio 2011). In addition 35 % of all perishable foods worldwide, and here fruits and vegetables, fall victim to the interruption of the cold-chain on the transport to the customer (nachhaltigkeit.org 2011). In Germany though this figure is significantly smaller, in which the following aspects are in the foreground. In supermarkets and private households many foods are disposed whose expiration date has expired. Annually approx. 20 million t of foodstuffs are disposed in Germany (HR 2011) which correlates 1/5 to 1/3 of all foods (Dradio 2011).

Transport packaging is also an important source of logistic waste. One way transport packaging has to be disposed after the distribution or can be reused. Corrugated board is for example used as crates. The German industry of corrugated boards in 2008 had a distribution of 4.35 million t (VDW 2010). Corrugated boards in 2008 had a share of 68.4 %, foil of 8.2 %, solid board of 7.1 % wood of 11.3 % and packaging of plastic materials of 5.0 % of the overall transport packaging emergence (VDW 2010). Foils are used for the strapping, solid board also in form of crates, wood appears in pallets and plastics as well, e.g. in crates. Under the assumption that corrugated board exclusively is used as transport packaging, the emergence of transport packaging 2008 was around 6.4 % million t.

Like not least the initiatives of the BMELV [Federal Ministry of Nutrition, Agriculture and Consumer Protection] reveal, in the segment of the generation / distribution and trade of foods still considerable optimisation potential may be expected. Like first results (University Stuttgart 2012) of scientific researches show, in many branches and to a large extent foods have to be disposed during the distribution and the trading. Facing this, an example for a measure is considered: "Voluntary agreement with the retail association for a supply meeting the demands of retailers of food".

Under this measure governmental administrations and market players from the area of end product manufacturing (manufacturers of brand name products) and trade store chains will agree on the voluntary implementation of measures for the prevention of product and packaging waste.

After successful start of the implementation of the example measure in the food section and in an analogue approach further fields, like e.g. printed goods, textiles as well as packaging in general shall be included.

7.4.1.1 Example measure B IV 1.1: Voluntary agreement with the federation of retail establishments on food deliveries to stores that are tailored more closely to requirements

Objectives

The measure aims on the prevention of waste caused by fresh foods and processed food products with limited shelf life.

Characterisation

With the measure a voluntary agreement between the Federation, respectively the individual Federal States, and the concerned associations of producers as well as the retail association is aspired to align the delivery of shops with foodstuff more on the real demand and therefore significantly reduce food waste at this point. For this to begin with, in

collective work groups the necessary practical detailed measures will be worked out. In the course of this collaboration of stakeholders further reasons for the formation of preventable food waste on the way of the products from the manufacturer to the consumer will be identified and possible solutions worked out. The work groups will be initiated by the Federal government and the governments of the individual Federal States. Existing networks which frequently have a regional reference, like for example “foodRegio-net” and “competence network nutrition” in Schleswig Holstein, should be participated in the collaborations (MLUR 2011).

Initiators and addressees

The initiators are the Federation, represented by the Ministries BMU and BMELV as well as the individual Federal States, represented by the responsible Ministry of the States.

Addressees are the concerned associations of producers, the retail association and the practitioners of the firms (industry and retail). During the enquiry for a study of the MLUR Schleswig Holstein (MLUR 2011) the retailing stakeholders showed great interest to actively participate in collaboration for a prevention of food waste in the retail.

Waste prevention potential

From the roughly estimated 20 million tons food waste per year a significant part accrues in households where they have to be disposed (HR 2011). Another important collection point though is the food retail. But to date there is still a clear lack of information, so that for the retail industry neither the volume of waste nor the prevention potential can be defined. First appraisals of an analysis for the BMELV (University Stuttgart 2012) estimate a volume of 550,000 annual tons of food waste in the retail.

Environment effects

Because of the large volumes that have to be disposed and the quite often significant specific pollutions from the manufacturing (agricultural production) and supply (cold chains), the foodstuff turning into waste, have a relatively high ecological importance.

The manufacturing of 1 kg apples with storage and regional transport is connected with a potential of greenhouse gas of approx. 0.25 kg CO₂ equivalents of which 0.1 kg arise from the cultivation in a regional plantation. The cultivation of a regional head of lettuce produced summer, causes 0.05 kg CO₂ equivalents, the production of 1 kg beef in 22 kg CO₂ equivalents and the production of one litre of milk in 0.75 kg CO₂ equivalents (Reinhardt et al. 2009).

On the basis of the few data and information on the waste emergence and the fact that the prevention potential cannot be quantified, all in all ecological effects cannot be named.

Indicators

The flows of product masses and therefore as well the foods that have to be disposed as fresh or finished goods, since they are “unmarketable” due to the oversupply of the retail industry, will hardly be covered statistically. Information of general statistics can therefore not be used for the monitoring.

The measure aims on voluntary agreements. The successful implementation can thus be assessed by the share of those food retailers committed to such an agreement, Part of the agreement could also be a documentation of the emergence of product waste in the retail industry, in order to retrace the development over a certain period of time.

Social and economic effects

If the adjustment of food supply meets with the acceptance of the costumers, no negative social or economic effects are expected.

Conclusion

Facing the high economic effort for the production of the demanded quantities of food, a prevention of product waste due to oversupply in the retail industry is highly relevant.

Recommendation

The example measure is recommended for the implementation.

Example measure B IV 1.1: Voluntary agreement with the federation of retail establishments on food deliveries to stores that are tailored more closely to requirements	
Objectives:	The measure aims to better meeting the demands of the retail industry, and therefore also targets the reduction of fresh and processed food products that have to be disposed as "unmarketable" due to an exceeded shelf-life.
Characterisation	Voluntary agreement between the associations and individual companies of the food retail industry and governmental institutions on the federal level and the level of each individual Federal State.
Link to measures set out in Study I	(81): Courtauld Commitment (UK)
Link to Annex IV WFD	9. Use of voluntary agreements, consumer/producer panels or sectoral negotiations, ...
Instrumental character	Voluntary agreement
Initiators	Federal and States ministries
Addressees	Food retail industry and it' associations
Waste prevention potential	According to the current state of knowledge, beside in private households, food in form of product waste accrues primarily in the retail. The prevention potential cannot be estimated, but presumably it is high.
Environmental impacts	Because of the high volume of waste, as well as the quite significant specific environmental burdens from the (agricultural) production and supply (cold chains) becoming waste foodstuff has a higher ecological meaning. On the basis of the few data and information on waste emergence and the unquantifiable waste potential, ecological effects in total cannot be estimated.
Indicators	Share of the retail industry that has signed such agreements apart of the agreement could be a documentation of the product waste emergence in the retail.
Social impacts	No negative effects expected.
Economic impacts	No negative effects expected.
Conclusion	Facing the high economic effort for the production of the demanded quantities of food, a prevention of product waste due to oversupply in the retail industry is highly relevant.
Recommendation	The example measure is recommended for the implementation.

7.5 Measures in the starting-point V: Waste-preventing retail

7.5.1 Measure B V 1: Support for voluntary measures by the retail sector to prevent (packaging) waste

Background

With this measure governmental administrations support targeted measures of the commerce (retail sector) that aim on the reduction of packaging waste. Retail trading can to a certain extent influence the emergence of packaging waste.

This is given, whenever goods can be delivered in bulk packaging to the retail and there being forwarded to the customer open and loose and, as the case may be, in small amounts. By the open delivery of goods, a part of the sales packaging can be avoided. But comprehensive avoidance is only given, if the transfer to the customer is not “packed” again, which is difficult to do in the individual case.

Much simpler is it, to take influence on the use bags. Those are used quite often by the customer to transport the purchased goods. This applies for the retail in general, regardless the product groups. A waste prevention measure aim not only on “plastic bags”, but analogue as well on any kind of one-way carrying bags and here definitively those of paper as well.

If single shops provide such bags only very restrictively to the customers, it bears quite an economic risk for them due to the fierce competition. For such shops there is the danger that customers rather turn to shops which offer a full service, including carrying bags free of charge.

In particular for spontaneous purchases, like quite usual in the non-food segment, customers will rarely be equipped with their own carrying bags.

The retail industry will therefore just then be won for such a measure, if it is associated with a positive image. For that a corresponding integration into a comprehensive public relation campaign from public authorities on the topic of waste prevention and resource conservation is indispensable.

Facing these considerations, an example measure that seems to be useful could be: “support of exemplary companies in the commerce by corresponding public relation work”. The here described reference to carrying bags has to be viewed in the context of the example measure C VI 1.2. If a fee / charge / contribution on one-way carrying bags would become mandatory, an orientation of this measure on carrying bags will become obsolete.

This measure offers an alternative to a general prohibition of one-way carrying bags of plastics or paper which will be outlined in another chapter.

7.5.1.1 Example measure B V 1.1: Support for exemplary retail establishments by means of suitable public relation activities

Objectives

The measure aims on a decrease in the use of one-way carrying bags of plastics and paper.

Characterisation

By comprehensive public relation work of governmental institutions exemplary companies of the commerce shall be supported, either for their renunciation of one-way carrying bags or for the handing over solely in exchange with a significant contribution. Alternatively in the shops there would have to be cotton bags or the like sold, so that spontaneous purchases are still possible.

If governmental administrations support these measures by information campaigns, public awards or similar initiatives, a significant incentive to implement such measures could be given. This could for instance be done by competitions in municipalities or counties in relation with a corresponding award to the retail companies.

Initiators and addressees

The initiative has to come in all cases from the public institutions. The level of actors can still be different.

1. Public actors on the municipality level win the local retail industry over to a renunciation of one-way bags respectively to a significant pricing for them.
2. Public authorities on the level of Federation or individual Federal States allure the retail sector to a renunciation of one-way bags respectively to a significant pricing for them.

In both cases it should be taken care that an as high as possible number of retailers will be won over to join this measures.

Addressee of this measure is the retail industry or its associations.

Waste prevention potential

In the year 2008 in Germany 171,000 t of pouches and bags were produced (VDW 2010). By this measure, to support exemplary companies that renounce the free hand-over of one-way bags by a broad public relation work, only a small part of waste prevention potential will be affected (cf. Example measure C IV 1.2).

Environmental impacts

The production of 1 kg of shrinking foil is connected with a greenhouse gas potential of 2.38 kg CO₂-eq (APME 2005). If this environmental burden is set into a relation of the overall production of pouches and bags, by way of calculation this results in a theoretical environmental burden potential of approximately 400,000 t CO₂-eq climate relevant gases.

For a more precise balancing of the ecological effects this would have to be supplemented by balancing the ecological effects of the disposal of these bags. These effects are the failed ecological benefit of recycling, of energy recovery, or other disposal of the bags, respectively the additional burden through this.

It cannot be excluded that a part of the one-way bags from plastic and paper are reused in households as garbage bags. A saving of carrier bags from paper and plastics can therefore might involve an increase in the demand of special garbage bags. This way the increased

production of garbage bags can consume a part of the calculated environmental relief (cf. Example measure C IV 1.2).

Indicators

As an indicator key data of production and distribution of the corresponding products are suitable.

Social and economic effects

No negative effects are expected.

Conclusion

The environmental relief that can be achieved by the specific measure is expected to be rather low.

The support of pioneer enterprises in the commerce which help to establish the willingness to join waste prevention projects in the commerce is recommendable, independent of the accessible direct aims.

Recommendation

The example measure is recommended for the implementation.

Example measure B V 1.1: Support for exemplary retail establishments by means of suitable public relation activities	
Objectives:	Reduction of the emergence of one-way bags and pouches of paper and plastics. If governmental administrations support these measures with information campaigns, public awards or the like, relevant incentives for their implementation are given and the effect of these measures is increased.
Characterisation	Governmental administrations systematically support measures of the (retailing) commerce that aim on reducing of (packaging) waste.
Link to measures set out in Study I	(81): Courtauld Commitment (UK) (274) MINI-MUELL e.V.
Link to Annex IV WFD	12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
Instrumental character	Economic promotion / awareness
Initiators	Ministries and governmental administrations of the States
Addressees	Retail sector and retailer
Waste prevention potential	Depending on the implementation degree of specific WPMs. Theoretical potential approx. 170,000 t/a of bags.
Environmental impacts	If this environmental burden is set into a relation of the overall production of pouches and bags, by way of calculation this results in a theoretical environmental burden potential of approximately 400,000 t CO ₂ -eq climate relevant gases. The theoretical potential of environmental relief by the full prevention of pouches and bags annually sums up to 400,000 t of CO ₂ -eq climate relevant gases.
Indicators	Key data of production and distribution
Social impacts	No negative effects expected.

Example measure B V 1.1: Support for exemplary retail establishments by means of suitable public relation activities	
Economic impacts	No negative effects expected.
Conclusion	From an ecological point of view the measure is sensible, independent of the size of the prevention potential and the assessed environmental relief.
Recommendation	The example measure is recommendable for the implementation.

7.5.2 Measure B V 2: Provision of information and advice on the prevention of logistics waste

Background

For the overall subject field of logistic and prevention of product waste, relatively little information and data exists that would allow a more detailed quantification. This does not only apply for the field of logistic of food.

It cannot be expected that logistical waste, in terms of product waste, accrue “without need”. It is always combined with a financial loss which is, facing the competitive situation and the quite small margins, of little use. On the other hand, the logistic underlies various organisational and economic boundary conditions which obviously in their out-balancing do not lead to an absolute prevention of product waste. This might particularly apply for those foods where the monetary value per piece or trading unit is relatively low. To place waste prevention measures in this segment successfully, the understanding of the processes has to be as good as possible.

Therefore a useful measure seems to be a well-founded scientific research of the subject. This should happen to a lesser extent by a theoretical depiction of the flows of goods and material in the logistic chains (most relevant for foodstuff), but rather in an intensive exchange between the central stakeholders. Only this way the circumstances and basic conditions can be identified which explain and define the current practice and thereby strategies for solutions to be developed towards an optimisation from the perspective of waste prevention.

Facing these considerations, the implementation measure described in the following would be useful: “Basic data collection on the subject waste prevention in the logistic in cooperation with the trade associations, and dissemination of data on an internet platform”.

7.5.2.1 Example measure B V 2.1: Collection, in cooperation with sector associations, of basic data on waste prevention in logistics and dissemination of the data through an Internet platform

Background

The foundation for the measure will be a scientific processing of the logistic chains, i.a. in the area of food, aiming to identify interfaces in the life-cycle of the individual product groups with a relevant volume of generated waste, but also with a connection to transport packaging and where opportunities of optimisation are expectable. These are to be identified by interviews with stakeholders of the branch, especially with producers and importers, forwarders, as well as whole sales and retail companies. Experiences of a research in Schleswig Holstein display a willingness of the participating stakeholders actively to take part in such waste prevention projects (MLUR 2011).

To communicate possible solutions, an internet platform seems to be fitting, since in this sector a multitude of varying stakeholders has to be included as addressees. In addition to this the platform can be used for a further experiential exchange, so the knowledge that is won by the scientific research of the subject, is only a first impulse towards waste prevention. For the optimisation of the situation in commerce and logistic in the sense of waste prevention, further measures are necessary.

Objectives

In the end the aim of this measure is the prevention of product waste in the logistical chain. To begin with, the necessary data basis has to be provided.

Characterisation

By the promotion of scientific research of logistics on waste prevention approaches an important precondition for further measures to prevent product waste in the commerce will be established. The prepared information will be offered on an internet platform. Thereby especially small and medium-sized companies will have the opportunity to inform about facts to receive suggestions from best practice examples and take their own initiative.

Initiators and addressees

Actors are the Federation and the States. Such an initiative is based on an exchange with the trade associations as well as with the representatives of the larger enterprises on the Federal level. The internet platform serves as well the consultation and the exchange between the companies, at least on the national level.

Addressees are logistics and commerce companies.

Waste prevention potential

Since the whole range of goods is addressed by the measure, the waste prevention potential cannot be estimated.

Environmental impacts

No ecological impacts working in the opposite direction to the minimisation of the waste volume are expected. The measure aims not directly on the prevention of (product) waste in logistical chains, but on the creation of a knowledge basis to deduce and support practical implementation measures.

Economic and social effects

No negative effects are expected.

Conclusion

The measure can support an improvement of the data basis on waste quantities and prevention potential in the field of logistics, and therefore found further implementation of practical prevention measures.

Recommendation

The example measure is recommended for the implementation.

Example measure B V 2.1: Collection, in cooperation with sector associations, of basic data on waste prevention in logistics and dissemination of the data through an Internet platform	
Objectives:	Prevention of product waste in the logistic chain and preparation of the necessary basic data.
Characterisation	By the promotion of scientific research of logistics on waste prevention approaches an important precondition for further measures to prevent product waste in the commerce will be established. The prepared information will be offered on an internet platform. Thereby especially small and medium-sized companies will have the opportunity to inform about facts to receive suggestions from best practice examples and take their own initiative.
Link to measures set out in Study I	(2) The promotion of research and development (5) Provision of information (8) Awareness campaigns
Link to Annex IV WFD	12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
Instrumental character	R + D projects
Initiators	The measure will be initialised by the Federal government in collaboration with the trade associations
Addressees	The measure aims indirectly on the logistics industry. Directly a research programme will be initiated, in cooperation with the trade associations.
Waste prevention potential	cannot be estimated
Environmental impacts	No counterproductive effects are expected.
Indicators	As an indicator to begin with the fact whether such researches were initiated can be used.
Social impacts	No negative effects expected.
Economic impacts	No negative effects expected.
Conclusion	The measure can support an improvement of the data basis on waste quantities and prevention potential in the field of logistics, and therefore found further implementation of practical prevention measures.
Recommendation	The example measure is recommendable for the implementation.

7.5.3 Measure B V 3: Support of low-waste, regional retail

The promotion of market for regional products has many generally positive effects. For instance, the tendency of supporting the region also economically is strengthened by this concept. But the environmental protection as well is in the focus, in particular the reduction of transportation distances and all the related environmental burdens, plus the product waste that appears during the supply above the regional level due to the transport itself as well as during the cargo handling and the stocking.

Facing these considerations, the example measure as described in the following seems to be useful: “Campaign for the promotion of a market for regional products with the focus on food”.

7.5.3.1 Example measure B V 3.1: Campaign to promote sales of regional products, focussing on food

Background

With this measure the individual Federal States (ministries, district councils) and the municipalities shall support the implementation of concepts for a regional commerce by

- reasonable priced provision of premises and properties,
- financial and organisational support for the founding of organisations (private and non-profit corporations, collective associations etc.),
- consultancy,
- provision of communication platforms,

respectively to initiate or promote such initiatives. Thereby regional distribution structures will be promoted, so optimised solutions for logistics, like delivery on demand or use of multi way packaging, can develop better in most of the cases.

In many regions of Germany initiatives for the promotion of regional products exist, mostly in the food section. Here is an important point of leverage for the extension of these initiatives about the aspect of resource conservation and waste prevention. Additionally they should be supported and expended on further products, e.g. furniture, textiles and second-hand products of all kinds. This measure aims not solely on the retail industry, but beyond this on strengthening weekly farmer's markets, direct sales of producers, delivery services ("vegetable box" et al.).

The focus of this measure is on the food section. Here first rough estimate reveal a significant volume of product masses that get lost in the delivery chain between production and retail by trading and transporting and end up as waste. A first, but only little dubitable estimate, can be found in an analysis for the BMELV (University Stuttgart 2012) where about 500,000 annual tons are assumed.

Objectives

The waste prevention potentials of short distribution ways shall be made available. In particular it is aimed on the economisation of transport packaging and costs.

Characterisation

This measure will promote, respectively create, incentives for a regional trade by promoting existing initiatives to support regional markets or initiate new.

Initiators and addressees

The measure will be initiated and promoted by governmental administrations on the federal and states level. Practically the measure should be implemented by regional actors, i.e. on the level of county councils or counties.

Addressees are producers, primarily those of food and here with a focus on agriculture and market gardening as well the regional commerce ("vegetable boxes", organic stores, retailers on weekly markets and their operators plus initiatives that promote the regional commerce).

Targeted waste and products

The measure aims in particular on the prevention of waste from any kind of fresh, unprocessed or partly processed food. According to the current stage of knowledge, especially bakery products and fresh produce (fruit and vegetable) accrue in larger quantities for the disposal.

Waste prevention potential

According to an analysis of the EHI Retail Institute of September 2011, in annual average 310,000 tons of nutrition are lost due to breakage or spoilage. According to the same analysis the lost on the same account for fruit and vegetable averages around 5 % loss for the full-range retailers without discounters). Not included are data of charity organisations (non-profit food banks) (EHI 2011). A study of the FAO even estimates 10 % loss in Europe and Russia (Gustavsson et al. 2011). 2009 in Germany in total 3.2 million tons of fresh fruit were purchased and 4.95 million tons of fresh vegetable (annual magazine agricultural markets 2010 / Jahresheft Agrarmärkte 2010, LEL)²⁶⁴. 5 % loss thus equals approx. 400,000 tons fruit and vegetable waste.

This estimation excludes that a great part of the fruit and vegetable is not merchandised through the retail industry, rather by other distribution paths, which might be related to varying shares of waste. By this way, according to a study of the Jacobs University, worldwide 35 % of the overall perishable food ends up in the garbage every year (nachhaltigkeit.org 2011). This amount results in developing countries mostly from cooling and storage problems, but just as well at the transition points of food chains in Germany, interruptions in the cold chain can lead to problems. Beside this in industrial countries the wastefulness, i.e. the supply above the demand primarily of households, is the main reason.

Environmental impacts

The agricultural production of 1 kg apples (including storage and regional transport) is connected with a greenhouse gas emission of approx. 0.25 kg CO₂ equivalents, for a regional head of lettuce produced summer it is 0.05 kg CO₂-eq (Reinhardt et al. 2009). The emergence of annually 400,000 tons of fruit and vegetable equals accordingly a greenhouse gas emission of approx. 60,000 tons of CO₂-eq.

Counterproductive effects have to be suspected, when the purchase even of small quantities is carried out directly from the producer, but distances have to be covered that are significantly higher than the distance to a food discounter. The environmental burdens related to the purchase tours are counterproductive to the ecological successes for the lower efforts for storage and distribution. this has to be regarded in the individual case.

Social and economic impacts

Promoting markets for regional products strengthens the local value chain and has therefore positive social and economic effects.

²⁶⁴

EHI Retail Institute e.V.: LEH v[food retail industry] loses 310,000 tons food annually, 20.09.2011

Indicators

The development of the measure is difficult to be tested. Since the implementing measures can vary considerably in the detail, instruments for the review cannot be installed.

Conclusion

Measures for the promotion of regional merchandising structures affect many environmental fields positively, and should for this reason primarily be included into general catalogues of environmental measures.

Recommendation

The example measure is recommended for the implementation.

Example measure B V 3.1: Campaign to promote sales of regional products, focussing on food	
Objectives:	In regional distribution structures optimised solutions for logistics can be developed easier (key words: delivery on demand, use of multi way packaging...) Above this by reducing the distances of transportation, additional environmental relief are effective.
Characterisation	With these measure incentives to promote, or create regional trading are given, when existing initiatives of regional markets or the initiation of new activities are supported.
Link to measures set out in Study I	-
Link to Annex IV WFD	11. Economic instruments
Instrumental character	Financial promotion
Initiators	individual Federal States and municipalities
Addressees	Regional producers (of food), markets and retailers as well as initiatives to their support.
Waste prevention potential	The measure aims primarily on packaging waste and on product waste that tend to emerge more, if distribution paths are longer and logistical chains are more differentiated.
Environmental impacts	60,000 t CO ₂ -eq by prevented product waste. In addition to this positive effects come from the partial prevention of packaging and saved logistical efforts.
Indicators	Share of the directly or regional merchandised goods in the overall turnover of goods, particularly of fruit and vegetable. Since the regional commerce is not bound to develop a waste prevention potential, this will have to be checked in the course of/before governmental promotion measures.
Social impacts	No negative effects expected.
Economic impacts	No negative effects expected.
Conclusion	Measures for the promotion of regional merchandising structures have positive effects on many environmental fields and should for this reason primarily be included into general catalogues of environmental measures.
Recommendation	The example measure is recommendable for the implementation.

8 Characterisation and Evaluation of Waste prevention measures in Field C: Waste-preventing purchasing decisions and uses; and general education and advice for waste prevention

In the Article 11-16 of Annex IV of the WFD the waste prevention measures that influence the purchasing and utilisation phase are mentioned. These consider the points of leverage VI to VIII in reference to the life-cycle stages according to figure 4²⁶⁵.

8.1 Measures in the point of leverage VI: Waste-preventing purchasing decisions and uses

An essential starting-point for waste prevention measures is the influence on purchase decision. By the directed choice of products as well as the conscious determination of demands both, the production and the utilisation phase as well as disposal are influenced.

In the consumer society through advertising and other external impulsions, demands for goods are aroused, not always matching the realistic demand after a closer examination. Not only the currently more focussed handling of food which was subject of discussion in the highly respected film “taste the waste”²⁶⁶ points this out. In general this applies as well for some purchases of complex consumer durables which end up used rarely or not at all to be stored in the attic or basement.

In cases like these, a matter-of-fact demand analysis can conclude that consumer durables, like for instance garden equipment, are actually applied only frequently by an individual household, so the question might be obvious whether it would rather be useful to fall back on equipment rental or if a collective purchase of users (e.g. neighbours) would be appropriate. The “sharing” of goods between several users became quite popular in the case of car sharing, and could as well be extended on other consumer goods.

Along with a purchase decision comes the weighing of different durable goods. Long lasting and repairable consumer goods are – not only from the waste prevention standpoint – generally advantageous. Particularly short-lived and waste-intensive are items that are laid out on a one-time use.

The measures of this starting-point primary aim at the optimisation of the consultancy and information and at a best practice implementation by the public actors.

8.1.1 Measure C VI 1: Taxes/Levies on packagings and waste-intensive consumer goods

In general there are several options of levy regulations on packaging and waste-intensive consumer goods. Examples on this exist, inter alia, in Denmark, Finland and the Netherlands. Hereby it has to be considered that in some countries those taxes have to be seen as alternative to the German Dual System registration of packaging according to the Packaging Ordinance, particularly in the Netherlands (Bergsma 2009). The tax can be oriented towards the consumption of material in combination with a qualitative assessment of the material as well as considering the life-cycle to a certain extend (Netherlands, Denmark), or be

²⁶⁵ For this reason the names of measures and examples refer to the points of leverage of chapter C VI to C VIII.

²⁶⁶ <http://www.tastethewaste.com/>

determined per container and only for one-way packaging on a fixed rate (Finland: on one-way without deposit approx. Euro 0.70, on one-way with deposit Euro 0.17 per container). In Denmark, beside packaging for beverages and other foods, products like dog and cat food, perfume and cosmetics, soaps and other detergents, paints, lacquers and a number of chemical products are taxed (Dehoust et al. 2009).

Like almost no other product plastic bags from fossil crude oil symbolise the throw-away-mentality of the industrial societies. Apart from the verities that go through a second use e.g. as garbage bags, the average lifespan of a one-way bag is not more than 30 minutes, which is a very short using period in proportion to the sheer unlimited durability of plastic bags. Because of the public discussion on plastic waste in the oceans and in some parts of Europe perceptible “plastic bag littering”, the EU Commission launched a public consultation on options to reduce the use of plastic bags in begin of 2011. Therefore, as examples for collecting taxes and levies on waste-intensive packaging, the forerunner project referring to levies and taxes on plastic bags and packaging will be chosen for the description and evaluation on example of beverage packaging.

8.1.1.1 Example measure C VI 1.1: Packaging tax specified on the example of beverage packaging

Background

In 2009 a proposal for packaging tax in Germany was presented, which was specified exclusively for beverage packaging in the first instance, but in principle, it could be carried forward to other packaging and certain (simple) products, similar to Denmark and the Netherlands. The proposal also contains a comprehensive legal examination to clarify the admissibility of such a tax (Dehoust et al. 2009). In further studies on this issue, contrary estimations concerning the usefulness of a steering, i.e. incentive, tax were supported. Whereas PriceWaterhouseCoopers (2011) holds the view that steering taxes on non-reusable packaging support multiple-use systems, bifa (2010) believes that steering taxes are not suitable. “The Federation shares the view of the bifa-study, after which a steering tax would not lead to the desired result. Both are to be held against such a tax, the missing acceptance of the population, and the difficulty of defining a tax level across all beverage segments and market developments that is to unfold steering effects without causing economic strangulation.” (Deutscher Bundestag 2011)²⁶⁷.

To begin with only the basic procedure for the example of beverage packaging will be outlined in this measure.

The tax amount shall be adjusted in a way that a steering effect towards a reusable system and one-way packaging that is ecologically of advantage will be achieved. Minimum target is to reach the guidelines/stipulations of the Packaging Ordinance PO. It is to be taxed in relation to the quantity of material used to produce the packaging. In proportion to the climate impacts of the materials, the tax rates will be set per kg of material.

One-way and reusable packaging will be handled basically the same way. This means that in each system it will be taxed according to the necessary material input for the production of containers. Reusable systems benefit only by reduced material inputs due to the filling of the

²⁶⁷

translated from the German original

same containers for several times. The ecological advantage of low material input, e.g. by high circulation rates or the use of less “harming” materials, like for instance secondary materials or sustainable, renewable resources, affects the tax amount directly. Thereby an incentive is given, to optimise reusable systems to reach higher circulation rates.

The de facto circulation rates are researched on behalf of the UBA frequently by the GVM²⁶⁸ (GVM 2009).

The tax amount per used quantity of primary material varies in the (first) proposal according to Dehoust et al. (2009) between 9.3 Euro per kg for aluminium, 3.5 Euro per kg for polystyrene, 1.7 Euro per kg for other metals and 0.1 Euro per kg for wood. For the use of secondary raw material and renewable raw material, reductions are intended.

Table 8-1: tax rate for the individual material type (Dehoust et al. 2009)

Material type	tax rates		
	> 50 %	50 % - 75 %	>75 %
	Source material	Secondary material	Secondary material
	€/kg	€/kg	€/kg
Glass	..**	0,6	0,5
Aluminium	9,3	6,6	3,4
Other metals	1,7	1,1	0,8
PET	2,9	1,8	1,2
PO	2,0	1,2	0,8
PS	3,5	1,9	1,1
PLA*	2,3	..***	..***
Paper and cart board*	0,4	0,2	0,1
Wood	0,1	0,1	0,1
Other types of material	1,7	1,1	0,8

* with NAWARO / renewable raw material – bonus

** packaging from glass with more than 50 % source material are not on the market in relevant quantities

*** packaging from PLA secondary raw material are not on the market

This results for instance for the beverage segment of water in the following tax rates:

Glass reusable (53 circulations): 2.5 Cent/l

PET reusable (15 circulations): 2.0 Cent/l

Beverage cart board box: 3.3 Cent/l

PET one-way: 9.4 Cent/l

Tin plate can: 14 Cent/l

Glass one-way: 49 Cent/l.

In the discussion on the effectiveness, it was doubted whether the mentioned differences between ecologically disadvantageous and advantageous packaging, except for the one-way glass, is high enough (Dehoust 2009) to reach a corresponding steering effect. In the recommendation according to Dehoust et al. (2009) it is proposed, to adjust the in the practical determination process in a way, that the desired control target will be met. Also tax aspects under the constitutional law have to be considered in regard of the actual tax level.

In Dehoust et al. (2009) also the legal admissibility of this tax is scrutinised. The authors come to the conclusion that the tax is admissible in consideration of constitutional and EU law as well.

Objectives

By the taxation of beverage packaging the general negative effects of their production shall be reduced. This can be achieved by reducing the packaging volume for beverages in general as well as by a shift away from one-way packaging to ecologically advantageous packaging like e.g. reusable packaging.

With the practical example of the beverage packaging, the WPM aims on the enforcement of an 80 % share of ecologically advantageous one-way packaging and reusable packaging, according to the packaging ordinance, for the whole beverage market. In the year 2007 the share was almost 55 % (GVM 2009).

An extension on packaging in general is basically possible and could open up further waste prevention potentials.

Characterisation

The tax on beverage packaging shall be directed towards a steering effect of reusable systems and ecologically advantageous one-way packaging. It should be taxed according to the quantity of materials used for the production of packaging in relation to the climate effects involved.

Liable for the taxation should be the distributors (including the importers) of the packaging.

The tax should be introduced in addition to the Dual System.

Initiators and addressees

Initiator of the measure is the Federal government who determines the tax and promotes an according packaging tax on the European level.

Addressees are the distributors of packaging as well the importers and since it can be expected that the costs at least partly will be passed on to the product prices, indirectly also the consumers.

Waste prevention potential

The waste prevention potential in relation to the financial year 2007 (Standard) was calculated in three scenarios in Dehoust et al. (2009).

To prognosticate the effects of the tax in detail was left aside. I was rather assumed that the specifications of the packaging ordinance of 80 % reusable systems and ecologically

advantageous packaging could be fulfilled this way. In case that this target should not be met instantly in the practical application, the recommendation was, to increase the taxes up the point when the target was met.

In scenario 1 an exemplary decline of the filling capacity in one-way types of packaging was assumed, to show which financial and ecological effects would be related. As an exception the share of tin plate cans in the beverage segment beer was left on the level of 2007. For fruit juice drinks without CO₂ the filling capacity was added to the beverage cart board box, for any other kind of beverage to the corresponding reusable systems. The circulation rates of the reusable systems will be increased by 25 %. For the glass reuse up to maximum 53, for PET reuse maximum 25 circulations. The PET reusable bottles will be produced up 50 % from recycling material. For glass reuse in the segment water the share of green glass will rise up to 70 %²⁶⁹. The share of aluminium lids will be reduced from 60 % on 30 % in favour of lids from PE.

In the scenario 2 and 3 in each beverage segment the shares of reusable and ecologically advantageous packaging will be increased on 80 %. The share of reusable containers in the beverage segment beer will stay on the level of the actual condition of 86 %. Any other conditions of balance refer in scenario 2 to the standard variation, in scenario 3 the scenario 1.

For the surveyed beverage segment beer, wine, water, soft drinks with and without CO₂ for the year 2007 (standard), 2.09 million t were identified as the overall mass of beverage packaging. The overall filling volume that was based for the scenarios equals 37 million litres (Dehoust et al. 2009).

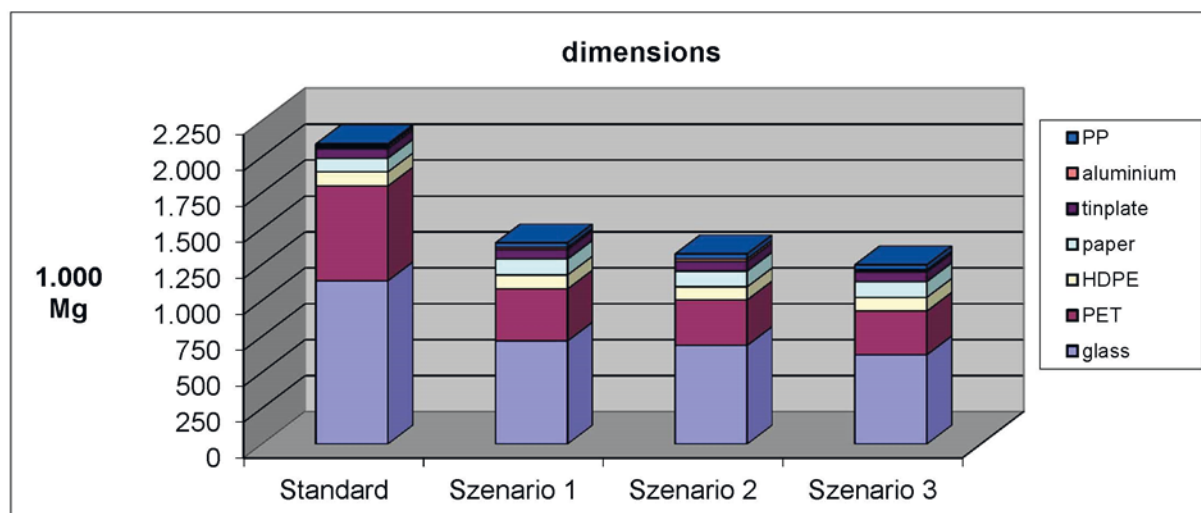


Figure 8-1: Packaging volume overall and per material (Dehoust et al. 2009)

The volume of beverage packaging will be reduced in the surveyed scenarios up to 0.84 million t per year (approx. 40 %) down on 1.25 million t per year. The reduced volume concern particularly glass and PET packaging (Dehoust et al. 2009). The volume portrays as well one-to-one the waste prevention potential, since packaging is short-lived and mostly – with the exception of reusable bottles – accrues as waste in their year of production.

²⁶⁹

For this, a new standard bottle will have to be introduced.

The potential would even increase, if the tax is extended correspondingly on other packaging.

Environmental impacts

The steering effect goes directly to the consumption of material. This means that reusable systems are taxed as well. Thereby it is taken into account that solely sustainable systems of reuse with high circulation rates are considered.

In the proposal it is assumed that transportation expenditures (taxes on fuel) and costs for the cleaning of the reusable bottles either are already taxed or will be burdened with levies or are regulated independent from the beverage packaging tax.

In order to reach the control aim it is assumed that the climate-relevant burden of approx. 3 million t CO₂ per year, related to the production of packaging (i.e. regardless the disposal costs and benefits) is cut down on 1.7 million t CO₂ per year.

Because a great share of the savings is supposed to be gained by the restructuring towards reusable systems, these advantages partly are exhausted again by the higher efforts for transport and rinsing of the reusable bottles. To figure this share is not possible. Current eco balances reveal for example that in the compare of PET one-way bottles and PET and glass reusable bottles, the circulation rates of 15 to 25 which can be achieved in the reusable pool, a significant advantage of the reusable packaging against the ecologically disadvantageous one-way packaging can be maintained (cf. e.g. Detzel/Kauertz et al. 2008).

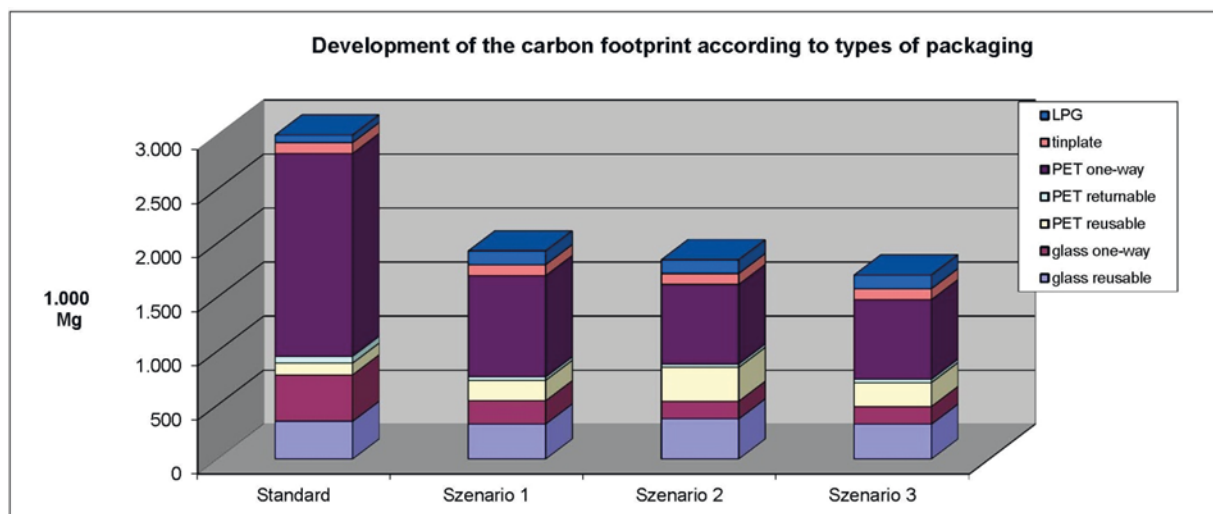


Figure 8-2: Development of the carbon footprint according to types of packaging (Dehoust et al. 2009)

Indicators

To control the effectiveness of the measure, the analysis of the statistical data on beverage packaging brought into circulation as well as the development of the share of reusable packaging and ecologically advantageous one-way packaging is suitable. Indirectly also the amount of tax revenues which is supposed to decline when the control target is met, can be consulted. All data can be related to the overall filling volume in order to compensate changes in the beverage sales.

The data have to be collected anyhow for the determination of the tax. For this reason a good initial position of data can be assumed.

Social impacts

In general there is rather less acceptance for taxes in the public and politics. But the most acceptances can be expected for taxes due to environmental protection, like e.g. the packaging tax (Dehoust 2009).

The consumers have to carry the additional costs for the packaging, but can as well reduce these by a reorientation towards environment-friendly packaging systems.

After all, by partial conversion towards reusable systems, the packaging tax will create jobs despite the expectable declines in product quantities for one-way packaging (Dehoust et al. 2009). Massive production declines are expected in the field of glass one-way packaging.

If supporting measures for the further development of reusable systems are taken, like for instance the establishment of reusable centres for the return of reusable containers, it can be assumed that further positive job effects in the service sector will occur. Such supporting measures can if necessary be promoted by the tax revenues.

Economic impacts

The economic impacts of the measure can be described through the level of taxation. In the status quo variation that starts from a 55 % share of reusable and ecologically advantageous one-way packaging, the overall tax revenue sums up to approx. 3 billion Euros per year. The average tax rates per beverage segment then will vary between 35.2 Cent/l for beer and 21.0 Cent/l for wine. Adjusting and achieving the 80 % rate of reusable and ecologically advantageous one-way packaging declines the tax revenue on 1.7 billion Euros per year. The average tax rate per beverage segment varies then between 3.1 Cent/l for water and 6.7 Cent/l for wine.

To increase the effectiveness of the measure, the tax rates could as well be increased about the factor 2 to 5 which would lead to correspondingly higher burdens and tax revenues. This would lead to tax revenues and therefore burdens between 6 and 15 billion €s per year which by corresponding adjustments decline to 3.5 to 8.5 billion Euro. Compared to this the tax revenue of the tobacco tax was around 14.3 billion Euro in 2009.

To reduce the overall burdens due to this tax and by the same time keep the differences in the tax rates which are necessary for the steering effect, adjustments in the taxation system are an option. This would have to be reviewed during the determination process, so that e.g. the tax rate for all systems could be cut down on the rate for the ecologically best systems. Thereby for example the taxation of advantageous reusable systems that participate in realistic reusable pools, could be dropped or diminished. The tax levels of any other packaging systems for beverages would be reduced by the same amount as well.

Conclusion

The achievable contributions to the environmental relief are relevant, in case the tax is high enough to reach the desired steering effect. From the present point of view and under consideration of the discussion on the proposal, it can be assumed that the tax rate set in the

analysis should at least be increase about factor 3, in order to reach the desired steering effect.

It is important that the packaging tax is only recommendable as a supplemental and additional instrument to the packaging ordinance and the one-way deposit. The successes achieved there, in reference to the promotion of recycling and the prevention of littering cannot be achieved solely by the tax.

The economic and social impacts of this measure have to be reviewed thoroughly. During the practical determination of the tax a compensation for low-income consumers should, if necessary, be financed by an investment of the tax revenues.

By the expansion on further types of packaging, like for instance one-way beverage cups in the coffee-to-go sector and similar packaging concepts, new trends that would lead to an increase of generated waste, can promptly be taken in consideration by this measure.

Recommendation

The example measure is recommended for the implementation by the experts under the condition that legal examination reveals that tax rates with steering effects are still permitted.

Example measure C VI 1.1: Packaging tax specified on the example of beverage packaging	
Objective of the WP measure	By the taxation of packaging the negative effects by the production of packaging shall be reduced in general. To realise this, an 80 % share of reusable and ecologically advantageous packaging which is set in the packaging ordinance, will be enforced for the whole beverage market.
Characterisation of the WP measure	<p>The tax on beverage packaging shall be directed towards a steering effect of reusable systems and ecologically advantageous one-way packaging. It should be taxed according to the volume of materials used for the production of packaging in relation to the climate effects involved.</p> <p>Liable for the taxation should be the distributors (including the importers) of the packaging.</p> <p>The tax should be introduced in addition to the Dual System and the deposit obligation! One-way and reusable packaging will be treated in principle equally.</p>
Link to measures set out in Study I	<p>(52) Carbon Tax on Packaging; Netherlands;</p> <p>(83) Tax on products and packaging, Denmark.</p> <p>(184) Tax on Packaging, Finland.</p>
Link to Annex IV WFD	11. Economic instruments
Type of measure/ Instrumental character	Determination of taxes
Initiators of the measure:	Federation
Addressees	<p>Directly: distributors of (beverage) packaging including the importers</p> <p>Indirectly: consumers</p>
Waste prevention potential	<p>The overall mass of 2.09 million t per year for the surveyed beverage packaging can be reduced about approx. 40 % or about 1.25 million t per year in favour of reusable packaging.</p> <p>The potential would increase by an expansion on further packaging.</p>

Example measure C VI 1.1: Packaging tax specified on the example of beverage packaging	
Environmental impacts	<p>In order to reach the control aim it is assumed that the climate-relevant burden of approx. 3 million t CO₂ per year that comes with the production of packaging is reduced down on 1.7 million t CO₂ per year. So the saving effect is approx. 1.3 million t CO₂ per year.</p> <p>By the restructuring towards reusable systems, these advantages partly are exhausted again by the higher efforts for transport and rinsing of the reusable bottles.</p>
Indicators / benchmarks	Reduction of the beverage packaging brought into circulation, increase of the share of reusable systems and ecologically advantageous one-way packaging.
Social aspects / impacts	<p>In general the acceptance for taxes is rather low in the public and in politics.</p> <p>The consumers have to carry the additional costs for the packaging, but can (and should) as well react on these by a reorientation towards environment-friendly (and accordingly cost-efficient) packaging systems.</p> <p>After all, jobs will be created, since the handling of reusable packaging is more labour-intensive than returning one-way containers to machines. This is an essential point for the increase of the one-way share (Dehoust et al. 2009)</p>
Economic aspects / impacts	<p>The overall tax revenue starts with approx. 3 billion Euros per year. The average tax rates per beverage segment then will vary between 35.2 Cent/l for beer and 21.0 Cent/l for wine. Adjusting and achieving the 80 % rate of reusable and ecologically advantageous one-way packaging declines the tax revenue on 1.7 billion Euros per year. The average tax rate per beverage segment varies then between 3.1 Cent/l for water and 6.7 Cent/l for wine.</p> <p>Passing the full tax amounts on the consumer, would constitute an increase of costs. This effect on low-income consumers needs to be reviewed separately.</p>
Conclusion	The achievable contributions to the environmental relief are relevant, in case the tax is high enough to reach the desired steering effect. It is important that the packaging tax is only recommendable as a supplemental and additional instrument to the packaging ordinance and the one-way deposit. The successes achieved there, in reference to the promotion of recycling and the prevention of littering cannot be achieved solely by the tax. The economic and social impacts of this measure have to be reviewed thoroughly. During the practical determination of the tax a compensation for low-income consumers should, if necessary, be financed by the tax revenues.
Recommendation	The example measure is recommended for the implementation by the experts under the condition that legal examination reveals that tax rates with steering effects are still permitted.

8.1.1.2 Example measure C VI 1.2: Levy on disposable bags

Background

In Germany annually 65 plastic bags are used per person and year (UBA 2008). Compared to the European average which is supposed to be 500 bags per person and year (Wolter 2011) this is an astonishingly small value. Moreover, there is a not precise figure of paper bags. According to Europe's largest manufacturer of plastic bags²⁷⁰, the Germans annually use approx. 10 paper bags in the average.

²⁷⁰

80 % of the customers choose plastic bags, 15% paper and 5% cotton bags (Papier Mettler form Morbach/Hunsrück, Germany recited in: Philipp Krohn in: Frankfurter Allgemeine of 30.7.2008).

In opposite to the synthetic bags, the paper bag's environmental image is positive in the public, though wrongly. Eco-financial researches on disposable paper bags provide evidence of significant environmental burdens. Even in an eco-balance-sheet published by the Federal Environment Agency in 1988, the polyethylene bag scores better than the paper bag compared by the environmental impacts (UBA 1988). 20 years later, the Swiss Federal Laboratories for Materials Testing and Research (EMPA) come to a similar conclusion. They also ascertained the environmental impact of cotton bags and came to the conclusion that these have to be used minimum ten times before their environmental impacts are lower than those of the synthetic disposable bags (Zogg 2008, S. 15).

Because of the Storage Ordinance²⁷¹, since 2005 in Germany household waste may not be unprepared be deposited any more. Disposable bags of paper and synthetics either come to the mechanical or the exegetical recycling. In case of the waste incineration disposable bags can set free CO₂, and because of the applied colours, pigments, softeners or even heavy metals.

Using disposable bags spoils valuable resources, in particular raw oil and wood, in very short time. There is only the shopping bag or net for the multiple uses left as a sensible ecological alternative.

Objectives

This measure approaches a waste product that has a negative image in the general public, but still is used in masses: the disposable bag. Aim of the measure is to reduce the littering of the one-way bags significantly. But relevant environmental relief effects can be expected due to a change in the environmental awareness of the population as well as by the successful investment of the financial resources that can be raised.

Characterisation

The disposable bags of plastic and paper in the food segment, at the cash points for quite some years partly are only given out against payment of small minor fee of approx. 0.10 €. This might already have diminished the consumption of these products to a certain extend. Precise data on this effect are not available. By levying the disposable bags the "selling price" will significantly be increased, respectively, in the non-food segment, a pricing has to be established in the first place. With the measure a general procedure and considerable pricing is aspired. The tax or levy shall include all disposable, one-way bags, e.g. as well those of paper.

The taxation of plastic bags (Plas-Tax) was introduced in Ireland in 2002. By a tax of 0.22 € per bag, the emerging bags were reduced by 90 %. For the purchases they were substituted by mostly by the increasing use of reusable containers.

The detailed setting of a successful tax rate stays reserved to the practical specifications for the implementation of the levy. The levy should, in relation to material and costs of the production for the disposable bags, be set between 10 and 40 Cent per bag.

²⁷¹

Directive on the Environmentally-friendly Storage of Municipal Waste (AbfAbIV) of 20. February 2001.

Initiators and addressees

Initiators for a federal-wide levy on disposable bags are the responsible Federal ministries. In addition to this an EU-wide solution is favourable.

Addressee is the retail industry to whom the levy is intended for.

Waste prevention potential

Household plastic bags have a weight between 10 and 40 gram. So with an average of 20 gram annually 1.3 kg packaging waste per capita is generated. The determined 65 plastic bags per person and year result in 5.3 billion plastic bags with an approx. weight of 100,000 tons packaging waste year by year in Germany. Additionally there are more or less 50,000 tons of those very thin plastic bags that usually are given out on fruit markets. This leads to an annual overall volume of 150,000 tons of waste from synthetic bags in Germany (Residua Ltd. 2008). Due to the higher material weight of paper and cotton bags it can be assumed that they increase the waste volume about 100,000 tons as well. So the overall volume of waste is around 250,000 ton per year. In proportion to the residual waste emergence of approx. 35 million tons, the disposable bags have a share of approx. 0.7 per cent by weight.

To estimate the potential and the related environmental impacts, an overall range from 40 % to 80 % disposable bags less in consumption will be assumed²⁷². For the production and disposal (recovery) of one-way plastic bags this would mean a reduction of 50,000 t/a to 100,000 t/a. So this would mean an average of 75,000 t/a. Even though the number of emerging paper carrier bags is lower, the prevention potential is estimated on additional 50,000 t/a, due to the higher specific weight. The influence by an increase in the consumption of garbage bags and multiple usable bags, plus the bureaucratic efforts for the survey and accounting of the levy, has to be offset against the environmental relief. In the lump sum it cannot be made a final extrapolation of the reduction potential due to the only imprecisely calculable decrease potential and the counterproductive effects which cannot be numeralised exactly as well.

Because of the negative image of disposable bags, particularly plastic bags, that is widely spread in the public, the vigorously pricing of an environment levy on behalf of ecological reasons, positive effects can be expected. The support of an ecological awareness and the related, but hardly collectable side effects are such positive effects (cf. Example measure B V 1.1: Support of exemplary companies in the commerce by corresponding public relation work).

Environmental impacts

Paper and synthetics are disposed either materially or in a thermally. In both cases, the way of disposal aims to use the valuable attributes of these waste materials which can lead to larger environmental relief effects than what is directly related with the disposal itself. The ecological assessments look different when the environmental burdens from the manufacturing of these bags in included. Still the additional expenditure for multiple use

²⁷²

The prognosis of a specific saving referring to the amount of the levy cannot be made. The successes in Ireland cannot be transferred since the starting situation was different during the introduction of the Plas-Tax, so the arrangement was not identical with the present recommendation.

bags and increased consumption of garbage bags has to be set off against the amount of 125,000 annual tons. Therefore the direct environmental relief by this measure is likely to be low.

But for disposable bags of synthetic material there is also the problem of an inappropriate disposal. If they end up in the environment, they are not biologically degradable and harm in both, the ground and water (finally in the oceans) animals and enter their food chain.

Exemplary estimations on possible environmental reliefs will be explained in the example measure B V 1.1 (cf. Example measure B V 1.1: Support of exemplary companies in the commerce by corresponding public relation work).

Indicators

Sales figures of the according packaging manufacturers and the revenues from the levy.

Social impacts

Except from the packaging manufacturers there is no reason to be apprehensive of resistance or significant shifting effects.

The problem that results from the use of disposable carrier bags is already rooted in the broad public for quite a long time (Jute instead of Plastic). Therefore the measure should meet the acceptance of the greater part of the consumers.

Economic impacts

If it is presumed that by now in Germany about 10 billion plastic bags of diverse size enter the market and that the levy would diminish this number by the half, and then on approx. 5 billion disposable bags the levy could be collected. It should vary, depending on the material effort, between 10 and 40 Cents. With average amount of 20 Cents, this results in revenue of roughly one billion Euros.

Since disposable bags are still offered, the spontaneous purchases will not be complicated. From the retail industry's point of view therefore no relevant negative economic effects have to be expected.

Conclusion

Beside the described practical relief potentials, this measure has most of all a symbolic character, unfolding its relief effect on the environment as well by the side effects of the environmentally educating impact.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 1.2: Levy on disposable bags	
Objectives	The measure aims on the avoidance of disposable bags to the greatest possible extent in favour of multiple use containers (cotton bags or other conventional carrier bags).
Characterisation of the WP measure	By a levy on disposable bags the “selling price” will be increased significantly, respectively, in the non-food segment, a pricing has to be established in the first place. With the measure a general procedure and considerable pricing is aspired. The tax or levy shall include all disposable, one-way bags, e.g. as well those of paper.
Link to measures set out in Study I	(62) Plas-tax Ireland
Link to Annex IV WFD	11. Economic instruments
Type of measure/ Instrumental character	Taxes and levies
Initiators of the measure:	Federal level / additionally influence on EU
Addressees	Addressees are commerce and consumers
Waste prevention potential	In Germany each year approximately 150,000 t plastic bags are used. Paper bags where no figures can be presented add to this. The waste prevention potential cannot precisely be prognosticated. For the production and disposal (recovery) of one-way plastic bags this would mean an average reduction of approx. 50 %, i.e. 75,000 t/a. For paper carrier bags the prevention potential can roughly be estimated about 50,000 t/a.
Environmental impacts	Beside the relieving effects of the avoided production costs (quantitatively), the environmental problems of littering (qualitatively) have to be considered. The influence of the increasing consumption of garbage bags and multiple usable bags on the balance of environmental impacts reduces the relief. Example measure B V 1.1 provides exemplary estimations of possible environmental effects.
Indicators	Sales figures of the concerned packaging manufacturers.
Social impacts	Except from the packaging manufacturers there is no reason to be apprehensive of resistance or significant shifting effects. The problem that results from the use of disposable carrier bags is already rooted in the broad public for quite a long time (Jute instead of Plastic). Therefore the measure should meet the acceptance of the greater part of the consumers.
Economic impacts	Since disposable bags are still offered, the spontaneous purchases will not be complicated. From the retail industry's point of view therefore no relevant negative economic effects have to be expected.
Conclusion	Beside the described practical relief potentials, this measure has most of all a symbolic character, unfolding its relief effect on the environment as well by the side effects of the environmentally educating impact.
Recommendation	The example measure is recommended for the implementation.

8.1.2 Measure C VI 2: Greater prioritisation of waste prevention aspects in purchasing recommendations

Background

According to a survey of the BMU, more than half of the German population thinks that their consumption behaviour is a (very) important contribution to environmental protection (BMU 2010). The consumer should therefore necessarily have the opportunity to inform themselves about sustainability effects of a (complex) product, before they make a purchase

decision. And they should be motivated to take such opportunities. The media that comes into decision for this should be

- networking
- generally accepted
- (easy) understandable and
- if possible known by all consumers.

General quality assessments and purchase recommendations are currently published with more or less intensive reference on environmental topics, and are available in various media systems, like magazines, books or internet. Well known and respected is the Stiftung Warentest²⁷³, the more towards environmental protection oriented publishers ÖKO-TEST Verlag GmbH²⁷⁴, the consumer centres²⁷⁵, other consumer protection associations, e.g. the consumer initiative²⁷⁶. And above this various private product test platform exist on the internet, plus the trade and branch magazines with their web-pages, which give purchase recommendations and product assessments for their branches as well.

Focussed on the environmental performance of a product in the assessments and recommendations are the environmental and nature conservation associations²⁷⁷, some web-pages²⁷⁸ related to this field, plus the ministries and technical authorities for environmental protection of the Federation and the States. In addition to this there are two more web-pages where the focus is on consultancy for sustainable purchase:

- www.nachhaltig-einkaufen.de of the Consumer Initiative e.V. where general purchase recommendations on sustainability are given and
- www.ecotopten.de, a page that is run by the Öko-Institut in collaboration with the Institute for social-ecological Research (ISOE), promoted inter alia by the BMU. Here are practical products recommendations are given for – from the ecological point of view particularly important – top products of ten consumption branches (therefore the name ecotopten).

In the information on sustainable purchase, the ecological assessment is mostly focussed on the field's energy consumption and climate protection (CO₂ emissions). Therefore the following measure is recommended: "Internet platforms for recommendations for a waste-preventing purchase". The web-page promotes the collection and expansion of information for consumers to take purchase decisions that support waste prevention and resource conservation.

²⁷³ <http://www.test.de/>

²⁷⁴ <http://www.oekotest.de/>

²⁷⁵ Verbraucherzentrale Bundesverband e.V.: <http://www.verbraucherzentrale.de/>

²⁷⁶ <http://www.verbraucher.org/>

²⁷⁷ For instance: <http://www.nabu.de/> and <http://www.bund.net/>

²⁷⁸ Cf. e.g.: <http://www.utopia.de>

8.1.2.1 Example measure C VI 2.1: Internet platforms for recommendations on waste-preventing purchasing

Background

To give consumers an aid to their purchase decision-making there are various options: newspapers, television, flyers and the internet. Here the internet as information and consultancy media becomes more and more important (MARESS AP 12 2009).

The web-page of ecotopten.de for instance includes in their evaluation, beside environmental criteria, also product labels and quality tests (e.g. of Stiftung Warentest). As well the costs are a central element. Not only the purchase price of a product, like usual for EcoTopTen, but also the follow-up costs for the consumption of operating material, electricity, water or taxes, insurances and losses in value are considered. By the use of research results EcoTopTen formulated sustainable innovation targets were formulated and communicated towards interested enterprises. It is supposed to consider increasingly for the assessment of durability and reparability of products as well. The assessment of the products will be displayed transparently and understandable, in order to secure the liability of the platform for the consumers.

To motivate users of the website furthermore to access the service, the page should be designed as interactive as possible. An example is the interactive aid to decision-making for television sets on the page www.ecotopten.de. Here, a short questionnaire inquires the consumer behaviour to give individual advice on the important facts afterwards. Continuously the product range is extended and manifold information is updated. An update in shorter intervals would be desirable and should be included in the arrangement of the web-page proposed here. Alternatively the existing website should be extended accordingly.

Objectives

This measure aims on a resource saving and waste-preventing consumption by providing information and consultancy. In order to fulfil this, an interactive web-page shall be created that serves consumers for a wide variety of products as a source of information and aid for their purchase decision-making. In addition to the already emphasised key points energy consumption and climate protection (CO₂ emissions), the criteria resource conservation and waste prevention shall be integrated in the product evaluation. Alternatively an already existing internet platform for ecological purchase decisions could be extended on these criteria.

The measure aims therefore on a change of the consumer behaviour by targeted information towards the consumption of resource saving and waste-preventing products. Products which have a short durability, respectively which are not provided with repair options are either not represented on such an internet platform or accordingly marked and rated. If an increasing number of consumers call the internet platform in for their purchase decision, it can be assumed that the consumption of durable and easily repairable products increases as well. The constantly rising access statistics of the page ecotopten.de (Graulich 2007) for instance, point towards a growing interest of consumers in internet platforms for ecological purchase decisions. Furthermore by learning and cost-saving decisions of the consumers, reactions from the markets can be provoked. This means, the more sensitive the

consumers react on questions of material and resources, the sooner companies will react on such aspects (MARESS AP 12 2009).

Characterisation

The governmental actors initiate an internet platform that evaluates products of a widest possible range according to general environmental criteria with a proper consideration of the criteria resource conservation and waste prevention. Important points are the durability and the repair options of the evaluated goods. Above these, additional, for the consumer particularly relevant criteria shall have some influence on the evaluation.

According to the model of EcoTopTen the platform will offer practical tips for each product group, beyond the purchase decision. This means that recommendations for the handling of products will be given (e.g. maintenance of washing machine or dish-washer, reference to duplex printing or energy-saving), alternatives on the purchase will be offered (e.g. option of rental garden equipment), and the possibility of repair or second-hand sale to recover, respectively, the proper disposal of products will be explained. These tips should, if possible, be optimised with links to interregional web-pages, and in particular, to regional suppliers.

The platform will be published with according measures, like collaborations with different organisations (e.g. consumer protection centres, environmental associations) and media partners in order to reach the highest possible share of consumers. By partnerships with one of the multiple stakeholders of the re-use community (associations and networks of second-hand warehouses and repair services et al.) and the new production (industry associations, brand manufacturers et al.). Plus, taking in the commerce as well, here with the securing of credible neutrality and independence, the efficiency and acceptance of the page will be increased in all directions.

It should be reviewed, whether the information can be offered without initiating a new page, if an existing and well established page could be extended complemented. In the best case, this could be taken as an opportunity to lead some of the existing pages together and increase therefore their level of awareness and acceptance.

Initiators and addressees

Initiators of the measure are governmental institutions on the Federal level in collaboration with the responsible authorities on the States level.

Addressees of the measure are existing institutions with the competence to evaluate and collect data.

Indirectly all consumers, producers and the commerce.

Waste prevention potential and environmental effects

This measure contributes in the information and raises the awareness of consumers, the commerce and the producers, and it supports therefore the all other measures. The reduced consumption of short-living and not repairable products leads to the diminishing of emerging waste with the connected environmental effects without offering precise figures.

Indicators

Indicator is the successful establishment of a comprehensive internet page on ecological purchase recommendations, and here in particular on waste-preventing products. The number of accesses on this page would be an indicator as well. Above this, surveys under the page users can deliver data about its quality and functionality. In addition to this the level of consumer awareness can be surveyed.

Social and economic impacts

Negative social and economic impacts by this measure are not expected.

From the consumer protecting point of view, offering transparent information is an improvement of consumer education.

Conclusion

The measure promotes knowledge and sensitivity of consumers in reference to resource protecting and waste-preventing products. It promotes sustainable consumption and therefore saves resources and prevents waste in the long term.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 2.1: Internet platforms for recommendations on waste-preventing purchasing	
Objectives	With the support of an internet platform the consumer will be informed in waste-preventing products. Additionally purchase recommendations will be given, in order to support sustainable consumption
Characterisation	As many products as possible will be evaluated according to their durability and reparability, and the consumer will be informed about this. Recommendation on product handling and alternatives to the purchase will be offered. The page will be raised to awareness by several other measures.
Link to measures set out in Study I	(267) EcoTopTen
Link to Annex IV WFD	12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers
Instrumental character	Consultancy
Initiators of the measure:	Public authorities, waste management
Addressees	Institutions for consumer consultancy
Waste prevention potential / Environmental impacts	The consumption of durable and repairable products leads to a reduction of the waste emergence with the connected environmental effects without offering precise figures.
Indicators	Successful establishment of a comprehensive internet page on ecological purchase recommendations, here in particular on waste-preventing products. Number of accesses on this page.
Social and economic impacts	No negative effects expected.
Conclusion	Sustainable consumption and therefore resources savings and waste prevention are promoted in the long term by information and increased awareness.
Recommendation	The example measure is recommended for the implementation.

8.1.3 Measure C VI 3: Consideration of waste prevention as a part of meaningful ecolabelling of products

Eco-labels can contribute a significant support for environment-friendly consumption by taking the effort from the consumer, to collect information on eco-friendly products for each single purchase. A liable and clearly communicated label can help that at least a certain share of the consumers in case of doubt rather decides for the eco-friendly product in the moment the purchase decision is made. With the Blue Angel Germany has an established eco-label over quite a long period of time. Therefore, as example measure, the “enforced consideration of waste prevention aspects in the award criteria of the Blue Angel” will be described.

8.1.3.1 Example measure C VI 3.1: Greater consideration of waste prevention aspects in the award criteria of the Blue Angel ecolabel scheme

Background

The Blue Angel is deemed to be the best-known eco-label worldwide. Since 1978 eco-friendly products and services are awarded, which are selected by an independent jury according to defined criteria. “The Blue Angel is awarded to companies as kind of a reward for their commitment to environmental protection. They use it to professionally promote their eco-friendly products in the market.”²⁷⁹ The Blue Angel is an instrument of the environmental policy that is voluntary and in line with the market. It is made to accelerate the structural change of the economy towards a sustainable development.

Holistically developed awarding principles of the Blue Angel are attached to four protection aims (“save the climate”, “save the resources”, “save the water”, and “save environment and health”). Currently there are awarding principles of the Blue Angel for 120 product groups. For waste prevention particularly relevant are the 13 product groups in the focus of “resource protection”.

The Blue Angel's brand core traditionally is strongly influenced by the topic of resource protection, i.a. by aspects like the promotion of recycling, recovery, or in general the waste prevention²⁸⁰. In the course of the MaRes project, other view points as strategic options for the enhancement of the Blue Angel were developed and analysed, and this could support waste prevention through an efficient resource input.

1. Products from “resource-light” materials,
2. products from secondary raw material (is already addressed in recycling paper products, in some construction products, plus recycling synthetics),
3. products of renewable raw material,
4. products with an extended lifespan (partly already addressed today in the segment electronic and electrical devices, e.g. by the supply with spare parts, guarantees, simple exchange of accumulators),
5. resource-efficient services (occasional examples, like car-sharing, cleaning services are already taken in today).

²⁷⁹ <http://www.blauer-engel.de/>

²⁸⁰ http://ressourcen.wupperinst.org/downloads/MaRes_AP12_5.pdf, S. 6

In particular the points 1, 2 and 4 clearly feature a relation to the aims of waste prevention. Table 8-2 lists the five product categories in the field of resource conservation with most licence holders.

Table 8-2: Product categories of the Blue Angel “save the resources” (source: www.blauer-engel.de)

Name and number of awarding principle	Enactment year	Period of validity until end of*	Licences	Provider
RAL-ZU 5 Hygienic paper of recycling paper Save the Resources	1979	2013	239	63
RAL-ZU 14 Recycling paper Save the Resources	1982	2013	473	186
RAL-ZU 30a Products from recycling plastics Save the Resources	1984	2012	104	49
RAL-ZU 35 Wallpaper and woodchip from mostly paper recycling Save the Resources	2006	2014	162	66
RAL-ZU 56 recycling cardboard Save the Resources	1989	2013	263	84

The waste prevention aspect should be strengthened beyond this. To get there, for instance the project “Top 100 – Eco-labels for Climate-relevant Products”²⁸¹ can be taken as a model.

In the framework of the national climate initiative a project for the promotion of product-related climate protection was initiated by the Blue Angel (“Top 100”, project period 2009 to 2012). The Top 100 systematically researches aspects of climate protection in the most important product groups. From this, new awarding criteria are derived, than discussed with the market participants, and finally set as standards. The ultimate objectives are fostering rapid transformation of markets towards energy-efficient best products, pointing consumers the climate-friendly way to their purchase decision, plus to extend and optimise product-related information systems.

The following practical project objectives are aimed with climate-related eco-labels:

- highlight ecological and cost-related reduction potentials for the 67 product groups with climate relevance,

²⁸¹

cf.: http://www.bmu-klimaschutzinitiative.de/de/projekte_nki?p=3&d=301

and

http://www.blauer-engel.de/de/blauer_engel/presse/newsletter/newsletter_detail.php?we_objectID=188

and

http://www.oeko.de/forschung_beratung/themen/nachhaltiger_konsum/dok/1122.php

- comparison of the carbon footprints of conventional and best products using exploratory eco-balance sheets,
- derivation of awarding criteria,
- set market incentives, plus motivation of manufacturers and commerce for the development and marketing of best products,
- development of target-oriented communication and information strategies for consumers, as well as for manufacturers to increase the acceptance of the eco-label,
- consumer information for the purchase and use of climate-relevant products,
- derivation of stipulations on new product groups according to the Eco-Design Directive. And for Best-Products according to promotion programmes for products, derivation of innovation objectives for product-related innovations in the companies.

During the project, screening-PROSA-assessments²⁸² will be conducted for the selected product groups and services. They contain a market and stakeholder analysis, an oriented eco balance, a life-cycle-costing, a benefit analysis, and rating models to derivate awarding criteria.

For example to date the following product groups assessments were carried out:

energy meter, baking ovens, solar battery chargers, dish washers, microwaves, extractor hoods, compact fluorescent and LED lamps, compact desktop computers (netbooks), VoIP telephones, eco-friendly vessel operation, thermally insulated windows, HiFi compact stereos, lithium-ion accumulators, thin-clients, water-saving shower head, wood chips and pellets, E-book readers, passenger elevators, toasters, desktop computers and computer keyboards, portable computers, computer monitors and many others.

It is to be examined, whether the waste prevention aspect can be supported in awarding the Blue Angel, similar to the initiative “Top 100” project for the Blue Angel segment “save the climate”. Using the experiences concerning waste prevention and resource conservation made during this project, the most important product groups shall be identified to receive particular awarding criteria. But it has to be considered that finding criteria for the field waste prevention is clearly more difficult than for climate protection. Therefore it should be reviewed from the start, which groups of consumer goods have a priority to be labelled.

It is also to be reviewed, if updating the awarding criteria for existing product groups finds the licensees' acceptance.

Objectives

With this measure the aspect of waste prevention shall be lifted to a higher level in the connection with resource conservation in the awarding of the Blue Angel. Above this it is to be published that waste prevention aspects are taken more into account, and that

²⁸²

PROSA - Product Sustainability Assessment is a method of the Öko-Institut for the integrated analysis of ecological, social and economic impacts: <http://www.prosa.org/>

recognising the label in purchase decisions, essentially contributes to environmental and resource conservation.

Characterisation

The Blue Angel aims on consumer products, where in general all products that fulfil the corresponding award criteria, can apply for the Blue Angel. In selected product areas the awarding criteria will additionally be used as recommendations for the environment-friendly procurement.

It is to be examined, if an initiative similar to the “Top 100” project on the Blue Angel “climate protection” can also identify the most important product groups in respect of waste prevention and resource protection. Awarding criteria are to be developed in order to reach this target.

Initiators and addressees

The measure needs the initiative of the organisation which master-minded the Blue Angel²⁸³:

- the Federal Ministry for Environment, Nature Conservation and Nuclear Safety as label owner;
- the Federal Environmental Agency targeting “Eco-Design, Environmental Labels, Environment-friendly Procurement” develops the technical criteria and the awarding fundamentals of the Blue Angel in terms of being the agency of the eco-label jury;
- the Eco-label jury as independent decision committee with representatives of environmental and consumer associations, worker unions, industry, commerce, craft and trade, municipalities, science, media, churches, and individual Federal States;
- and the RAL gGmbH as being the awarding administration.

Addressees of the measure are both, the producers as well as the consumer, whereas both, private persons can orientate in the Blue Angel, but the label, or rather the awarding criteria behind, also can be used as basis for waste-preventing (public) procurement.

Waste prevention potential and environmental impacts

Since the measure only indirectly prevents waste, a specific estimation of the prevention potential, or the related environmental impacts, is virtually impossible. In the framework of an empirical survey though, it was stated that labelling ecologically advantageous products with the Blue Angel increases the average willingness of consumers, to pay a higher price for such products: 36 % of the questioned persons are willing to pay 5 % more, 12 % would pay up to 10 % more, and 2.5 % would even pay up to 15 % more²⁸⁴.

Indicators

Suitable indicators to control the success of this measure are:

²⁸³ http://www.blauer-engel.de/de/blauer_engel/wer_steckt_dahinter/index.php

²⁸⁴ <ftp://ftp.zew.de/pub/zew-docs/dp/dp9525.pdf>, S. 6

- number of product groups where the aspect waste prevention is adequately considered;
- number of products of these groups labelled with the Blue Angel.

Additionally surveys can raise the awareness level of the environmental award Blue Angel, as well as the satisfaction of the consumers.

Social and economic impacts

Negative social or economic effects are not expected from this measure. The costs for extending the criteria could at least partly be compensated by expanding the included products, and the connected returns from licensing. The precise costs depend on the concrete arrangements of the measure.

Conclusion

The Blue Angel is established as environmental label. An alternative in opposite to this would rather lead to insecurity on the consumer's side.

To increase the consideration of waste prevention aspects in awarding the Blue Angel, and for that reason to carry out a project according to the model of TOP 100, can in principle support information and sensitisation of implementing waste prevention measures. But also a number of problems are to be assumed which requires thorough examination of the prospects of success of this measure. In particular these are:

- It is difficult to set suitable criteria for the requirements of waste prevention (durability, recyclable and such).
- It is difficult to ask the licensees of the environmental angel subsequently to include criteria into their product groups.
- The designation only of new product groups is not considered to be effective, because the most important product groups are already included today.

Recommendation

The measure is recommended under the condition that an examination stating that meaningful criteria for waste prevention can be defined and suitable product groups can be identified.

Example measure C VI 3.1: Greater consideration of waste prevention aspects in the award criteria of the Blue Angel ecolabel scheme	
Objectives	The aspect of waste prevention in connection with resource conservation is to be strengthened in awarding the Blue Angel.
Characterisation	With an initiative similar to the Top 100 project on the Blue Angel "climate protection", the most important products are to be identified in respect of waste prevention and resource conservation. Awarding criteria are to be developed in order to reach this target. Besides, the prompt up-dating of the awarding criteria for existing product groups is carried out.

Example measure C VI 3.1: Greater consideration of waste prevention aspects in the award criteria of the Blue Angel ecolabel scheme	
Link to measures set out in Study I	(31) Support of ecological product labels (Blue Angel) (231) Support programme "Fabrik der Zukunft" (future plant), example: establishing a sustainability label for repair-friendly constructed electronic and electrical devices (white and brown goods)
Link to Annex IV WFD	13. Promoting reliable eco-labels
Instrumental character	Consultancy/labelling
Initiators of the measure:	BMU, UBA, RAL gGmbH, eco-label jury
Addressees	Consumers, industry as being manufacturers and in charge for the procurement, public authority procurement departments.
Waste prevention potential / environmental impacts	Supports waste prevention indirectly. Specific estimation of the prevention potential is not possible. But surveys reveal that consumers use eco-labels.
Indicators	Product groups where the aspect waste prevention is adequately respected. Number of products of these groups that are labelled with the Angel.
Social and economic impacts	No negative effects expected. Measure supports consumer protection.
Conclusion	The Blue Angel is established as environmental label. An alternative in opposite to this would rather lead to insecurity on the consumer's side. To increase the consideration of waste prevention aspects in awarding the Blue Angel, and for that reason to carry out a project according to the model of TOP 100, can in principle support information and sensitisation of implementing waste prevention measures. But also a number of problems are to be assumed which requires thorough examination of the prospects of success of this measure.
Recommendation	The measure is recommended under the condition that an examination stating that meaningful criteria for waste prevention can be defined and suitable product groups can be identified.

8.1.4 Measure C VI 4: Green / waste-preventing procurement

Background

Measures for the promotion of environment-orientated and waste-preventing procurement in the public sector can for one thing start at a specification of the administrative regulations regarding waste prevention by the Federation and the Federal States. On the other hand, the support of the consequent implementation by multiplexed and structured information of the procurement operators is necessary.

Measures in this field describe an important exemplary role of the public sector, regardless of their specific waste prevention potential. Besides that, they offer a potential for the expansion on the private sector, and influence the commerce, to take environment-friendly and low-waste products into their assortment, respectively, the manufacturers, to produce them.

Volume of orders and signal effect

An ecology-oriented public procurement of goods and services by private and public institutions can stimuli pioneering ecological innovations for an ecological transformation of the market economy.

Thereby the particular attention is on the public procurement. Not only by the high annual of the public consume amounting to 260 billion EUR throughout Germany (Acker et al. 2010), the public authorities have a market power exercising a significant signal to the private economy.

For instance is the share of the public expenses and investitures in the overall demand in Germany in the segments transport infrastructure around 98 %, supply and disposal 46 %, IT and electronic devices around 21.5 %, new construction and renovation without public housing around 6 %.

Approximately 63 % of the overall demand volume origin from municipalities including public enterprises, 25 % from the Federation including subordinated authorities, research institutions, Federal Employment Agency and Deutsche Rentenversicherung / Federal Pension Insurance, and 12 % from the individual Federal States (McKinsey 2008).

This volume of orders from the public authorities, in itself, can be decisive trigger and incentive for the producing economy to invest in sustainable and ecologically innovative ways of production and market solutions. Long-term purchase agreements with the public authorities reduce the inhibiting effects of investment risks for companies, like they occurs in form of costs of market entry and the risk of Sunk Costs²⁸⁵.

In opposite to a private frame, public procurement offers a larger scope for specific requirements on targeted controlling of ecology-oriented industry policy in ordinances and administrative regulations. Specific requirements can save labour costs in the segment of procurement, like practitioners keep emphasising (MLUR 2011). Thus the measure also contributes to the reduction of bureaucracy on the national and European level. In the framework of rules on public contracts ecological potentials can directly be realised, and suitable measure be evaluated. In connection with the ecology-oriented public procurement, the suggested measures have an increased chance to be implemented. Subsequently, and if the measures, investments, products and services prove the test of time, they can be expanded on the private sector in the course of an ecological regulation.

Waste prevention effects of the public procurement

In the context of the WFD the private or public procurement has a high waste prevention potential. Depending on the formulation of the respective procurement directives and ordinances, and the implied life-cycle costs, waste-preventing and ecologically advantageous effects arise on all up and downstream levels of the structured life-cycle stages, like e.g. on the choice of resources and working materials, the product design or possible recycling and reuse decisions. Decisions of public procurement for ecologically innovative solutions in the field of goods and services imply therefore a considerable waste prevention potential, in particular when durability, intensification of use and recycling or reuse are consequently realised in the process management of the public procurement.

The point is that an ecological public procurement will be superior when life-cycle costs are considered from the perspective, narrowed down to a strictly operational economic analysis. Here, the follow-up costs in form of costs for utilisation and disposal will be set in relation to

²⁸⁵

The term “Sunk Costs” describes executed investments, mostly in large-scale projects, and investments in infrastructure which cannot be liquidised again afterwards and are lost in case of project failure.

acquisition costs. Consequently, in view of the relation between economic and ecological benefit, a win-win situation is created. The analysis of life-cycle costs which was already carried out, highly affects the waste and surplus quantities related with public procurement, and thus partly exploits the existing waste prevention potential.

In a comprehensive economic analysis, that is, regarding external costs in form of ecological and social impacts, which are caused by the production and consumption and go beyond the business horizon. Exact figures of the waste prevention potential can only roughly be estimated due to the structural valuation problem of external costs²⁸⁶. For relevant product groups though, specific calculation support would be necessary. Considering ecological aspects in the public procurement has both, quantitative as well as qualitative waste prevention potentials in relation to the volume of waste and surplus material.

Legal scope for relevant measures on waste prevention

The options for decisions of the public procurement are generally determined by international and national procurement law, specified in European and national regulations and standards²⁸⁷. Another crucial factor is to be found in the European principles for a free movement of goods and services. Within these, basic principles that are reflected in the European procurement directives (free movement of goods and services, principle of non-discrimination, right of establishment et al.). The procurement directives are guided by the principle of equal opportunities, thus by equality in competition, as well as the principles of transparency and publication of public contracting. The guidelines on European level were implemented in national, regional (Federal State) law and municipal law by the means of various bills (Acker et al. 2010).

The State-specific and municipal law regulations on public procurement differ to a large degree and the aspect of ecological public procurement is very unspecific in wide parts, and formulated rather abstract. Therefore an ecologically innovative public procurement for the particular institutions connected with high legal risks a high degree of legal uncertainty (Hermann/Acker 2010).

Obstacles and need of action

The ecological benefit of ecological public procurement in general and the waste prevention potential in particular, are currently rather underused. Especially technical and legal risks are obstacles to the ecology-oriented and innovation-oriented public procurement.

Depending on the complexity of the subject of tendering, the demand on the technical and legal knowledge of the persons in charge for the procurement increases. Particularly innovative new solutions increase information efforts and uncertainty, since new procedures

²⁸⁶ The valuation of external effects can economically only be determined approximately; exact figures in monetary terms fails due to a multitude of problems, like absent markets, inadequate accountability to causers et al. (UBA 2007).

²⁸⁷ Central EU standards derive from guidelines 2004/17/EC, 2004/18/EC, and various EuGH decisions, e.g. the cases C-513/99, C-448/01, German procurement law complies usually to §§ 97 ff. ARC (GWB), Ordinance on the Award of Public Contracts (Vergabeverordnung, (VgV)) and contracting rules for public contracts VOL/A (award rules for services), VOB/A (Contract Procedures for Building Works) and VOF (freelance services).

need to be tested first. Connected are also other risks, located in the project management, that retroact from the technical complexity and the lack of technical experience. The legal risks are mainly given by the legal uncertainty regarding the correctness of the procedures in terms of public procurement law, plus a possible cancellation afterwards (Hermann et al. 2009).

These risks mentioned above also reflect in the analysis of the existing State-specific ordinances on the award of public contracts for procurement. To a very far degree, they show differences and uncertainties regarding the possibilities in the field of an ecological public procurement. This is revealed as well by the fact that there are rarely binding regulations in the individual Federal States and the little specific, rather abstract procurement guidelines (Hermann/Acker 2011).

It is criticised that the public procurement was not allowed to be used for the promotion of innovations, since the procurement departments (resp. centres) were overburdened with that (Hermann et al. 2009).

The risks, resulting from the lack of information and technical knowledge as well as from legal uncertainties, are the main causes that the recourse is made to traditional, but ecological harmful technologies, products and services, instead of reaching the full potential of ecologically innovative solutions. These aspects of waste prevention are not sufficiently considered, and therefore important potentials of environmental relief are only inadequately respected, is accompanied with this.

To reach the full potential of waste prevention in the public procurement to a higher degree, there is a need of action which is examined closer in the following measures:

- Complementing and specifying the public procurement laws or ordinances of the Federation, the Federal States and the municipalities by standards for a waste-preventing and resource-saving public procurement.
- Development and expansion of competence centre for sustainable procurement

8.1.4.1 Example measure C VI 4.1: Supplementation and concretisation of the public procurement laws, ordinances and administrative guidelines of the Federation and Federal States to include waste-preventing and resource-conserving provisions

Background

The formulation of the public procurement laws or ordinances of the Federation, and the individual Federal States consider the aspects of waste prevention, but as well other environmental aspects, in varying consequence and with little specification. With the measure, comprehensive and detailed administration regulations as complementation of procurement law and ordinances shall be stimulated on the Federal, States and municipal level. As example, the “Administrative Provision for Procurement and Environment of Berlin” (Berliner “Verwaltungsvorschrift Beschaffung und Umwelt” (VwVBU)) shall be taken. The tables 8-3 list concrete examples for restrictions and exclusions on procurement of the Berlin public procurement directive that address directly to waste prevention. Table 8-4 shows exemplary the assessment of demand and according service description on the example of the Berlin VwVBU.

Using these examples, a degree of concretion and detail can be shown that offers specific restrictions, respectively exclusions on procurement, plus detailed specifications of services and performance sheets. In order to make the actualisation of the specific standards on technical details easier, they could be included in the technical specifications. In the procurement ordinances are to give the technical specifications a binding character.

Table 8-3: Restrictions / obviations on procurement with waste/preventing effect of the Berlin VwVBU, annex 1 from 19.09.2011: (in extracts and not final, compiled by authors)

Type of restriction or exclusion	quantitative WP	qualitative WP
Electricity from nuclear production resp. combined heat and power		+
Devices for hot drinks in individually packed portions	+	
Mineral water, beer, soft drinks in one-way packaging (except cardboard packaging)	+	
disposable tableware and cutlery in canteens, university cafeterias and major events	+	
Products whose transport packaging contains less than 80 % of recycling material	+	
Colours on heavy metal basis		+
Construction material with partly halogenated CFC and FC contents, respectively their use in the production		+
Wood/based panels whose equilibrium concentration is greater than 0.5 ppm		+
PVC construction parts with lead and cadmium stabilisation or without labelling or take/back guarantee of the manufacturer		+

Requirements on the devices to be purchased will be made in these specifications of services, like e.g. available spare parts to support the reparability of imaging devices “printer, fax machines etc.”, durability of energy-efficient lamp, modular construction for printer cartridges for the reuse (see also table 8-3 and 8-4). These and similar standards serve other procurement institutions as guide and example (best-practice) and can in general be used as a model for the private procurement.

Objectives

With this measure an improved information basis and a secure legal basis for waste-preventing and ecology-oriented procurement processes shall be initiated. With clear standards on the procurement of waste-preventing products in the procurement ordinances plus specifications in complementary administrative provisions, the legal risks and the related efforts of a committed ecological procurement shall be minimised in the practical work.

The implementation of the waste prevention and environmental relief potential of an ecological procurement shall be improved.

Characterisation

With the measure the standards of waste-preventing and resource-efficient procurement in laws and ordinances for the award of public contracts on the Federal and States level will be enhanced, and, as far as possible, brought into agreement with each other. Comprehensive and detailed administration provisions will be released as specifications and complementa-

tion. As an example, the “Berliner Verwaltungsvorschrift Beschaffung und Umwelt (VwVBU)” (Administrative Provision for Procurement and Environment of Berlin) shall be taken.

Table 8-4: Assessment of demand and service characterisation on the basis of specific performance sheets according to the Berlin VwVBU, annex 1, (in extracts and not final, compiled by authors)

Type of service characterisation (exemplary)	quantitative WP	qualitative WP
Fluorescent lamps The average lifespan of the lamps amounts minimum 10,000 hours according to EN 50285. The lamps fulfil the requirements of the highest possible class of energy-efficiency. The lamps contain less than 5 mg mercury. Source: EU eco-label (2002/747/EC), EU energy-label (98/11/EC)	+	+
Refrigeration appliances In the device halogenated organic compounds are prohibited as coolant and foaming agent or in the production of the insulating material. Halogenated polymers are not allowed. Neither halogenated organic compounds are allowed to be added as flame retardant. In addition, no flame retardants are allowed that are marked with the R/sentence R 50/53 according to table 3.2 of the annex VI of the EC directive 1272/2008.		+
Rechargeable alkali and manganese batteries In 100 % discharging minimum 25 charging cycles are possible. The batteries do not contain any material as constitutional components that are mentioned in the EC Directive 12/72 2008 are marked in the annex II of the same directive with the danger symbol and code letters: (T+) and (T) have to be marked with the R/sentences according to annex III of the same directive. The batteries may neither contain cadmium nor mercury. Source: Blue Angel, RAL-UZ 92 of May 2009, EC Directive 12/72 2008.	+	+
Imaging devices / fax machines <u>Reference for the client:</u> Imaging devices are printers, scanners, fax machines, copiers and multi-function devices. The devices have to be able to work with recycling paper from 100 % waste paper which have to be in accordance with the stipulations of the EN 12281:2002*. For the repair of the devices, the spare part supply has to be guaranteed minimum 5 years after delivery. Spare parts are such parts which can fail typically during the usual application of a product. Other parts that regularly last above the lifespan of a product lifespan are not to be seen as spare parts. The applied printing modules are taken back by the providers and prepared for the reuse. For the device, single cartridges in all colours are available. Sources: Energy Star (2009/347/EC), Blue Angel RAL-UZ 122 of May 2009, Blue Angel RAL-UZ 55 of March 2008, EC Directive 1272/2008, Guideline 98/101/EC, Guideline 91/157/EEC.	+	+

*Print and office paper requirements on copiers for the duplication with dry toners; German version EN 12281:2002.

Initiators and addressees

The measure will be executed by the Federal and States ministries which are responsible for the public procurement, and will be supported professionally and technically by the ministries of the environment as well as the concerned agencies. It aims binding on public procurement institutions and guiding on private suppliers.

Waste prevention potential

A reasonable estimation of the overall waste prevention potential of measures on public procurement is not possible on the basis of the today available data (cf. also Hermann et al. 2009).

Targeted waste concerning a prevention concept in the field of the Public Procurement can be found preferably in the segments of stationeries, electronic devices, IT products, canteen supply, construction projects and vehicles. A focus with high potential of prevention could be the reduction of the paper consumption by the optimisation of the EDP and communication processes, respectively, the consequent conversion to the use of recycling paper (MLUR 2001). The recovered paper utilisation rate was in 2009 in total at 70 %²⁸⁸, graphic papers at 49 %²⁸⁹. There definitely is a potential for growth which could help to protect the resource wood. The wood saved by this way, can be used instead of this for other purposes, and replace fossil fuels.

Potentials to prevent waste are just as well to be found in the public procurement area of IT products, like computer, monitors and printer itself.

For instance, in the public administration of the Federal State Schleswig Holstein, 22,000 IT jobs do exist. This equals a share of 20 % of the all jobs in the State's administration. Most of the procured desktop PCs and the required peripherals (monitors, keyboards, cable etc.) have an average lifespan of 4 to 5 years, so annually about 4,000 to 6,000 new PCs with equipment are procured. The share of laptops rises thereby²⁹⁰ (MLUR 2001).

Desktop PCs, exclusive of monitors, have a raw material demand²⁹¹ of approx. 109 t/t, whereas laptops have about 270 t/t (Giegrich et al. 2012). But the weight of a desktop PC is 11.3 kg, those of a laptop is only 3.2 kg (Ecoinvent, Prakash et al. 2010). Therefore a desktop PC causes about 370 kg more raw material demand than a laptop. The for the use of a PC required monitor in addition increases the difference even further to the disadvantage of the PC.

If the procurement would mostly be converted towards laptops and the medium lifespan of the procured laptops increased by 20 %, per IT workplace more than 150 kg raw material, respectively, per purchased computer 600 kg could be saved annually. If one applies the share of approximately 20 % IT workplaces from the Schleswig Holstein State's administration to the overall number of employees in the public service in Germany according to the figures from the middle of the year 2010 of approx. 4.7 million²⁹², altogether one million IT

²⁸⁸ In the measure programme sustainability of the Breg of 6.12.2010, it is regulated that the input of recycling paper has to be increased from now 70 % up to 90 % until 2015.

²⁸⁹ Info Association of German Paper Factories (Verband deutscher Papierfabriken). Paper 2010 at <http://www.umweltbundesamt-daten-zurumwelt.de/umweltdaten/public/theme.do?nodeIdent=2314>

²⁹⁰ In 2009 in Germany in total 13 million of PCs were sold, 8.7 million of that as laptops (Prakash et al. 2010).

²⁹¹ The raw material demand is indicated in t raw material per t product/material. Here in the text simplified as t/t.

²⁹² Employees of the Federation, the States, communities and administration unions, incl. the indirectly public services (professional and regular soldiers, social insurances carriers, German Federal Employment Agency, German Central Bank, Federal Railway's asset management, successor companies of the former

workplaces can be assumed. The overall raw material demand that could be economised in Germany by the above described conversion to laptops, and the choice for devices with a longer lifespan, in the public IT procurement, results therefore in more than 150,000 t/a. Still it has to be considered that the conversion to laptops will not automatically lead to environmental relief effects (cf. chapter Waste prevention potentials and environmental impacts of measures prolonging the lifespan).

With this waste prevention measure, beside the quantitative, as well the qualitative prevention can be supported. Because in the public administration also relevant quantities of waste are produced, which have to be covered by a consignment note, and which shall be addressed in the course of the ecological procurement²⁹³

Environmental impacts

Relatively specific statements are available on the greenhouse gas emissions of the public authorities in the field of energy consumption (electricity, heating, mobility). According to this, the public sector contributes with 42.8 million t CO₂ equivalents to a total of 4 % of overall emissions in Germany. Approximately 55 % of the emissions are caused by the public sector in the building segment, and here again, 60 % result from their heating (McKinsey 2008). Similarly specific data for the segment waste prevention are not available, by now.

Indications for the potential of the procurement of office devices result from the following information:

The production per ton desktop PC, exclusive the monitor, is connected with a greenhouse gas emission of approx. 22 t CO₂-eq, plus an acidification potential of about 150 kg SO₂-eq which amount to 190 t CO₂-eq and 340 kg SO₂-eq per ton laptop (Giegrich et al. 2011). Per device for the desktop PC this results in approx. 250 kg CO₂-eq, respectively, 1.7 kg SO₂-eq, and for the laptop about 600 kg CO₂-eq, respectively, 1.1 kg SO₂-eq. By an extension of the lifespan per PC (assumption 50 % desktop PC and 50 % laptops) of 20 %, in the whole public administration throughout the Federation, almost 100,000 t CO₂-eq and almost 300,000 kg SO₂-eq can be saved annually.

On the manufacturing side there is, regarding these environmental effects, in opposite to the overall raw material consumption, a clear advantage of desktop PCs compared with the laptop to be noted. But in the utilisation phase, the laptop uses less energy. The utilisation phase contributes, depending on the specific device and the survey method, between 6.6 and 74 % to the overall greenhouse gas emissions of a complete laptop life-cycle. A specific consideration can therefore only be derived from the individual case (Prakash et al. 2010). Independently from the individual case, those environmental impacts for the manufacturing of PCs that should be reduced by a longer and/or more intensive utilisation phase can be categorised as important.

public post office, and corporations, institutions and foundations under public law) according to BMI (2011).

²⁹³

In Germany in 2008 in the economy segment “public procurement, defence, social insurance” 2.48 million Mg waste which have to be covered by consignment notes were produced by 2,191 waste producers. This is 11.4% of the overall accrued volume in Germany (MLUR 2001, Destatis 2010b).

Repairing defect printer parts prevents the disposal of other, still working parts. Thereby, in particular in case of colour laser printers, the burden of the production per device of 240 kg CO₂-eq, 1.6 kg SO₂-eq and 4,628 MJ cumulated energy demand (Stobbe 2007), will be distributed over a longer lifespan. In comparison, the production of one coloured toner module is related with 216 MJ cumulated energy demand (Ecoinvent 2012).

Like the examples here and in the chapter “Waste prevention potentials and environmental impacts of lifespan prolonging measures” present, in the individual case public procurement can lead to even relevant contributions to the reduction of environmental pollution. An accurate estimation, in terms of figures regarding the overall measure, is not possible!

Indicators

Number of the actualised, specified and detailed administration regulations on the Federal, States and municipal level.

Social impacts

Negative social impacts are not related with the measure.

Economic impacts

The large volumes of contractual agreements with public authority's effect investment-friendly the green low-waste products, and therefore support, respectively, ensure growth in innovative ecology-oriented economy sectors. Above this, multiplication effects on the national economy can be foreseen, which will stimulate employment, productivity and sales in these branches.

Public authorities have therefore a pioneering role with model character for the private economy.

Conclusion

This measure can enable the inclusion of qualified guidelines for the waste-preventing procurement into the public procurement laws and ordinances of the Federation, the Federal States and the municipalities. Thereby an improved information basis and legal security will be achieved. The waste prevention potential can only be calculated as an example. But it can be assumed, by means of individual exemplary estimations, and in consideration of the substantial volume of contractual agreements of the public authorities, that altogether the volume is relevant.

An important function of this waste prevention measure is that the public authorities take a role model character, in order to show that the guidelines for waste prevention are taken serious in the public administration. Thereby preconditions will be created to win private persons and companies for the participation in the programme.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 4.1: Supplementation and concretisation of the public procurement laws, ordinances and administrative guidelines of the Federation and Federal States to include waste-preventing and resource-conserving provisions	
Objectives	Creation of a substantiated information basis and legal security in order to realise the waste prevention potentials of the procurement
Characterisation	With the measure the standards of waste-preventing and resource-efficient procurement in laws and ordinances for the award of public contracts on the Federal and States level will be enhanced, and, as far as possible, brought into agreement with each other. Comprehensive and detailed administration provisions will be released as specifications and complementation. As example, the "Berliner „Verwaltungsvorschrift Beschaffung und Umwelt (VwVBU)" (Administrative Provision for Procurement and Environment of Berlin) shall be taken.
Link to measures set out in Study I	Measures 19, 59, 102, 158, 259
Link to Annex IV WFD	15. Integration of environmental and waste prevention criteria into calls for tenders and contracts, in line with the Handbook on environmental public procurement published by the Commission on 29 October 2004.
Instrumental character	Regulatory, informational
Initiators of the measure:	Competent ministries on the level of the Federation and the Federal States, supported by the environmental ministries.
Addressees	Procurement institutions on the federal, states and municipal level, and indirectly private procurement, households.
Waste prevention potential / environmental impacts	In the overall sum not assessable. On the example of computers, a rough estimation results in economised raw material of altogether more than 150,00 t/a.
Environmental impacts	In the overall sum not assessable. On the example of computers, a rough estimation results in a reduction potential of altogether more than 100,000 t CO ₂ eq/a
Indicators	Number of adjusted administration regulations.
Social impacts	No negative social impacts.
Economic impacts	Secures and promotes investments, growth and employment in innovative ecology-oriented economy sectors. Above this, multiplication effects and further impulses are expected, due to the trend-setting role public authorities can have for private procurement and private households.
Conclusion	Better information basis and legal security improve the options of waste prevention in the course of public procurement. Thereby the public administration takes an important role of model character for the overall waste prevention programme.
Recommendation	The example measure is recommended for the implementation.

8.1.4.2 Example measure C VI 4.2: Promotion and expansion of actor cooperation and information platforms on green public procurement

Background

Guidelines for an ecological public procurement in administrative regulations alone, are not sufficient, to reach the full potentials regarding waste prevention. The procurement institutions and their clients need support in the technical preparation of specifications. In these, the detailed guidelines for products and services concern their environmental compatibility and here in particular in with a focus on waste prevention. With the measure, central

information platforms shall be created and/or existing platforms (e.g. www.beschaffung-info.de, www.bescha.bund.de) be expended, up-dated and, in the best case coordinated. With comprehensive and adjusted criteria catalogues, technical specifications, data sheets and service characterisations for the various fields of demand, relevant foundations for a waste-preventing purchase/procurement can be laid, and more transparency can be given.

Besides that, it needs the collaboration of all participants, in order to support the procurement in the choice of eco-friendly products, as well as to inform the producers and distributors about the new frame conditions for purchase, respectively contracts. Only this way it will be possible that the supply can meet the existing demands. The State Secretary Committee for Sustainable Development has decided in October 2011 that a central competence department for sustainable procurement shall be established in the Procurement Office of the BMI (German Federal Ministry of the Interior). This department currently being established can take essential tasks in the suggested collaborations between stakeholders.

A research inquiring the preconditions for corresponding WPM in Schleswig-Holstein shows a high willingness of the participants to contribute actively in the collaboration among stakeholders. The practitioners responsible for the central public procurement of the individual Federal States see a great demand in clear decisions for the products or services that have to be purchased. Accordingly providing information for the procurement departments has to be combined with clear guidelines, and an according motivation of their customers, which, in the end, make the decision in the choice of the specific procurement (MLUR 2011).

Institutions responsible for the procurement, maybe also the private procurement and private households shall just as well profit from the results of the stakeholders' collaboration, and the provided information. This helps, to avoid that waste prevention and environmental relief potentials fail due to the individual cognitive narrowness facing the complexity of the decisions, or rather that they will not be put into practice.

The results of the collaboration among stakeholders give an important input for the creation of the platform. It is recommended to set it up throughout the federation and only if the demand indicates this, specifications of this central information will be implemented by individual Federal States and municipalities on their own platforms.

Since 1998, the municipality of Vienna has practice in such collaboration among stakeholders and has originated the programme OekoKauf Wien. The aim is a more ecologically oriented purchase of goods, products and services for all departments of the municipal administration. According to a decree of the municipal administration director, all results (criteria catalogues, position papers, studies, sample folders) of "EcoBuy Vienna" must be applied with binding effect. In 26 work groups experts have compiled criteria catalogues for the tendering procedures which continue to be updated and amended. The criteria catalogues are reviewed, in terms of their legal validity, by the "advisory committee law" (Beratungsausschuss Recht), and are formulated in a way that contents can directly be copied into tender specifications. The overview of the very comprehensive retrievable results which are available on an internet platform, serves for the application of tenders according

to the Austrian Bundesvergabegesetz BvergG 2006 (Federal Law for Contract Awards)²⁹⁴ (cf. MLUR 2011).

The support of the stakeholders in the public procurement can be build up on the training concept that was developed by the Oeko/Institute and the ICLEI for the Federal Environment Agency. The training materials are prepared and were already used in 20 trainings in Germany (Öko Institut/ICLEI 2011).

Objectives

Aimed is the support, respectively the further development, of central information platforms and collaboration of stakeholders²⁹⁵ in the public procurement which can as well be used by the private procurement, when indicated. This way, the coordination of demand and supply shall be improved, so the related efforts of searching and informing will be reduced. It is aimed that, by offering and preparing relevant information, signals are send to suppliers and producers, to familiarise with ecology-oriented and waste-preventing requirements, and thereby stimulating an adjustment of the production.

At the same time, the information platforms are relieving for the procurators as well as the households. And, the platforms support the demand for innovative solutions, products and service with a waste-preventing potential. By exemplary best-practice approaches the search and information effort will be significantly reduced for the procuring institutions.

Characterisation

Establishment of a collaboration among stakeholders (cf. chapter Measure A 2: Building comprehensive cooperation among actors), and expansion of central information platforms to improve the coordination of demands on the procurement side, and the offers of producers with respect to ecological orientation and waste prevention.

Initiators / addressees

The responsible authorities of the Federation and the Federal States initiate stakeholder collaborations for the public procurement for and together with the departments responsible for procurement, their clients and suppliers, the producers, plus the experts of the environmental administration. The currently being build competence centre of the BMI (German Federal Ministry of Interior) can initiate and supervise the collaboration.

Existing information platforms will be expanded and coordinated.

Waste prevention potential / environmental impacts

Serves as support of the above mentioned example measure C VI 4.1 and contributes in achieving the exemplary waste prevention potentials and environmental impacts listed there.

²⁹⁴ Overview is available at <http://www.wien.gv.at/umweltschutz/oekokauf/arbeitsgruppen.html>

²⁹⁵ Like e.g. the currently being build competence centre in the Procurement Office (BSchAmt) of the BMI (German Federal Ministry of the Interior), the mentioned, already existing sectoral information platforms.

Indicators

Recommendable as indicators are:

- Number of the functioning actor collaboration and networks for public procurement.
- Number of product groups and products where specific information and assistance for the public procurement departments are available on a nation-wide internet platform.
- Number of accesses on the internet platform.

Social impacts

The exchange between the participating stakeholders will be promoted.

See here also the explanations on example measure C VI 4.1.

Economic impacts

See here also the explanations on example measure C VI 4.1.

Conclusion

With the measure the transparency and reliability in achieving the objectives ecological procurement can be considerably be increased. An independent estimation of the prevention potential though is not possible.

Recommendation

The example measure is recommended for the implementation (in addition to the example measure C VI 4.1).

Example measure C VI 4.2: Promotion and expansion of actor cooperation and information platforms on green public procurement	
Objectives	Support of transparency and an information basis for the improvement of waste-preventing purchase.
Characterisation	Establishment of collaboration among stakeholders, and expansion of central information platforms to improve the coordination of demands on the procurement side, and the offers of producers with respect to ecological orientation and waste prevention.
Link to measures set out in Study I	Measures 19, 59, 102, 158, 259
Link to Annex IV WFD	15. Integration of environmental and waste prevention criteria into calls for tenders and contracts, in line with the Handbook on environmental public procurement published by the Commission on 29 October 2004.
Instrumental character	Informational
Initiators of the measure:	(Environmental) ministries on the level of the Federation and the Federal States, collaborations among stakeholders of private and public authorities.
Addressees	Procurement institutions on the federal, states and community level; their customers, suppliers, manufacturers; and indirectly private procurement, households.

Example measure C VI 4.2: Promotion and expansion of actor cooperation and information platforms on green public procurement	
Waste prevention potential / environmental impacts	Cannot be estimated in isolation. See here also the explanations on example measure C VI 4.1.
Environmental impacts	See here also the explanations on example measure C VI 4.1.
Indicators	See here also the explanations on example measure C VI 4.1.
Social impacts	See here also the explanations on example measure C VI 4.1.
Economic impacts	See here also the explanations on example measure C VI 4.1.
Conclusion	Information basis improve the options of waste prevention in the course of public procurement.
Recommendation	The example measure is recommended for the implementation.

8.1.5 Measure C VI 5: Promotion of waste-preventing product service systems

An essential point of leverage for waste prevention measures is the influencing of purchase decisions. The directed choice of products and the conscious determination of the demand and the method of use affect both, the production and utilisation stage as well as the disposal stage.

In the consumer society by advertising and other external influences, artificial needs for goods are created which also applies for many durable consumer goods that are rarely used and stored in the attic or basement in the end.

In this case, a needs assessment can come to the conclusion that a durable commodity, like for example a gardening tool, will in fact only be used by a single household in longer and fewer intervals, and so it seems to be obvious to check, whether it would not make sense here, to fall back on equipment rental. An alternative could be, to buy equipment collectively in a user community (e.g. neighbours). The “sharing” of goods between several users became quite popular in the case of car-sharing, but can just as well be transferred to other consumer goods.

Product service systems could be an important starting-point for an economised use of resources and offer a high waste prevention potential. The product service highlights the benefit that a certain product brings. If systematically analysed and used, integrated solutions can be realised for many fields of demand (e.g. mobility, households and habitation).

In this paragraph new utilisation strategies for their potentials of waste prevention will be tested. The options, how they can be promoted and supported by specific measures, will be described as basis for specific measures. Here, a special attention will be given as well to the development of infrastructure, exchange centres and networks for stakeholders (Rabelt et al. 2007).

Background

Ways of joint use to satisfy needs exist ever since inside different social and political communities. Various forms of community property, e.g. the mediaeval Commons, are shaped by history²⁹⁶.

With increasing prosperity and individualisation, other cultural patterns have evolved, above all, the individual use which has caused the collective use of goods to take a back seat. Newer developments in contrast show a tendency now to a consumption that is rather without property, and in the social sciences, there is increasingly the talking about the appearance of post-material attitudes in certain society milieus and world regions²⁹⁷.

Although these consumer potentials can empirically be proven, there are restraining factors that have prevented a further dissemination by now (MARESS AP12 2011). Measures have to be taken here which result from the identification of central problems.

State of research and outlook

The debates on new utilisation concepts, starting with the publications of Walter Stahel (1993) in the 1980ies and 1990ies, can be categorised as following:

- duration extension (reuse, repair, maintenance),
- intensification of use (joint use like flat-sharing community and car-sharing),
- substitution of goods by services (rental, lending).

Resource-efficient and waste-preventing product service systems are discussed in the literature as well under the synonyms and concepts like “using instead of owning” (Stahel 1993), “products as service delivery machines” (Schmidt-Bleek et al. 1995) and “consumption without ownership” (MARESS AP12 2011). This terminology's aim is to discuss the use of commodities for the satisfaction of demands separated from their physical basis and thereby enlarge the perspective. An important aspect here is the determination of different “regimes of utilisation” (MARESS AP12 2011). These aim at the satisfaction of (consumer) demands, without the owners of goods necessarily being identical with the users. Some of them are commercial forms (e.g. leasing, rental, sharing), but as well private self-organised forms are practised (e.g. exchanging, lending, non-commercial sharing) (MARESS AP12 2011).

Experiments in the 1990ies showed the limitation of sharing concepts by central hiring stations and their expansion on most different commodities like gardening tools, kitchen equipment, tools etc. Here in particular the difficulty of the coordination of supply and demand constrains a further propagation (Consumer advice centre Baden/Württemberg 1996). With the emergence of modern options of information and communication, and the potential of almost unlimited real time communication, the frame conditions have changed essentially, so an actualised evaluation of such approaches is adequate and necessary. The

²⁹⁶ In this connection is primarily the form of Commons as commonly used land an often discussed phenomenon. Later debates on the so called Commons revive the specific development conditions of forms of community property and ways of utilisation. In 2009, the Nobel Prize in Economics was awarded for this subject (cf. e.g. Helfrich 2009, Ostrom 1990).

²⁹⁷ As post-material attitudes are termed that accentuate immaterial values and demands (cf. Ingelhart 1998).

modern technologies enable extended forms of dematerialisation of consumption by using the better communication options (Stampfl 2011). In particular the influence of social networks and the web 2.0 on the feasibility and the acceptance of different utilisation concepts should be review with appropriate research projects.

Limiting and supporting factors for waste-preventing product service systems

Whether intensifying the product use is possible, depends on income, education, age and individual attitudes regarding consumption, property, ecology et al. (MARESS AP12 2011). These factors determine to a high degree the individual ways of consumption and utilisation.

Limiting is a strong orientation towards property where goods are attributed to be identity-establishing, as well as customarily strongly fixed consumption practices. The transaction costs plus the timely effort of searching, picking-up and bringing back, prevent a further expansion of such concepts. This applies as well for the subjectively experienced necessity that the needed goods have to be of constant availability; and an often observed, distorted and critical perception of the price-performance ratio in renting goods in relation to buying. The want of care and inadequate cleanness in handling with goods, is partly experienced as problematic. Already existing, practised forms of rental, lending and exchanging options, are not sufficiently communicated. For this reason, the consumers are only inadequately informed about the possibilities of such concepts (MARESS AP12 2011).

Beside these socio-demographic and psychographic factors, the product specific manifestations are essential factors for the probability for or against a common use of goods. Restraining are hereby low acquisition costs and a short lifespan. With a strong preference of the consumers for current and fashionable attributes, long-term innovation cycles have a negative effect on the business, in particular for commercial suppliers of product service systems. With high or not predictable utilisation frequencies and non-standardised, individually on the user tailored products, the purchase will preferably be private (MARESS AP12 2011).

Limiting factors will as well be identified in the socio-economic frame conditions. Here to be mentioned are a strong decline in prices of consumer goods and raw material markets, a very pronounced focus on economic growth in politics and society, and an absence of consumption role models in “using instead of owning” (MARESS AP12 2011).

Consumption without ownership is seen, according to Scholl et al. (MARESS AP12 2011), as a promising concept, if a subjective appreciation for more diversity and a low level of product loyalty is offered by a broad range (of rentals). If the service of common use is experienced as relieving, the probability that this kind of property is increased. A car-sharing user for instance can rely on several types of vehicles and is relieved from the maintenance, repairs etc. Depending on the utilisation frequency, sharing approaches offer an economic relief, because, for instance, the acquisition costs, costs of maintenance and repair, become no longer necessary. Risks due to lacks in quality right after the end of guarantee periods (keyword planned obsolescence), are borne by the providers of the product service systems. Supportive for the acceptance are high acquisition costs of the products, a low utilisation frequency and their good planning reliability, plus the standardisation of products in combination with a low level of identification for the users.

Supportive frame conditions for the consumption without ownership are additionally seen in the change of cultural pattern, in particular in the change of dominant consumption forms, and in the modified requirements on mobility and flexibility (MARESS AP12 2011).

Specific examples for intensified utilisation

Foundations for high utilisation intensity are to use products commonly or over a long period of time. Examples are, beside others, the joint use of laundries, repair services of shoemakers and watchmaker's workshops, tailors, rental locations and second-hand shops. Also the joint rental of flats and houses, the use of taxis, the car-repairing and the still widespread exchange of baby and children's equipment, are in fact part of systems of intensified product utilisation (cf. Rabelt et al. 2007, MARESS AP12 2011).

The joint use of large machinery (e.g. in agriculture), office communities, joint practices, leasing of office equipment, car-sharing and reuse methods for computers will expand this principle as well on household and gardening tools. In order to increase the prospects of success of these new strategies, the knowledge of the target group's demand structures is necessary. Households are usually fully equipped for the daily use. A conventional lending will therefore only be successful, if it deals with products for very special events. Such events can be childbirth, wedding, relocation, accident or death. Another target group for lending and repair systems, as well as for the proposal of second-hand goods, are financially disadvantaged households, for instance households with children and youngsters, students, pensioners and unemployed persons. Therefore it is required to find an ecological and economic positive connection between what the people in nearer surrounding need, respectively could need, and what is offered in the immediate region, respectively could be offered there (Kopytziok 2007).

Environmental impacts and possible rebound effects

By intensifying utilisation resources can be economised and waste prevented, but goods can wear out faster and need repair and maintenance more often due to improper handling which has a negative environmental effect and might overcompensate the positive impacts (MARESS AP12 2011). Logistics and transport can cause additional burdens of intensification which generate negative effects in the overall balance. Scholl et al. (MARESS AP12 2011) concluded for the field of tool rental that the ecological burdens caused by the transport from and to the lender dominate the ecological effects. From an ecological perspective these measures not per se recommendable, but only with a thoroughly arrangement to avoid as far as possible the referring rebound effects (cf. as well Scholl/Winfried 2004 and Kopytziok 2011).

Another factor of negative environment impacts can appear in form of rebound effects, in case that new utilisation concepts generate an accordingly higher demand *MARESS AP12 2011). If classes with lower income can use more services, e.g. because of the lower price, this is quite positive from a social point of view, but the environmental burden rise. Such measures are possibly worthy of promotion, but not necessarily to be classified as a waste prevention measure. In the design of frame conditions, it has to be ensured that during the implementation of the measure that rebound effects are avoided to the widest extend and, if necessary, can be identified at an early state.

Measures to be taken

- Financial support of waste-preventing product service systems in order to spread their expansion;
- support of waste-preventing product service systems by preparing communal infrastructure;
- consultancy and research, information and communication campaigns on waste-preventing product service systems.

8.1.5.1 Example measure C VI 5.1: Financial support for waste-preventing product service systems

Background

Public authorities should financially support the establishment of integrated solutions for various fields of demand. In the mobility area, beside the conventional car-sharing providers, enterprises should be supported to develop, and successfully establish, integrated traffic solutions including bicycles, public transport and car-sharing.

In the demand area of habitation, companies, property managements, respectively house owners or housing communities, should be supported in concepts for their residential complex to offer, maintain and coordinate the joint use of various household equipment (e.g. washing machines, dryers, vacuum cleaners etc.). This form of joint utilisation is especially in Switzerland a common phenomenon.

The companies and housing communities should be financed from promotional funds (as the case may be, financed by tax returns of a future material input tax), financial grants and receive additional low-cost loans (e.g. from the Kreditanstalt fuer Wiederaufbau KfW) for the founding and consolidation period. At the same time it seems to be useful to modify the existing legal regulations on rent, lending and leasing towards ways of using that replace individual ownership, since their current orientation is not considered as being expedient (Willand/Neuser 2003, UBA 2012).

The measure is combined with a particular consideration of networks of actors for the collection, documentation and publication of know-how for the further transfer of knowledge by consequent accompanying research. Beside the commercial possibilities, also self-organised, non-commercial forms (e.g. non-profit organisations, collective associations etc.) can be supported which work on concepts of intensification of utilisation in the area of active citizenship.

In the course of ecological procurement, public authorities should coordinate the concepts that have to be developed, with the respective criteria of the procurement law. And, with the volume of public procurement, ensure the economic success with a reliable purchase. For instance, in many cases, the participation of the public authorities in car-sharing and integrated traffic concepts can be more economic than the maintenance of the self-owned car pool. For small suppliers, the municipality as customer can provide an important contribution to the financial cover of their supply²⁹⁸. This could as well be included in the

²⁹⁸

<http://www.gvv-donaueschingen.de/car-sharing.html?&L=0>

criteria of the public procurement law (cf. chapter measure C VI 4: Environment-orientated / waste-preventing procurement).

Objectives

Objective of the waste prevention measure is to promote integrated solutions, primarily in the fields of mobility, household and habitation, with financial resources of public authorities in order to support their development and dissemination as well as to increase their market penetration. The measure aims on the development of ecologically advantageous, integrated concepts for the intensification of utilisation for different fields of demand. And to introduce as well as consolidate these at the market. Indirectly intended is that the purchase of complex, durable good for the private utilisation declines absolutely as well as relatively compared to jointly used good. Thereby the resource and energy demand as well as the related surplus and waste amounts are reduced.

Characterisation

The measure comprises mainly in financial aids for entrepreneurship and business consolidation, plus the financial support of civil society organisations in the field of waste-preventing product service systems.

Initiators / addressees

The measure should be initiated by the public authorities on EU, Federal, States and/or municipal level. It aims on companies of the private economy, non-profit enterprises and organisations (e.g. collective associations, registered non-profit associations etc.). In order to increase the acceptance, the direct involvement of users in participatory processes is important.

Waste prevention potential

The waste prevention potential, for instance of car-sharing, is described in detail in the excursus Car-sharing (cf. Chapter excursus: Ecological evaluation on the example of car-sharing).

Environmental impacts

A rough estimation of the ecological impacts from a joint use of lawn mowers is based on the information of the website of the North American company Briggs & Stratton. The data of an eco-balance from one of their lawn mower products are published here²⁹⁹. According to this, the manufacturing of a lawn mower is related with a greenhouse effect of easily 100 kg CO₂-eq. According to this, each year approximately 120,000 t CO₂-eq are caused, due to the annual sales of 1.2 million lawn mowers in Germany³⁰⁰. If lawn mowers would be acquired and commonly used in neighbourhood initiatives, so that 5 of 6 lawn mowers would be economised, annually about 100,000 t CO₂-eq could be saved.

²⁹⁹ <http://www.basco.com/Sustainability/life-cycle-assessment/results-summary/>

³⁰⁰ <http://www.derwesten.de/wirtschaft/sattes-gruen-satte-umsaetze-id4466959.html>

Approximate environmental relief figures result from a study about the comparison of the community Niederkaufungen (KNK) with an average ecologically oriented nuclear family for the demand areas habitation, nutrition and mobility. It has to be taken note of that Niederkaufungen is affected by a collective and cooperative working and lifestyle with the tendency to vegetarian and vegan eating habits, with a higher degree of self-supply and an awareness in the use of mobility (Rabelt et al. 2007). In this comparison the greenhouse gases emitted per capita and year is approx. 3 t CO₂-eq in the case of KNK whereas the nuclear family emits almost 5 t CO₂-eq, and the nation-wide average inhabitant emits almost 8 t CO₂-eq. The greater share of environmental savings results from collective ways of utilisation in the demand areas habitation and mobility (Rabelt et al. 2007) where the decisive factors are specific conditions affecting the way of habitation and lifestyle. The share of waste prevention cannot be quantified.

Indicators

The success of these waste prevention measure can be indicated by using the following parameters:

- number of the formations of organisations which offer joint utilisation concepts
- number of participants in joint utilisation concepts
- number of products that are used together.

At the same time it should be checked whether rebound effects appear. This can happen through surveying the consumption and user behaviour.

Social impacts

Integrated utilisation concepts with their orientation towards the actual costs of utilisation offer social participation to the greatest possible extend, in particular to groups with low income, elderly people and children who would remain excluded otherwise. Beside other reasons, this results from the lower acquisition and utilisation costs per capita which also amortise faster. On the example of mobility it becomes apparent that the development of multimodal transportation concepts the demands of groups in consideration who are either not able or not willing to drive by themselves. This gives space to ecological rebound effects, but has to be reviewed in the individual case.

The impacts regarding jobs have to be surveyed. The fact that in the meantime even many large car producers invest in the field of car-sharing projects, shows that the industry is ready to take new challenges due to the changes in the user habits. This can and should be understood as a chance to invite the industry also in further measures for the promotion of new utilisation concepts!

Particularly in self-organised utilisation concepts, important additional social benefits arise, like the strengthening of social cohesion and the regional value creation (Rabelt et al. 2007).

Economic impacts

The reduction of sales and production figures would cause a massive structural change for producers and component suppliers in the automobile sector which would affect many jobs. On the other hand positive employment prospects can be expected in the service sector.

Scholl (1998) comes to the conclusion that only under favourable assumptions; the overall employment effect would be neutral or even positive.

Those different automobile producers have recognised the economic potential of car-sharing is evident from their participation in precursor projects with their own offerings. For instance in Ulm from Mercedes-Benz or in Hamburg (car2go), Volkswagen in Hannover (Quicar) or BMW in Berlin and Munich (DriveNow), such offerings are already made. This way the automobile producers react to a trend and improve costumers' loyalty, especially under the younger generation.

Therefore it can be foreseen that the measure, beside its waste-preventing impact, can have a relevant signalling effect toward an ecological modernisation of the society. In view of the employment effects, a final decision cannot be made due to the dynamic transformation process.

Conclusion

The measure is recommendable from the ecological and social point of view. Beside the substantial reduction of environmental impacts, an additional social advantage can be generated. The economic impacts cannot yet be finally assessed.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 5.1: Financial support for waste-preventing product service systems	
Objectives	Support of transparency and an information basis for the improvement of waste-preventing purchase.
Characterisation	Establishment of collaboration among stakeholders and expansion of central information platforms which coordinate the demands of procurement and the offers from the producers with regard to ecology orientation and waste prevention in a better way.
Link to measures set out in Study I	266, 272
Link to Annex IV WFD	11. Economic instruments like.....
Instrumental character	Financial measure
Initiator	EU, Federation, individual Federal States, Municipalities
Addressees	Companies, non-profit organisations, collective associations, consumers
Waste prevention potential	100,000 t CO ₂ -eq/a (approximate, only for lawn mowers in Germany)
Environmental impacts	Can only be figured exemplary for the increase of utilisation intensity of products, but not specifically for this measure.
Indicators	Formations of companies, respectively organisations, number of participants and number of products in joint utilisation, qualitative survey about user behaviour.
Social impacts	Lower income groups, children and elderly people can benefit from low priced intermodular mobility concepts and other concepts of joint use.
Economic impacts	Negative employment effects due to the intended decline of sales have to be expected. The substitution effects in the service area compensate this only under optimal premises.

Example measure C VI 5.1: Financial support for waste-preventing product service systems	
Conclusion	The measure can be recommended from the ecological point of view. A contribution to reach relevant environmental relief potentials is expected, but cannot be quantified specifically.
Recommendation	The example measure is recommended for the implementation.

8.1.5.2 Example measure C VI 5.2: Promotion of waste-preventing product service systems through provision of municipal infrastructure

Objectives

The aim of the WPM is to improve the foundations for the consumption of product services regarding transport, logistics and accessibility by offering budget communal infrastructures financed by public authorities. Thereby related transaction costs and practical barriers (pick up and return in the rental of goods, costs for searching etc.) shall be reduced. With this, it is aimed to increase the acceptance of waste-preventing product service.

Characterisation

(Municipal) building infrastructure will be provided with budget conditions for product service systems. These could be for integrated mobility offers (e.g. combination of car-sharing, public transport and communal bicycle rental)³⁰¹ or institutions for the joint use of durable household or leisure products (e.g. washing machine, impact drill, winter sport equipment etc.)³⁰². The measure supports therefore solutions for various demand areas which are related to complex as well as durable investment goods and commodities with high acquisition costs.

It is recommended to integrate this in a local “waste prevention centre” where further services like repair workshops and second-hand department stores can be centralised (cf. chapter: Example measure C VIII 3.1: Support for repair networks). It is appropriate to rely on present infrastructure of buildings that are owned by the municipalities. For instance, the available municipal building yards offer starting and enlargement options. The provision of parking places for the pools of sharing cars or rental bikes is important to be decentralised and conveniently situated.

At the same time, the public authority provides communal infrastructure that helps to create stakeholders' cooperation for an improved establishment of waste-preventing product service systems. These municipal “waste prevention centres” will be supplemented with (do-it-yourself) repair workshops. The supporting collaboration among stakeholders improves the infrastructure for communication and coordination of the respective demand and supply through sharing, or pooling³⁰³.

³⁰¹ An example for an integrated mobility concept of train, bus, bike-/car-sharing is the mobility card in Switzerland (www.mobility.ch). But it is not (yet) linked with public infrastructure, respectively, other sustainable utilisation concepts.

³⁰² In these fields are particularly many commercial suppliers, although the ecological effects are not without exception positive, due to the lack of a common infrastructure and a high transport volume (Rabelt 2007).

³⁰³ Unlike sharing, pooling means to share goods which are owned by private households.

Initiators / addressees

The measure will be implemented on the municipal level in cooperation with the stakeholders of the private economy and civil society organisations. If possible, it will be relied on existing infrastructure. Additional funds will be provided by programmes of EU/Federation/Federal States, and the improvement of legal options will be promoted.

Waste prevention potential / environmental impacts

The individual implementation measures of measure C VI 5 complement each other. A selective estimation of the influence on the prevention potentials and the environmental impacts is not possible. (Compare explanations on waste prevention potential and environmental impacts in measure C VI 5.1 and on the specifically described example of car-sharing at the end of the chapter).

Indicators/benchmarks

See example measure C VI 5.1.

Social impacts

See example measure C VI 5.1.

Economic impacts

See example measure C VI 5.1.

Conclusion

The measure increases the acceptance of product service systems by reducing practical obstacles. This way their positive ecological, but as well their social and economic impacts, are strengthened and supported. A separate impact assessment cannot be made.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 5.2: Promotion of waste-preventing product service systems through provision of municipal infrastructure	
Objectives	Through the measure practical barriers shall be reduced and the coordination be improved in order to promote the smooth operation of product service systems and increase their acceptance.
Characterisation	The measures develops a (communal) infrastructure, respectively, expands it to communal "waste prevention centres".
Link to measures set out in Study I	266, 272
Link to Annex IV WFD	11. Economic instruments
Instrumental character	Financial measure, provision of existing infrastructure
Initiator	The measures will be initiated on the level of EU, Federation and individual Federal States
Addressees	Municipalities, and private, respectively civil society actors

Example measure C VI 5.2: Promotion of waste-preventing product service systems through provision of municipal infrastructure	
Waste prevention potential	See for evaluation of examples car-sharing (chapter Excursus: ecological evaluation using the example of car-sharing)
Environmental impacts	See for evaluation of examples car-sharing (chapter Excursus: ecological evaluation using the example of car-sharing) and example measure C VI 5.1
Indicators	See for example measure C VI 5.1
Social impacts	See for example measure C VI 5.1
Economic impacts	See for example measure C VI 5.1
Conclusion	Strengthening the acceptance of product service systems, support of positive ecological, social and economic impacts.
Recommendation	The example measure is recommended for the implementation.

8.1.5.3 Example measure C VI 5.3: Advisory and research activities, and information and communication campaigns on waste-preventing product service systems

Background

Public authorities should support information and image campaigns of stakeholders about utilisation intensification by offering partnerships, sponsoring and competitions, or run their own campaigns instead. The information refers on all methods of utilisation intensification which were mentioned in the previous example measure. The information and image campaign should increase the awareness level of rental, lending, giving and exchange offers, plus the offers in the field of sharing, respectively pooling, by developing publications, brochures and other suitable media. At the same time, image transfer counteracts existing prejudices, so changes in consumer behaviour are enabled.

New research projects can continue the already existing and review their results concerning the altered frame conditions. Other central questions result from the coordination among sharing and pooling projects, unclear legal questions³⁰⁴, and the general problem of acceptance. Above this, weak points and problems of the concepts have to be identified, also in view of their ecological impacts. Data availability referring to waste prevention and other environmental impacts shall be improved by research projects. Consultancy offers, derived from the new knowledge, will help the stakeholders to take appropriate actions. On the other hand, the instruments of activating research and consultancy will help to experience product service systems replacing property and create multipliers.

Experience-oriented approaches, an instrument of the event marketing, can stimulate a vivid impression to the target group and participating multipliers (cf. chapter measure C VII 3: Support of experience-oriented communication approaches by public institutions).

Objectives

This measure aims on the target group-specific support of waste-preventing product service systems through activating consultancy and research, information and image campaigns.

³⁰⁴

Older as well as current studies offer links. (cf. Willand, Neuser 2003, UBA 2012)

With activating research and consultancy on one hand interfaces shall be found that enable ecologically and economically positive effects between what the populations of an area need, or would want to use, and what is offered in their region, respectively, what could be offered there.

In cooperation with the suppliers, the awareness level of consumption without ownership shall be increased, and be made available for a broad level of population. The communication of practical experiences is supposed to create a positive basic attitude of each target group, so existing prejudices can be counteracted.

Characterisation

The public authorities initiate research and accompanying research projects, in particular in view of the possibilities for waste-preventing product service systems through new communication and information technologies. In particular the influence of social networks (e.g. facebook, google+, diaspora) and the web 2.0 technologies has to be considered. With activating research methods on one hand the demand interfaces are surveyed, on the other hand, multipliers are created for the new ways of utilisation.

Initiators / addressees

The measure is initiated by research and education departments on EU, Federation and Federal States level and aims on institutes and academies (universities, i.e.), as well as public and private organisations and companies in the field of education and communication.

Waste prevention potential / environmental impacts

The individual implementation measures in this measure complement each other. A selective estimation of the influence on the prevention potential and the environmental impacts is not possible. (Compare with the explanations on waste prevention potential and environmental impacts in measure C VI 5.1 and the practical example for car-sharing at the end of the chapter).

Indicators

See for example measure C VI 5.1.

Social and economic impacts

See for example measure C VI 5.1.

Conclusion

Using research and consultancy offers can improve the knowledge about waste-preventing product service systems, and increases their effect. According communication and information approaches increase their expansion, acceptance, and the related ecological advantages. This measure serves as complementation of the measure. In this relation it is very recommendable. A separate estimation of the prevention potential and the environmental impacts is not possible.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 5.3: Advisory and research activities, and information and communication campaigns on waste-preventing product service systems	
Objectives	Improved knowledge about possibilities and limits of waste-preventing product services and development of consultancy offers for information and communication campaigns to increase awareness level and acceptance.
Characterisation	Research, particularly in view of new information and communication technologies and review of results up to now, offers publications, brochures, and other suitable media for communication and information campaigns.
Link to measures set out in Study I	266, 272
Link to Annex IV WFD	11. Economic instruments
Instrumental character	Informatory
Initiator	Research and education institutions on EU, Federation, and Federal States level.
Addressees	Research institutes, universities, educational service providers, and communication service providers
Waste prevention potential	See for evaluation of examples car-sharing (section Background)
Environmental impacts	See for evaluation of examples car-sharing (section Background) and example measure C VI 5.1
Indicators	See for example measure C VI 5.1
Social impacts	See for example measure C VI 5.1
Economic impacts	See for example measure C VI 5.1
Conclusion	Expansion of knowledge and data basis, as foundation for more effective measures and increased acceptance of product service systems.
Recommendation	The example measure is recommended for the implementation.

8.1.5.4 Excursus: Ecological evaluation on the example of car-sharing

Since mobility has a high significance for environmental protection, and most of the experiences of the here described utilisation concepts are made within car-sharing, the characterisation and the ecological evaluation are specified on this example. Other aspects, like for instance social and economic impacts, will be covered in the chapter “Example measure C VI 5.1: Financial support of waste-preventing product service systems”.

Car-sharing provides the service to cover distances on demand, instead of buying a car which is used relatively rarely. This can be read out of mobility key figures that are surveyed annually since the middle of the 90ies for instance from the VAG Nuremberg³⁰⁵. According to this, only 62 % of all privately registered cars are put into operation on an average day. The number of daily drives per car slightly declined in the comparison of time. Today the figure is at 1.9 drives per day. As well in regard of the daily operating time, a downward trend can be observed. Whereas in 1989 a car was driven 41 minutes a day, in 2011 it was only 32 minutes. With this average operating time, the costs for a car are dominated by the

³⁰⁵

[http://www.vag.de/Mobilitaetskennzahlen/id1140/Mobilitaetskennzahlen-\[Kopie\].html](http://www.vag.de/Mobilitaetskennzahlen/id1140/Mobilitaetskennzahlen-[Kopie].html)

fixed costs. When using a shared car, the mere kilometres driven and the time operating the car are paid. Therefore it tends to be cheaper to share a car, if the annual travelling distance maximum is up to 12,000 km. In addition there is the option to have access to cars of different size and configuration, depending on the individual occasion. According to the annual report of the Federal Association CarSharing bcs (Bundesverband CarSharing) (BCS 2011), the number of users was rising about 20 % in one year, and includes now almost 200,000 persons altogether. Since 2007, car-sharing has been given a significant impetus in growth. The cars are spread over 2,400 stations in almost 300 cities and municipalities, up to now with a clear focus in the south and south-west of Germany.



Figure 8-3: Spatial distribution of car-sharing offers in Germany (accord. to BCS 2011)

Waste prevention potential

In the ideal case the use of a shared car can substitute the purchase of 7 to 9 private vehicles. But since the car-sharing model is used more intense, it has to be assumed that about 2 to 3 shared cars replace up to 9 private cars throughout their whole lifespan. Hereby several environmental relieves are achieved: beside the possible reduction of parking space and driving surfaces (overbuilt and sealed surface), all of the environmental pollution, that would accrues with the production of the economised cars³⁰⁶, will be omitted. The impacts from the recycling of these cars that pollute or relief, would have to be set of against the social and economic impacts, in particular the labour effects, see for C VI 5.1).

Under the above listed assumption one car-sharing replaces about 3 to 4 private passenger cars. With approximately one ton average weight, a car is made of 65.7 % from steel and

³⁰⁶

<http://www.stadtmobil.de/>

iron, 12.1 % from plastics, 5.7 % from petrol/oil/fat, 5 % from rubber, 3.3 % from light metal, 2.9 % from glass, 2.1 % from motor and cables, 1.3 % from non-ferrous metal, 1 % from varnish, 0.7 % insulation and 0.1 % from other materials (Schweimer et al. 1999).

According to Bringezu et al. (2000) the material input coefficients are hypothesised for steel 4.08 kg/kg, plastics 6.48 kg/kg, petroleum products 1.22 kg/kg, rubber like plastics 6.48 kg/kg, aluminium 6.09 kg/kg, glass 2.10 kg/kg, motor like steel 4.08 kg/kg and chrome for the non-ferrous metals with 13.50 kg/kg. These coefficients give a first impression of the production-related surplus masses and waste amounts.

The production of one passenger car with a weight of one ton causes, according to Giegrich et al. (2012), a cumulated raw material demand of 6.9 t (cf. chapter Example: passenger cars). Thus the overall production of 3.8 million cars per year, with an average weight of 1 t, are related with a cumulated raw material demand of approximately 26 million t. Assuming that through corresponding campaigns about 15 % of the potential buyers of new cars could be won for car-sharing projects, the sales of new cars on the home market would decline about 11 %. Thereby a cumulated raw material demand of almost 3 million tons could be saved. This amount is more or less also equivalent to related waste prevention potential.

The prevention potential is likely to even be increased with a holistic and integrated approach in the segment of mobility (e.g. mobility-car-sharing in cooperation with the SBB in Switzerland)³⁰⁷.

Environmental impacts

The production of one passenger car leads to an average net global warming potential of 4.2 t CO₂-eq (EcoInvent database 2010). In 2009 approximately 3.8 million new cars were registered. Their production has caused in total approximately 16 million t CO₂-eq (cf. chapter “waste prevention potentials and environmental impacts of lifespan prolonging measures”).

If, like described above, 11 % of the new car production can be saved, a reduction of greenhouse gas emissions balances to almost 1.8 million t CO₂-eq per year.

Regarding possible rebound effects, car-sharing for instance was labelled controversially. It could be a “starter drug” into the automobile traffic (Steding 2004). But this was disproved in several studies (Steding 2004).

8.1.6 Measure C VI 6: Waste-preventing organisation of events in public spaces or public facilities

The following measure, aiming on public corporations for waste management, respectively public law bodies, to use the waste-preventing options they have in order to influence public events, will be described and evaluated on the basis of the measures identified in the previous project: inclusion of the ban on disposable tableware in events on public properties and in public spaces into municipal statutes.

³⁰⁷

8.1.6.1 Example measure C VI 6.1 Inclusion in municipal statutes of a ban on the use of disposable tableware for events on public premises and in public rooms

Background

Public events are not only presented by municipalities or under their patronage. Often the events happen also on public ground or in buildings that are in public ownership.

The licence contracts for the spaces can be designed in a way that measures to prevent waste are included as obligatory conditions. The regulation on the abandonment of disposable tableware, cutlery and such is typical here. This can be included in the contractual conditions directly by the municipalities, but as well by schools and other (not only) municipal institutions.

Subsequently there is the option to define waste-preventing behaviour in municipal statutes. It can be defined here that public spaces can only be used for events when certain waste-preventing measures are taken. Already in 1989 the city of Nürnberg integrated clauses in their waste management regulations that defined a ban on disposable tableware in events on public ground. Later, this clause was anchored as well in the State Waste Act of Bavaria. The Federation, the Federal States and the municipalities are authorised, in accordance with § 2 para. 3 of the Packaging Ordinance to commit third parties to prevention and recycling of waste, when using their institutions or properties (Kopytziok 2010).

Many (mainly non-commercial) organisers receive monetary or non-monetary resources from public authorities, either for the event itself or in general. This can as well be a connecting factor to ensure waste-preventing measures.

Objectives

Events of any kind are more and more dominated from offers that are intended for the sale of food and drinks. According to this, the question in which way those are handed out has a growing importance.

The measure aims on the one hand on the prevention of waste amounts which are left for disposal after using non-reusable containers. These are drinking vessels, cutlery, plates and other dishes that are either from cardboard or from plastic. These waste amounts might, mixed with leftovers (and maybe other waste), mainly be delivered to the thermal treatment, respectively the energetic use. The positive ecological effects related with the disposal outweigh the burdens that are related with the disposal itself (logistic, incineration).

Accordingly, the main objective of this measure is the reduction of the burdens that result from the manufacturing of these products; including the waste amounts that accrue during the production and the distribution. These are higher than the substitution successes gained with the disposal.

Characterisation

Municipalities enact numerous statutes. They concern the organisational rights (e.g. main statutes), operational statutes (e.g. cemetery statutes), tax law (e.g. statutes on entertainment tax), building regulations (e.g. programme for the preservation of historical sites), in the Road Traffic Act (e.g. statutes on permissions and fees for the special use of public streets), or the police regulations (e.g. weekly market regulation).

With this measure municipalities are to be stimulated, to define waste-preventing standards in their respective statutes (e.g. waste or weekly market regulations) for events on public ground when they exceed a certain number of participants. Additionally this ban is to be included in contracts for the leasing of such places or buildings. Focus of the standards is the ban of non-returnable products in favour of reusable or cleaning systems for handing out food and drinks. In the municipality of Munich, the Commercial and Construction Disposal Act defines in § 4 (para. 9):

“During events that happen on properties or in institutions of the municipality, food and drinks are only to be handed out in recyclable packaging and containers for which a compulsory deposit is charged: this obligation applies as well for sales segments that are in municipal ownership. Possible financial support of institutions and events will depend on the compliance of this obligation. Exceptions of this obligation can only be made in extraordinary individual cases.”³⁰⁸

Initiators and addressees

Initiators of this measure are the individual municipalities (autonomous community). The Federation and the Federal States are to support the municipalities in this attempt by developing specific formulations for statutes and contracts, as well as through the organisation of an exchange of experiences between the municipalities.

The measure aims first of all on the organisers of festivals (sport or folk festivals) and other events when their event takes place on public ground. Indirectly the individual operators / licensees of sales and catering stalls are affected. In total commercial businesses, non-profit organisations and private enterprises are concerned.

Waste prevention potential

The emergence of non-reusable dishes can only roughly be quantified. The sales statistics were not assessed. For the rough estimation of the sold quantities, it can be referred to the specifications of the Municipality Bergisch Gladbach. For instance there are annually 11,000 t of non-reusable dishes made of cardboard and 13,000 t non-reusable dishes of plastic used in NRW (Abfallwirtschaft Bergisch-Gladbach). Under the assumption that the specific consumption is the same in the rest of Germany, an annual waste emergence of 50,300 t cardboard and 59,445 t plastic non-reusable dishes could potentially be prevented, if returnable dishes would be used.

Non-reusable dishes are not only used during public events, but also during smaller and smallest events, and so as well for private occasions. Beside this, non-reusable dishes are handed out in takeaways and other food stalls. That share of non-reusable dishes is not quantifiable. But it has to be assumed that a significant share is utilised during events, and therefore can be influenced through municipal statutes. In order to quantify the measure, a general number of 50 % of the currently sold non-reusable dishes is assumed. The background of this assumption is that, beside an adoption of the ban into municipal statutes everywhere, this ban of non-reusable dishes additionally becomes a precondition for the

³⁰⁸

Translated from the German original

financial support of events of all kinds. If one applies the above mentioned numbers, the prevented product quantity of 25,150 t/a cardboard and 29,722 t/a plastic results.

Environmental impacts

For the utilisation of non-reusable dishes several eco-balances exist which go back up to the 1990s. Still there is no knowledge of any balance that would examine the full range of dishes. For instance there are no statements on returnable (metal) and non-reusable cutlery (plastic); although the cutlery might only have the smallest share in the mentioned masses of non-reusable dishes.

A relatively up-to-date ecological assessment for non-reusable and returnable dishes (plates, cups etc.) is presented by Carbotech AG from Switzerland (Dinkel et al. 1999). According to this, dishes from EPS (polystyrene) perform most poorly in any categories of environmental impacts. Crockery causes only 1/3 of the climate impact of cardboard dishes and 1/5 of the burdens caused by plastic dishes.

Numerous eco-balances examine non-reusable and returnable cups from an ecological point of view. Surveys of Carbotech, Austrian Ecology Institute (Österreichisches Ökologieinstitut) and Öko-Institut date back to 2008 (ÖÖC 2008). According to this, all scenarios for returnable cups in major events present lower impacts on the environment than the scenarios with non-reusable drink containers, although for the scenarios with returnable cups worse frame conditions were consequently used. If one takes the impacts on the climate as a benchmark, the circulation rates of returnable cups have to be around ≥ 10 to be advantageous compared to cardboard non-reusable cups, and around ≥ 6 to reach the result compared to PET non-reusable cups.

For the quantification it is assumed that the prevented waste amounts (see above: 25,150 t/a plastic) are solely composed by drink containers and these solely are in competition to returnable containers made of plastic. If one takes a basis of a specific weight of 0.013 kg per cardboard cup, and 0.015 kg per plastic cup, it results in 1.9 million cardboard cups and almost 2.0 million plastic cups. With a specific manufacturing effort of 0.03 kg CO₂-eq per cardboard cup and 0.05 kg CO₂-eq per plastic cup, the climate contribution of non-reusable cups sums up to 157,133 t CO₂-eq per year. The same filling quantity assumed in returnable cups made of PP would imply a manufacturing effort of 19,600 t CO₂-eq. Under the assumption that non-reusable dishes were fully replaced by returnable dishes, annually about 137,533 t CO₂-eq could be saved.

Indicators

If one proceeds from the assumption that the consumption of such non-reusable articles occurs to a significant extent during events, an important indicator to assess the effectiveness of the measure is the development of sales figures for non-reusable dishes and cutlery.

Another indicator to check the successful implementation of this waste prevention measure can be the number of the municipal statutes which prohibit the usage of non-reusable dishes in the normal case.

Table 8-5: Climate impacts of non-reusable and returnable cups

Mass of non-reusable cups			
Cardboard	25,150	t/a	
Plastic	29,720	t/a	
Non-reusable in total	54,870	t/a	
Number of cups (0.5 l)			
Cardboard	1,934,615,385	pieces	0.013 kg /cup
Plastic	1,981,500,000	pieces	0.015 kg /cup
Non-reusable in total	3,916,115,385	pieces	
Climate impacts			
Cardboard	58,038,462	kg CO ₂ -eq	0.03 kg CO ₂ -eq/cup
Plastic	99,075,000	kg CO ₂ -eq	0.05 kg CO ₂ -eq/cup
Non-reusable in total	157,113,462	kg CO ₂ -eq	
Returnable (PP)	19,580,577	kg CO ₂ -eq	0.005 kg CO ₂ -eq/filling
Difference	137,532,885	kg CO₂-eq	
	137,533	t CO₂-eq	

Social impacts

The usage of returnable dishes, mainly in combination with mobile automatic dishwashers on events in question, is a measure well known for a long time. And it is broadly accepted by the citizens, i.e. the user of the dishes.

Nevertheless, the usage of returnable dishes has a tendency to decline. The reason for this should be found in the lack of acceptance on the side of non-profit organisations as well as commercial businesses. The use of returnable dishes is related to a clearly higher effort leading to higher labour costs during the event. On one hand a system for deposit and return has to be set up, on the other hand the returnable dishes have to be cleaned. For major events large professional companies providing returnable cups, picking up the used cups, take care of the cleaning, and return the cleaned cups again.

Since a large share of the population can be reached as customers of such events, the WP measure is highly suitable to reach a greater awareness for the aspects of waste prevention.

Economic impacts

The rearrangement of such events on the exclusive use of returnable dishes is related with higher costs. If the organisers are non-profit organisations, the higher labour costs will not tend to be monetised, in case of commercial operators though it will. If this will be cut down on the products, additional charges result which should be appropriate and hardly

noticeable. According to Kopytziok/Pinn (2010), for event organisers applying mobile automatic dishwashers is even more economic for events bigger than 250 persons; and for handing out foods for approx. 500 persons and above. Additionally it is pointed out that, according to a survey of the Austrian Ecology Institute, 85 % of the visitors of public events think it is more pleasant to consume food and drinks from returnable dishes, so the rearrangement will not lead to sales losses. The application of returnable dishes can therefore contribute to an improved attractiveness of such markets and thus as well to sales increases (cf. Kopytziok/Pinn 2010).

The successful implementation of the waste prevention measure leads to sales losses in the production and the trade of these non-reusable articles. A shift in demands towards other branch segments, in particular to the field of commercial systems for returnable dishes, takes place.

Conclusion

The achievable contributions to environmental protection are limited, because of the small prevention potential. Beside the specific environmental effects, the possibilities to raise the awareness of the population for waste prevention have to be taken into account.

Economic and social aspects not oppose this measure.

Recommendation

The example measure is recommended for the implementation.

Example measure C VI 6.1: Inclusion in municipal statutes of a ban on the use of disposable tableware for events on public premises and in public rooms	
Objectives	The measure aims on the prevention of waste masses that remain after the use of non-reusable dishes for disposal. These are drink containers, cutlery, plates and other dishes that are either from cardboard or from plastic.
Characterisation	Municipalities are to be animated, to include a mandatory ban on non-reusable dishes during events on public properties and in public buildings in one or more of their statutes (e.g. waste ordinance, weekly market statutes etc.).
Link to measures set out in Study I	(53) Waste concepts with changes in statutes during the Hessentag 1997 (95) Application of returnable containers (99) Utilisation of returnable dishes and mobile automatic dishwashers (Bavaria) (121) Waste prevention during major events (234) Green Goal – Waste Prevention
Link to Annex IV WFD	16. Promotion of the reuse
Instrumental character	Definition in municipal statutes (legislation)
Initiator	The measure will be implemented by each individual municipality (autonomous municipalities).
Addressees	The measure aims on organisers of festivals (sport and folk festivals) and other events in the first place.
Waste prevention potential	Annual amount of emerging waste 50,300 t cardboard and 59,445 t plastic non-reusable dishes. Precise estimations on the prevention potential are not possible.

Example measure C VI 6.1: Inclusion in municipal statutes of a ban on the use of disposable tableware for events on public premises and in public rooms	
Environmental impacts	Returnable dishes of Crockery cause only 1/3 of the climate impact of cardboard dishes and 1/5 of the burdens caused by plastic dishes (EPS – polystyrene). In major events returnable plastic cups have less negative environmental impacts than any of the evaluated non-reusable cups, even under most unfavourable circumstances, if they are used 10 times or more. Under the assumption that 50 % of the non-reusable dishes emergence can be replaced with returnable dishes, annually approximately 137,533 t CO ₂ -eq can be saved.
Indicators	Statistical data on the sales of non-reusable dishes and cutlery. Number of municipal statutes that exclude the use of non-reusable dishes regularly.
Social impacts	The use of returnable dishes and mobile automatic dishwashers meets a broad acceptance on the citizen's side. Many organisers avoid the effort of deposit systems and the cleaning of the dishes. This WP measure is suitable to raise more awareness on waste prevention aspects.
Economic impacts	According to Kopytziok/Pinn, the application of mobile automatic dishwashers in events of approx. 250 persons and above is even economically advantageous, if food is handed out to approximately 500 persons.
Conclusion	The possible contributions to environmental protection are limited. The measure can support the sensitisation of the public for waste prevention.
Recommendation	The example measure is recommended for the implementation.

8.2 Measure in the point of leverage VII: General education measures and public participation in support of waste prevention

8.2.1 Measure C VII 1: Inclusion of waste prevention in training curricula for teachers and tutors

Background

Environmental education is an important factor; hence in education greater attention should be paid to environmental protection and the careful use of (finite) resources. This includes as well discussing questions and aspects of waste management and prevention. This is why the technical competence of teaching staff in these questions is so important. To enable a long-term establishment of preventive waste management, where waste prevention is a serious element, teachers have to be informed about the need and the options of preventive actions. Above this a row of options to take influence has to be considered (see Figure 8-4).

Teachers in the extracurricular education (adult education centres, academies etc.) may for instance regularly work in environment or waste management administrations, in operational environment departments, independent environment agencies, non-profit environment associations, as well as in education centres or for the press. Although most of them have a solid education, but specific environmental knowledge became only lately part of educational curricula in some of the common professions.

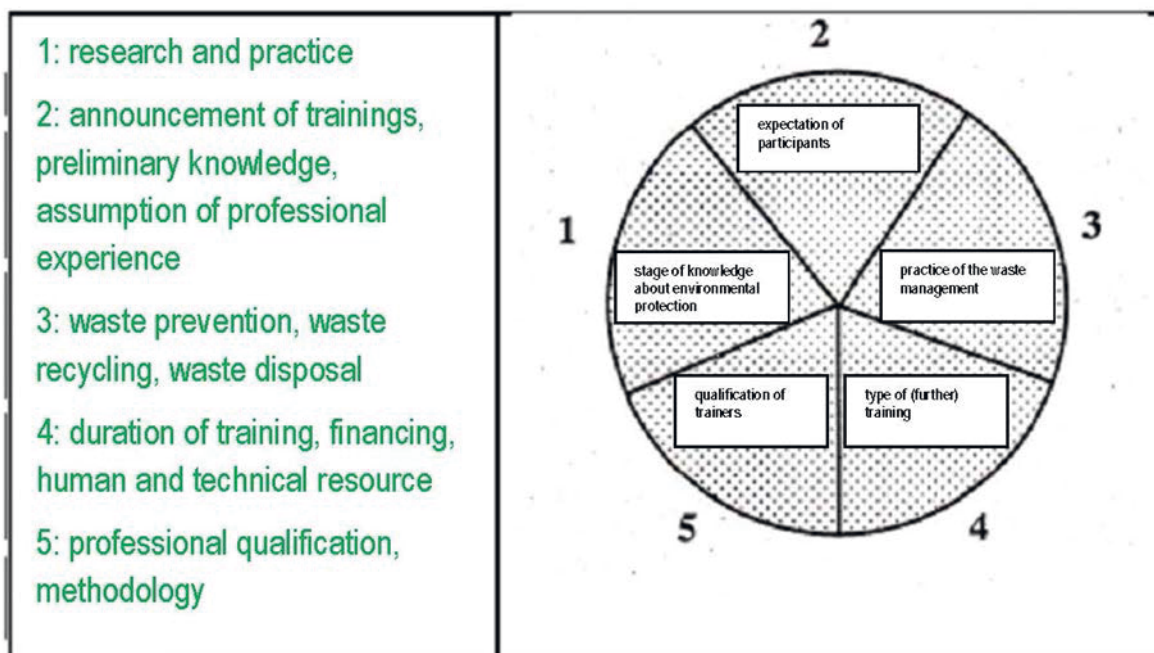


Figure 8-4: Relevant factors influencing the training (Kopytziok 1992)

The knowledge about environmental protection of many teachers is, if existing at all, based on the participation in further educations in this field. Most of these seminars are brief trainings where introductory or specified topics dominate. Although their organisers already see additional technical qualification worth mentioning in these seminars, it has to be noticed that the introductory brief trainings about waste management questions are not sufficient for teachers at all. And the specialised seminars, where in the broadest sense also symposiums and congresses are included, can solely be useful as an addition to already existing environmental education. Therefore specific aspects of waste prevention can only be discussed reasonable in such courses, if the participants have sufficient previous knowledge.

A well-grounded further education of teachers that duly respects the waste prevention includes the subject of the conventional waste management as well as the ecologically oriented.

In the educational curriculum of tutors and the teaching staff of primary as well as secondary schools many technical and pedagogical subjects are included. To appropriately respect a cross-sectional subject like environmental education, and in this relation the resource conservation, respectively the waste prevention, the (vocational) educational institutions have to make sure through interchanging that these subjects are placed in a prominent position in the curricula.

During the studies at the Teacher Training College of the University Heidelberg (PHH) where, among others, teachers are educated for primary and secondary general schools as well as intermediate secondary schools, various classes³⁰⁹ can be chosen, respectively the education can be oriented towards 45 different subjects. Traditionally the natural and social

³⁰⁹ <http://www.ph-heidelberg.de/faecher-ba-ma-a-z.html>

sciences, sport or art education are included here. Also the nutrition and consumer education can be part of the curriculum.

For instance the nutrition and consumer education (www.ebv-online.de) was developed in collaboration of the Universities Paderborn, Flensburg and the Teacher Training College Heidelberg. It deals with the issue of the humans as acting consumers in reference to consumer sciences, and explicitly addresses also consumer behaviour or quality assurance of goods and services. Offers like this can anchor a stronger focus on the subjects of resource conservation and waste prevention in the content of teaching.

Facing these considerations, the implementation measure, described in the following, seems to be appropriate: “Examination and adaptation of the curricula in the training of tutors and teachers on questions of resource conservation and waste prevention”.

In exchange with the individual Federal States, and subsequently the individual universities and non-university educational institutions, the Federation should examine the curricula of the individual courses of education in view of a sufficient recognition of questions on resource conservation and waste prevention.

8.2.1.1 Example measure C VII 1.1: Review and adjustment of teacher and tutor training curricula to include issues of resource conservation and waste prevention

Background

The inclusion of the subject waste prevention into the general school lessons is a central connecting point for sustainably anchoring society-relevant topics like resource conservation and waste prevention. The measure should therefore prove to be particularly beneficial in the medium and long-term. Opposing economic and social aspects are not apparent.

In order to strengthen a resource-saving behaviour through environmental education, it needs serious concepts, instruments, and changes in the present range of goods, as well as options to use products in a more ecological way. The sole appeal “to make everything better” overstrains pupils and teachers just as well as environmental activists in organisations, administrations and companies. When the hope of an understanding youth is not only a diversionary tactic, the actives in other fields have to reveal the serious deficits that were discovered, and name the barriers to amendments. And new, on cooperation with young people based paths have to be outlined and put to test. Options for future action have to be created that allow the experience that environmentally responsible behaviour is possible. In order to realise this, politics and economics have to offer more than mere declarations of intent. Any environmental education can only bear fruits, when school and family, politics and economics, support each other in a quasi-concerted action to collaborate to reach the aims of environmental protection [Kopytziok 2001].

Objectives

Governmental administration are to secure waste prevention becomes teaching and implementation subject in schools and universities, and the suitable further or vocational education is carried out. Resource conservation and waste prevention are to be established as professional subjects in the education of teachers. Thereby the precondition will be created to include waste prevention into the lessons of the various schools.

Characterisation

The issue waste prevention should be, framed by the definition of problems concerning resource conservation and waste prevention, of adequate importance for the contents of teaching of the various schools and training centres. Among other things this can be achieved when the topic is already factored during the education of teaching staff. Teachers should learn to relate the subjects “waste prevention” and “resource conservation”, which are both difficult to communicate, to more familiar topics like waste separation and recycling. The complexity of the teaching material should be adjusted to age and level of the pupils.

Initiators and addressees

Initiator is the Federal Ministry of Education and Research in connection with the ministries of education and cultural affairs of the individual Federal States. The individual Federal States contact the universities.

Addressees are the university and non-university educational institutions for tutors and the teaching staff of schools, which are different from State to State. In many States also the education for primary school teaching happens in the universities.

(Target) waste and (target) products

The measure includes in principle any kind of waste and product waste. Still, considering the context of developing contents of lessons for children, the focus is mainly on consumption goods.

Waste prevention potential

The waste prevention potential cannot be quantified.

Environmental impacts

The measure has positive impacts in the medium and long-term though they cannot be quantified.

Indicators

The adoption of suitable topics into the curricula of the subjects of study for school teacher's education can be used as indicator for the implementation of the measure. Benchmark is the share of universities that have adjusted the curricula of teaching staff accordingly.

Social and economic impacts

Opposing economic and social aspects are not apparent.

Conclusion

This measure is very important for the long-term implementation of knowledge and understanding about the necessity of waste prevention.

Recommendation

The example measure is recommended for the implementation.

Example measure C VII 1.1: Review and adjustment of teacher and tutor training curricula to include issues of resource conservation and waste prevention	
Objectives	Resource conservation and waste prevention are to be established as professional subjects in the education of teachers. Thereby the precondition will be created to include waste prevention into the lessons of the various schools.
Characterisation	Inclusion of suitable contents into the curricula of studies.
Link to measures set out in Study I	-
Link to Annex IV WFD	Not clearly relatable: 12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
Instrumental character	Information
Initiator	The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
Addressees	Universities
Waste prevention potential	Addresses mainly consumption goods: cannot be quantified.
Environmental impacts	Particularly positive medium and long-term impacts.
Indicators	Share of universities educating teaching staff that include the aspect of waste prevention into the curriculum.
Social impacts	No negative consequences expected.
Economic impacts	No negative consequences expected.
Conclusion	This measure is very important for the long-term implementation of knowledge and understanding about the necessity of waste prevention.
Recommendation	The example measure is recommendable for the implementation.

8.2.2 Measure C VII 2: Waste prevention in schools and universities

Climate protection and energy awareness became important subjects, also in schools and universities. For this reason numerous projects to the environment-friendly user conduct were realised in many German institutions. Here the leading intent was mainly saving energy and water, and waste separation. These projects aimed on one hand on the reduction of the actual consumption of electricity and heat, respectively to introduce the waste separation, or to optimise it. On the other hand, particularly in schools the pupils were to be participated. Since schools and universities additionally can contribute through waste prevention to a significant extent to environmental protection the knowledge about waste management processes and its basic conditions in these institutions, gains importance in the future. For this measure especially the possibilities for schools will be described. But for universities the same conditions are essentially similar (cf. chapter measure C VII 1: Waste prevention in the training of teachers and tutors.).

8.2.2.1 Example measure C VII 2.1: Waste prevention as campaign in schools and universities

Background

In the first step the various fields in which waste prevention is possible have to be identified. A checklist, like for instance arranged by the Ministry for Environment, Climate and Energy Industry Baden-Württemberg, helps to find the right approach (KlimaNet 2012). Examined has to be both, the quantity (e.g. paper consumption) as well as the quality (e.g. considera-

tions on lifespan for purchasing electrical or electronic devices). In addition to this, a consultancy free of costs should be enabled throughout the whole first phase. In the “fifty/fifty PLUS” project by Klima Bündnis and the Unabhängigen Institut für Umweltfragen (UfU) for instance, the schools were able to call the experts by phone (fifty/fifty PLUS 2007). Identification of fields and afterwards the elaboration of the waste prevention measures will be carried out by a working group (of teachers, maintenance person, pupils and possible other staff, plus interested parents). The staff (teachers, maintenance person, secretary, cleaning and cafeteria staff) has to be informed about the new measures and receive training.

Above this it is necessary to give a financial incentive, so the schools actually carry out the waste prevention and take the according measures. The model fifty/fifty of the project “fifty/fifty PLUS” has proved to be useful. In this model each of the participating schools receive 50 % of the energy costs that were saved in relation to the previous year (for the intended WP measure: savings in the procurement of paper or other operating materials, and disposal costs) returned to their free disposal. Other models are suggested by the Österreichisches Ökologie Institut (Austrian Institute for Ecology): in the benchmark-model, the difference of the residual waste emerged, is calculated, and the “saved” disposal fees are disbursed to the schools (Pladerer et al. 2010). As a further possibility the outsourcing of the disposal fees to the school autonomy is suggested. In this case, the school has to pay the disposal costs fully out of their own budget (Pladerer et al. 2010). Another incentive possibility is to organise contests between the schools. This is something that realised was as well in the “fifty/fifty PLUS” project (fifty/fifty PLUS 2007).

The next step is the introduction or expansion of the environmental education of the pupils on the subjects “waste prevention” and “resource conservation”. Pupils should be involved into the waste prevention topic as much and as close to the reality as possible for this purpose. This can already happen in the identification process and the development of the WPM, and can be included in the normal lessons as well. Projects that were realised in schools by now are for instance the establishment of environmental work groups, the arrangement of project days or excursions (Umweltschulen 2012). Hence, the curriculum should be expanding on obligatory and non-obligatory exercises in the field of resource conservation and waste prevention.

In order to support the teaching staff in choosing and preparing lessons or projects around the topic waste prevention, a central information web page is to be created or existing pages to be supported and enlarged. Existing pages, like those of the UN decade of “Education of Sustainable Development” (BNE 2012) or the private page “www.umweltschulen.de” already provide materials and recommendations for lessons about the various topics of sustainability. On websites like these, headmasters and teachers can inform themselves about the topic, and access various materials and ideas to prepare lessons and projects. To set up and advertise an official environment website for schools, e.g. in collaboration with the ministries for education and environment of the Federation and the Federal States, in combination with suitable communication through the school administration, could bring the environmental education in general as well as on waste prevention and resource conservation in particular considerably forward. The website should be installed in collaboration

with already existing nation-wide well established pages of the educational sector³¹⁰, e.g. www.bildungsserver.de.

In the course of this measure it should also be checked, if schools could be won over for the implementation of an eco-audit. Some schools have already had great success in performing an eco-audit according to EMAS³¹¹, and have increased their environmental standards, while they particularly focussed on the aspect of education. For this purpose, the audits were implemented and attended in projects with the pupils. For schools that want to carry out an audit, many supports are already available, like e.g. checklists, teaching aids, background information and similar material³¹². A nation-wide initiative on the realisation of environmental management systems in schools should be developed on the basis of the existing experiences, and, if possible, be implemented nation-wide. In the course of these measures it can be built on already existing projects of the Umweltgutachterausschuss (UGA) in the BMU³¹³ in cooperation with the MfUKE Baden-Wuerttemberg³¹⁴, like for instance training seminars free of costs on eco-audits in schools.

More detailed data on environmental protection in schools, with a focus on climate protection, is offered by the handout “Klimadetektive in der Schule”, which was, inter alia, created with the support of the BMU (Langner 2011). Referring information and training material on waste prevention and resource conservation should be developed, and be available for school administrations, schools and teachers.

The example of the Federal State Bavaria, where 2003 the “guidelines for the environmental education in the Bavarian schools”³¹⁵ were issued from the Bavarian States Ministry, is to be adopted from other Federal States and the Federation.

And last, but not least, in order to guarantee a good and nation-wide integration of environmental subjects into the everyday school life, in agreement between the environmental and educational ministries, these subjects should competently be included into the curricula and materials (schoolbooks, accompanying workbooks, films, DVDs et al.), respectively, if they are already included, they should be expanded, amended and qualified. The focus of this measure is on the topics waste prevention and resource conservation, but still is seen in connection with general environmental subjects (cf. measure C VII 1: Waste prevention in the training of teachers and tutors).

Objectives

This measure has two aims. The first one is to implement waste prevention in schools. This means that fields where waste prevention is possible are identified and specific measures developed in order to enable waste prevention. The second aim is the better inclusion of pupils in the various waste prevention measures. At the same time, environmental education

³¹⁰ E.g. www.bildungsserver.de

³¹¹ <http://www.umweltschulen.de/links/auditlinks.html#schulaudit>

³¹² <http://www.umweltschulen.de/audit/nachhaltigkeitinderschule.html>

³¹³ <http://www.emas.de/aktuelles/termine/2010-01-06-termine/284-oeko-audit-an-schulen/>

³¹⁴ <http://www.um.baden-wuerttemberg.de/servlet/is/63644/>

³¹⁵ <http://www.isb.bayern.de/isb/download.aspx?DownloadFileID=42f0c26ed8e8b03c68edfc402efbf47a>

has to stress resource conservation and waste prevention. In the long term this aims on raising the awareness of pupils for waste prevention also in an extracurricular daily life.

Characterisation

The fields where waste prevention is possible will be identified. Therefore already existing checklists will be used and developed further. Measures on WPM for the specific implementation in schools and universities will be developed. Financial incentives will be given in order to carry out the measure there. Pupils will be included, and the subject waste prevention will be integrated into the curriculum. A central website for the composition of lessons and projects will be created, respectively, existing sites will be enlarged.

Initiators and Addressees

The ministries for environment and education on the federal and states level (UMK and Conference of Educational Ministers). Municipalities whose waste consultants are or were already active (e.g. district Mettmann³¹⁶, district Emmendingen, municipality of Freiburg and neighbouring districts³¹⁷, Berlin³¹⁸) should be consulted.

Addressees are the schools administration, the responsible departments in the municipalities (school authority) and the schools themselves – in the end also the teachers and pupils.

Waste Prevention Potential

The measure has a particularly good waste prevention potential in the fractions waste paper and plastic packaging. In Austria the waste amount was reduced by 32 % (waste paper) respectively 26 % light weight packaging (Pladerer 2010). In Duesseldorf for instance, the introduction of a mailing list for parents saved 25,000 sheets of paper in one school year (Umweltschulen 2012).

In a project of the Berlin City Cleaning Service (BSR) in Berlin schools this kind of projects and intensive work of environmental consultants significantly increased the recovery rate, particularly for paper and light packaging. But moreover, the average waste emergence was reduced from 6.9 litres on 5.7 litres per waste generator (pupils, teachers and employees) and week, i.e. by almost 20 % (BSR 2002)³¹⁹. In a density of 250 kg/m³ and a pupil number of 11.7 million (DESTATIS 2010)³²⁰ this results in a nation-wide prevention potential of approximately 140,000 tons.

But also in terms of cleaning agents and in the procurement of durable products, in particular printers, copy machines, computers, beamers, televisions, equipment of kitchens and cafeterias etc. (cf. chapter measure C VI 4: environment-oriented / waste-preventing

³¹⁶ http://www.kreis-mettmann.de/media/custom/478_529_1.PDF?1086314557?La=1&object=med%7C478.529.1

³¹⁷ http://www.landkreis-emmendingen.de/media/custom/1406_719_1.

³¹⁸ BSR: <http://www.abfallberatung.de/konzepte/Bawosch.pdf>

³¹⁹ BSR Berliner Stadtreinigung, Alles klar mit BAWO. Abfallvermeidung und Abfalltrennung – ein Leitfaden für die Praxis in der Schule, Berlin 2002

³²⁰ Statistisches Bundesamt, Anzahl der Schülerinnen und Schüler geht um 1,3 % zurück. Pressemitteilung Nr. 105 vom 16.03.2010

procurement), a relevant contribution to waste prevention is possible. The ecological, low-waste orientation of school festivities has to be added.

Environmental impacts

Specific data on the evaluation of the enabled environmental impacts are not given. A large and particularly important share of this measure's use is the increased awareness of pupils which cannot be quantified anyway.

Indicators

The waste prevention can be estimated by the overall waste reduction of a school or all schools in a municipality.

In order to examine the overall implementation of the measure, the number of schools and universities that carry out campaigns on the subject waste and waste prevention, respectively introduce an eco-audit serves as an indicator.

Social impacts

Negative social effects are not to be expected. The social fabric of the schools will become better with the various measures on waste prevention (environment work group, project days et al.), and the group cohesion amongst the pupils will be strengthened. Above this, the pupils will be educated to be self-relying and develop a sense of responsibility. The environmental awareness taken in at school will in addition be carried to other social fabrics (mainly into the families).

Economic impacts

The measure has, when a financial incentive system is applied, mainly positive economic impacts on the schools, because more money is available for their free disposal.

Conclusion

The measure has on one hand a relevant direct waste prevention potential, particularly for the light packaging and waste paper, and for the whole field of procurement and organisation of school festivities. On the other hand teachers and pupils will be informed and sensitised about waste prevention. Therefore this measure has a long-term effect that lingers on in the everyday life outside of school.

It would make sense to implement this measure in schools as comprehensive environmental campaign in combination with other environmental topics.

Recommendation

The example measure is recommended for the implementation.

Example measure C VII 2.1: Waste prevention as campaign in schools and universities	
Objectives	Fields where waste prevention is possible are to be identified and specific measure developed. Stronger inclusion of pupils in the various WPM, plus an environmental education that stresses resource conservation and waste prevention.

Example measure C VII 2.1: Waste prevention as campaign in schools and universities	
Characterisation	Identify fields where waste prevention is possible (checklist). Develop measures for specific WPM. Financial incentives have to be given. Pupils will be included, and the subject waste prevention will be integrated into the curriculum. A central website for the composition of lessons and projects will be created.
Link to measures set out in Study I	
Link to Annex IV WFD	12. The use of awareness campaigns and information ... combined with 11. Economic instruments
Instrumental character	Sensitisation, information, economic
Initiator	public authorities
Addressees	Schools
Waste prevention potential	Mainly in the fields of plastic packaging and waste paper have high potentials.
Environmental impacts	Specific data are not available and cannot be quantified based on the present data.
Indicators	Volume of waste and number of participated schools.
Social impacts	No negative impacts. Social fabric of schools and the group cohesion will be strengthened.
Economic impacts	Positive economic impacts for the schools by financial incentives.
Conclusion	This measure has a considerable waste prevention potential. But more important for the positive estimation is the long-term effect of information and sensitisation of the pupils.
Recommendation	The example measure is recommendable for the implementation.

8.2.3 Measure C VII 3: Support for experiential communication approaches undertaken by the public sector

Environmental and consumer protection associations like BUND, NABU, Greenpeace, WWF, consumer advice centre, consumer initiative and others, but as well municipalities and ministries or competent agencies of Federation and Federal States, develop targeted campaigns on a variety of environmental policies. Hereby, through a target group-oriented mix of media and instruments, also measures in the field of social marketing are carried out. Social marketing aims less on the sale and distribution of products, but rather on the use of a suitable mix of instruments to cause a change in behaviour, values and attitudes of a specifically defined target group.

Central instruments are taken from the field of experience-oriented communication approaches. Specific settings and scenarios give target groups the possibility to gain sensory experiences to engage with the issue of the communication content. For waste prevention there are examples (Dehoust et al. 2010) like:

- the Wissens- und Erlebniszentrum “AW Erle” (knowledge and experience centre “AW Erle”);
is deemed to be a flagship project on sustainable closed substance cycles. The Abfallwirtschaftsgesellschaft Rendsburg-Eckernförde (waste management company) teaches amongst other things a sustainable use of resources to school classes and other visitors.

- the Jugendlifestyle-Kampagne “Overdose” (youth-lifestyle-campaign “Overdose”); A campaign against disposable drink cans with “event” character of the Federal Ministry for Environment, Nature Protection and Nuclear Safety (BMU) where waste prevention and youth culture was the subject.
- demonstration projects like the “Eden Project” in England; where understanding for responsible management of nature resources in the population is promoted, and where practical demonstration projects make suggestions for the everyday life,
- the Haus der BUNDten Natur at Hamburg³²¹; where children can experience nature in a hands-on manner;
- Kunst-Stoffe e.V. Berlin³²², a collection point for reusable materials with self-help workshops and educational trainings.

Beside this there are some projects for pupils, respectively pre-school kids that work with methods of theatre in education like for instance

- the environment theatre Unverpackt³²³, a professional theatre ensemble of the Wissenschaftsladen Bonn e.V.,
- the “Umweltgarten” (environment garden) and the “Erste Leipziger *Umwelttheater*” of Columbus Junior e.V.³²⁴

which discuss many environmental topics.

The campaigns aim on related questions like for instance resource conservation or waste management and could also, modified with financial support, be used to deepen the issue waste prevention. The environmental associations are experienced in campaigns and therefore an important potential partner for public authorities in the implementation of experience-oriented communication approaches of the waste prevention issue.

The communication, respectively the implementation of the measure, usually takes place through campaigns on a municipal level. Here the individual municipalities can create and implement campaigns on their own. They are directly “at the citizens” and therefore able to start initiatives that are coordinated according to the specific local situation. But often, particularly smaller municipalities are rather badly equipped with financial resources, so here as well a financial and organisational support would be useful.

The focus should necessarily be expanded though, from the classical subject “packaging” towards other and current aspects, like for instance the handling of foodstuff or lending / leasing / exchanging instead of buying.

Beside regional campaigns on experience-oriented communication approaches, some high-quality cine films have picked up environmental and social subjects, and present these in a commonly understandable and enthralling way. Films like “We Feed the World”³²⁵, “Plastic

³²¹ http://bund-hamburg.bund.net/ueber_uns/haus_der_bundten_natur/

³²² <http://www.kunst-stoffe-berlin.de/>

³²³ http://www.wilabonn.de/index_1597.htm

³²⁴ <http://www.natur-leipzig.de/>

³²⁵ Österreich 2005: <http://www.we-feed-the-world.at/film.htm>, and http://de.wikipedia.org/wiki/We_Feed_the_World

Planet”³²⁶ and “Taste the Waste”³²⁷ have drawn a larger audience compared to plain educational documentaries, and met an enormous media response. Supported by accompanying actions from the environmental associations and informative websites, profound discussions were provoked, also inside the affected industry branches, the trade and the responsible administrations. In some individual cases even research projects were stimulated.

The subject waste prevention, resource conservation would also be suitable for one or more cine films in this manner. Films like these should be stimulated by the environmental ministries on federal and states level, and be promoted by the ministries of cultural affairs³²⁸, in order to support the waste prevention programme in general and the individual measures in particular.

Facing these considerations, the example measure described in the following seems to be suitable: “Promotion of communities as well as environmental and consumer associations to develop and implement experience-oriented waste prevention campaigns”.

Public administrations ensure on a supra-local level that financial and organisational support is given for the installation of knowledge centres, plus the development and implementation of theatre plays and campaigns on waste prevention.

8.2.3.1 Example measure C VII 3.1: Provision of support to municipalities and to environmental and consumer associations to develop and implement experiential waste prevention campaigns

Objectives

The measure to train sensory experiences by using suitable communication approaches to cause changes in behaviour and attitude considering waste prevention in the medium and long term. Thereby also target groups are to be reached who remain reluctant towards classical information material like flyers, brochures or things like that.

Characterisation

The relevant institutions of the Federation and the Federal States as well as the public-law bodies get in touch with the municipalities belonging to their administrative district and in particular with the environmental associations and institutions of the consumer protection; here again their regional agencies are to be encouraged to organise experience-oriented campaigns about waste prevention. In doing so, the target groups will be identified first and suitable communication approaches will be chosen. In order to bring the varied fields of waste prevention closer to the target groups, possible forms are theatre projects, goal-

³²⁶ Österreich/Deutschland 2009: <http://www.plastic-planet.de/> and http://de.wikipedia.org/wiki/Plastic_Planet

³²⁷ Deutschland 2011: <http://www.tastethewaste.com/>

³²⁸ http://www.bundesregierung.de/Webs/Breg/DE/Bundesregierung/BeauftragterfuerKulturundMedien/medien/filmfoerderung/_node.html
“The Federation promotes the German film and the German film industry. More than 30 million Euro per year go to promotional programmes and awards. (...) Another 60 million are annually provided for the “Deutschen Filmförderfonds” - a successful model with positive effects for the whole film industry.”
(Translated from the German original)

oriented events, pioneer projects, life-style campaigns, but as well experience centres. Particularly measures on waste prevention that concern the practice of daily life, but also might being unusual or afflicted with prejudices, e.g. concepts of joint use for complex products (see also for chapter measure C VI 5: Promotion of waste-preventing product service systems), can be adapted best through experience-oriented communication approaches, and here especially through pioneer projects. Multipliers could in this connection also be the recycling depots.

Certain measures of waste prevention, particularly those being formed by cultural pattern and connected with the corresponding inertia behaviour, can only then successfully be effectively be implemented, when the behaviour modification exceeds a critical mass and the multiplying effect is caused.

Initiators and addressees

Initiators are the public corporations for waste management on the county council level and on the level of the independent cities (kreisfreie Stadt) as well as the Federation and the individual Federal States. But also the environmental associations and the institutions for consumer protection and the communes belong to a county.

Addressees are the consumers and all citizens who will be addressed target group-specifically.

Waste prevention potential

The waste prevention potential cannot be quantified for this, solely aimed on sensitisation, measure.

Environmental impacts

When the measure is successfully implemented, indirect positive ecological impacts are expectable, because the acceptance for other specific waste prevention measures increases. Nevertheless they can neither be described more detailed nor even be quantified.

Indicators

As indicator for the success of this measure the number of promoted and implemented will be used.

Social impacts

Changes in behaviour and attitude culminating in changes of cultural pattern can be caused.

Economic impacts

Economic impacts above the specific promotional costs are not expected.

Conclusion

The measure can be a valuable support of “classical” prevention measures.

Recommendation

The example measure is recommended for the implementation.

Example measure C VII 3.1: Provision of support to municipalities and to environmental and consumer associations to develop and implement experiential waste prevention campaigns	
Objectives	Aimed are changes in behaviour and attitude regarding waste prevention
Characterisation	Experience-oriented communication approaches will be financed and implemented on a municipal level. A sensory experience leads to behaviour changes, particularly when cultural patterns are to be changed.
Link to measures set out in Study I	Wissens- und Erlebniszentrum "AW-Erle" (221) Overdose – Eine Anti-Einwegdosen-Kampagne (256) Eden-Project (263)
Link to Annex IV WFD	12. The use of awareness campaigns and information for the broad public
Instrumental character	Sensitisation
Initiator	Federation, Federal States, municipalities, environmental policy institutions and unions
Addressees	Consumers, citizens
Waste prevention potential	The waste prevention potential cannot be quantified for this, solely aimed on sensitisation, measure.
Environmental impacts	Indirect positive ecological impacts are expectable, increasing acceptance for other specific WPM. Quantification not possible.
Indicators	Number of promoted and implemented measures.
Social impacts	Changes in behaviour and attitude will be caused cumulating in changes in cultural patterns.
Economic impacts	Economic impacts above the specific promotional costs are not expected.
Conclusion	The measure can be a valuable support of "classical" prevention measures.
Recommendation	The example measure is recommended for the implementation.

8.2.4 Measure C VII 4: Intensive public participation in waste prevention strategies

Background

At the latest since the subscription, ratification and implementation of the Åarhus convention, transparency and citizen participation are obligatory in the European Union in almost all decision-making processed regarding environmental issues.

The significance of citizen participation lays in the option for citizens to give suggestions to decision-makers before decisions are made, and to make them aware of possible mistakes, shortcomings and adequateness. Democratic and discursive processes lead to an improvement of the decision-making basis (Wiedemann et al. 1995). In the result the citizen participation is to serve the understanding and collective support of citizens for subsequent decisions being made under regard of the submitted suggestions. Beside that it can be expected that citizens who are directly involved into decision processes, support these and become multipliers in their surroundings, so they influence the success positively.

But citizens are not only to be participated in decision processes as individual persons, moreover in most of the cases also as groups, associations or organisations, because in both, the Åarhus convention as well as in the guidelines of the European Union and the German environmental legislation, most of the public participation is mandatory. And, public does not only mean individual persons, but in environmental affairs for instance the environmental associations and organisations, or the consumer protection associations as well. Individual persons will only in exceptional cases participate in superordinated decisions, so the participation of associations and organisations has a high priority here. On a municipal level on the other hand, it can be expected that the participation of individual citizens is significantly higher due to their better knowledge of their direct environment where their willingness to engage in such processes is stronger.

In front of this background the measure described in the following is of importance.

8.2.4.1 Example measure C VII 4.1: Timely and comprehensive involvement of the public in the design and implementation of waste management measures

Objectives

Particularly in the private field waste prevention measures can only lead to success, when they are supported by the citizens and applied accordingly. In order to get there, it is necessary that they are understood and accepted. For the implementation of waste management and waste prevention measures it is imperative to get a high level of acceptance (Vorarlberg 2006). Understanding and acceptance is the higher, the earlier and broader the citizens are involved in the concept development and arrangement of the measures. This is where this measure aims at.

Characterisation

Since citizen participation is to take place on every level, the following measures are considered to be successful:

1. Involvement of the citizens, but particularly the relevant organisations, in the development and evaluation of waste prevention strategies on the level of the Federation and of the Federal States.
2. The participation of citizens in the placing waste prevention concepts and the resulting individual measures on the communal level.

In the first case strategy groups for instance can be installed that are staffed e.g. with representatives from environmental associations, the waste management sector and science. On one hand these groups have the task to develop a waste prevention strategy that meets a broad acceptance. On the other hand, like in Lower Austria – (Niederösterreich - NÖ 2005) – they are to evaluate the waste prevention projects at some point in time afterwards, and to work out which topics should be emphasised in the following years. To make the participation easier for the environmental associations, financial support should be provided (e.g. expense allowance for the participation in workshops etc.). In the process of developing a national waste prevention programme, this happens already intensively.

In the second case several possibilities exist. For instance on a communal level, in bigger cities also on district level, work groups (ÖÖI 2004, Hamburg 1989) can be established developing concepts and implementation measures on waste prevention for

- priority areas like kindergarten, schools, households, restaurants, events etc.,
- waste groups, like household waste in general, packaging waste, bulky waste and hazardous / special waste as well as
- behaviours, e.g. consumer behaviour and throw-away-mentality.

The positive experiences during the experimental game for the introduction of the German recycling bin suggest the use playful elements, beside others, in order to animate the concerned public to participate (Dehoust/Ewen 2011). In particular the inclusion of such groups should be sought with these instruments, which would be potential “losers”, i.e. have a disadvantage from the planned measure, and therefore presumably oppose it.

Initiators and addressees

Initiators are those who develop and erect waste prevention strategies and concepts, and therefore establish corresponding implementation measures, i.e. the Federation, the Federal States, and the municipalities and communes. Since the participation on the federal level is largely completed by the adoption of the programme, the measure aims on the individual Federal States, in particular the municipalities.

Addressees are the citizens. But in superordinated strategies the environmental and consumer protection associations are of particular interest, since their participation can be expected most likely.

Waste prevention potential

The waste prevention potential of strategies on the federal and states level cannot be quantified. But in measures on the municipal level, for instance in Vienna where work groups on specific priority areas were established (Klement o.J.), it had been shown that the waste amount reduced in this neighbourhood by 7 %, whereas it increased by 12 % in the other parts of town in the same period of time. It cannot be quantified to which extend the reduction took place due to the participation of the public into the choice of waste prevention measures.

Environmental impacts

The environmental impacts of these measures are positive, even if they cannot exactly be named or quantified. In particular this measure is a contribution to the acceptance and expansion of further, partly specific, waste prevention strategies.

Indicators

The indicator for waste prevention strategies on the federal and states level can be the number of measures which were erected with citizen participation on the federal, states or municipal level, and included in concepts as well as implemented.

Indicator on a municipal level can be the comparison of the waste emergence, e.g. between neighbourhoods participating citizens early and broad and such where citizen participation

comes late and/or to a small extend or not at all. Corresponding surveys on the waste emergence are required though.

Social impacts

Not negative social impacts are to be expected.

Economic impacts

No negative economic impacts are to be expected.

Conclusion

The measure “citizen participation is, notwithstanding the fact that it is legally required, recommended from the ecological point of view, and indeed in an intensity considerably beyond what is mandatory. This way the understanding, acceptance and awareness for waste prevention measures can grow among the population and so their success increases significantly. The participation processes should be prepared, guided and attended by persons trained for these purposes. Beside this a financial support should be provided for the participation of NGOs on the federal and states level.

Recommendation

The example measure is recommended for the implementation.

Example measure C VII 4.1: Timely and comprehensive involvement of the public in the design and implementation of waste management measures	
Objectives	Aimed are changes in behaviour and attitude regarding waste prevention
Characterisation	Experience-oriented communication approaches will be financed and implemented on a municipal level. A sensory experience leads to behaviour changes, particularly when cultural patterns are to be changed.
Link to measures set out in Study I	(70): Development and implementation of the waste strategy in collaboration with the people (UK) (109): Waste prevention and recycling with the participation of citizens, (Austria) (239): Strategy Group Waste Prevention / mass flow management (Austria) (275): Group discussions on low-waste consumption patterns (Austria)
Link to Annex IV WFD	12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.
Instrumental character	Participation
Initiator	individual Federal States, municipalities and communes
Addressees	Citizens, environmental groups, environmental grass-root initiatives, environmental and consumer protection associations
Waste prevention potential	Hard to be quantified, in individual cases surely significant
Environmental impacts	Among others reduction of air pollutant emissions, resource conservation
Indicators	For strategies: Number of implemented measures. For concepts and implementation of measures: comparison of waste emergence from “fields” with and without citizen participation.
Economic impacts	No negative economic impacts to be expected.

Example measure C VII 4.1: Timely and comprehensive involvement of the public in the design and implementation of waste management measures	
Conclusion	The implementation of the measure serves to increase acceptance of waste prevention measures and programmes, and therefore their chances to be successful.
Recommendation	The example measure is recommended for the implementation.

8.3 Measures in the point of leverage VIII: Waste-preventing discarding

A crucial point of leverage for waste prevention measures in the utilisation phase is the disposal decision. Not always the will to make this decision comes out of the fact that products have reached the end of their possible lifespan, where they cannot fulfil their function. Consumer goods are often singled out before they reach this “limit”, because there is more need (for instance children's article) or demands etc. have changed.

The measures in this field mainly aim at erecting, initiating or supporting structures that can offer a platform to pass these products – if necessary after refurbishing – on to customers. Typical measures in this field are the support of non-profit markets for used products or the support of refurbishing structures or the provision of suitable brochures and other information materials. These measures all have an indirect effect. Incentives are given, although waste generators are not addressed directly.

More direct this is possible through financial incentives and signals. If the financial burden is affected by the number or volume of the waste that is to be disposed, in the ideal case a direct incentive is given, to think the decision of disposal over, and either continue to use the product, or else to pass it on to the above mentioned structures. If beside this, the structures for refurbishment and further use are (financially) supported, they will be less cost intensive for the consumer plus better accessible. Beyond this information and sensitisation of the population can be a third pillar in contributing the overall result.

An important aspect in the reuse of goods in Germany is their legal or illegal export abroad, preferably to newly industrialising or developing countries in Eastern Europe, Asia or Africa.

8.3.1 Measure C VIII 1: Financial incentives and signals for waste prevention

Financial incentives are not only of significance in questions of waste disposal. An arrangement of waste disposal charges on a polluter-pays basis in connection with an accompanying consultancy on options to prevent waste can be supportive to other waste prevention measures. That is why this measure is listed here, although the focus of it lays on the promotion of the separated collection of waste fractions which can be recovered, so in the first instance this measure is to promote the recycling of waste.

In the view of these thoughts the example measure described in the following seems to be suitable: “Charging systems on a polluter-pays basis on the example of weight or volume-related waste disposal charges”.

The public corporations for waste management, respectively the public law bodies, are requested to support other waste prevention measure through an assessment of charges on a polluter-pays basis in the arrangement of waste management statutes and waste disposal charges.

8.3.1.1 Example measure C VIII 1.1: Design of charges in line with the polluter pays principle, for instance through weight- or volume-based waste charges, accompanied by advice on waste prevention

Background

Waste disposal charges for private households and for commercial clients are determined by the waste disposal charge statutes. The charges can give incentives to reduce the overall waste amount, if the volume-based fees are accentuated compared to the basic charges; even though the main impact is the separation of reusable materials. This means that the main purpose of the volume-based fees in the first instance is the support of the waste separation, although they can be clearly waste preventive, particularly when accompanied by the necessary consultancy.

The service fee can be assessed according to container size, frequency of emptying, or the actual weight of waste delivered. The fee distinguishes between the different types of waste.

With the direct assignment of costs to waste amounts, and an according consultancy on waste preventive behaviour, in the ideal case also impulses are given in regard of consumption patterns (durability, type and volume of packaging etc.). The success of this measure can easily be read out of the waste balance sheets from the individual Federal States and the municipalities. The specific emergence of waste is normally lowest where the charging system is on a polluter-pays basis. For instance looking at the waste balance of Baden-Württemberg (Abfallbilanz BW, S. 64f.) this becomes comprehensible. The regional administrative bodies using an Ident System almost always have a residual waste emergence clearly under average³²⁹ compared with the individual fields with comparable structure and waste management system (introduced organic waste container). The fields with the lowest waste emergence, e.g. the “densely populated, urbanised area” Calw, Ostalbkreis and Zollernalbkreis, are those having an Ident System.

The correlation between the use of Ident Systems and the overall household waste emergence can best be understood on the example of the mass development of the Zollernalbkreis. In the year 2001 in this county the charging was reorganised, and the weighing of the residual and the organic waste container was introduced. The charges for organic and residual waste containers (0.23 €/kg) are identical. Additionally there is the basic fee and the fee for the container use. The collection of dry reusable materials is free of charge as far as possible.

As it can be seen from the mass development of the household waste at Zollernalbkreis (Zollernalbkreis 2010), in the year 2001 particularly the emergence of residual waste, but also organic waste, dramatically declined. This happened without any relevant shift to other waste streams and proofed so far to be sustainable. Since the overall waste amount declined, the waste preventive impact is documented.

³²⁹

This does not yet indicate a waste prevention achievement, but is mainly due to the increased participation in the separated collection of different waste fractions. Only if these systems also aim on incentives to prevent waste and as well offer corresponding consultative measures, reductions in the overall waste quantity can be gained.

Table 8-6: development of waste amounts in the county of Zollernalbkreis in kg/E*a (Zollernalbkreis 2010)

Year	Residual waste	Bulky waste	Organic waste	Reusable waste	Total
1995	93.7	16.0	73.6	131.0	314.3
1996	96.5	13.0	75.4	142.0	326.9
1997	98.3	12.7	78.8	158.0	347.8
1998	90.0	6.7	71.0	158.0	325.7
1999	97.8	12.0	78.3	163.0	351.1
2000	103.3	12.4	70,5	172.9	359.1
2001	74.7	13.0	56.0	177.7	321.4
2002	73.4	12.0	51.9	177.0	314.3
2003	72.0	12.0	50.0	167.0	301.0
2004	73.4	13.0	49.5	166.0	301.9
2005	72.8	14.3	48.0	172.2	307.3

That changeover of the charging system is usually without problems, when the waste container can clearly be assigned to the household as debtor of the charges, because each household has its containers at their disposal, or a common understanding about the use of the containers can be achieved between neighbours.

From a certain number of households per estate upwards, or even in case of large residual complexes, this is no longer possible. To implement an assessment of charges on a polluter-pays basis in these residual complexes as well, waste locks are useful. The following figure shows the example of the Zwickauer Müllschleuse of the company Wesoma GmbH (ltd.) at the municipality of Zwickau. There are numerous other providers on the German market.

Waste locks usually are large waste containers which are placed freely accessible. Waste can only be fed through gate secured with an Ident System (lock). With this it is guaranteed that solely households from the respective block of flats can dispose their waste into these containers. Also the Ident System can raise the frequency of use. This way the costs for emptying the container and for the disposal of the waste can be split for the individual households on a polluter-pays basis. The fee assessment can either be directly in responsibility of the waste management provider³³⁰ or indirectly happen through the property management in the course of the service charge statement. A common model here is

³³⁰

See on this as well:

<http://www.kbllangen.de/langenGips/Gips?SessionMandant=KBL&Anwendung=CMSWebpage&Methode=ShoHTMLAusgabe&RessourceID=902&WebPublisher.NavId=861>

contract the service from the property management to private service providers³³¹. The savings from the residual waste charges finances the acquisition. With this system reductions up to 50 % were observed within large residual complexes according to the Berliner Mieterverein (Berlin tenants association). Beside this, tenants of such complexes get the possibility to participate actively in the separated waste collection, and thus save waste disposal charges, just like the residents of detached houses or multiple dwelling units³³².

In order to prevent that the tenants increasingly dispose residual waste in a “cheap” way by surcharging the fractions of reusable materials, intensive consultative and controlling measures are urgently required.



Figure 8-5: Waste lock

Objectives

With this measure the setting of waste disposal charges is to be equipped with a component that allows connecting the level of waste disposal costs to the waste amount. If this volume-based component has a higher value compared to the basic charge, the tendency is likely to go towards a significant reduction of the overall waste emergence.

The measure aims on the reduction of the emergence of residual and commercial waste. If the volume-based fees are not only determined for reusable material masses, like organic waste in particular, and the measure is accompanied by consultancies on waste prevention, the incentive goes beyond a comprehensive shift between the individual systems to collect reusable materials, but moreover to a real reduction of the overall waste emergence.

The main target of this measure is the support of the waste recycling by increasing the separation of residual waste. Other waste prevention measures are to be supported by the

³³¹ See on this as well: <http://www.innotec-abfallmanagement.de/de/verursachergerechtesabfallmanagement-detailinformationen.htm> or <http://www.entsorgung-in-grosswohnanlagen.de/>

³³² <http://www.berliner-mieterverein.de/magazin/online/mm0309/hauptnm.htm?>
<http://www.berlinermieterverein.de/magazin/online/mm0309/030922.htm>

incentive to save waste disposal charges. For the successful implementation of this combination an accompanying consultancy is necessary.

Characterisation

In waste and charging statutes in all county council and independent cities (kreisfreie Stadt), respectively from all the public law bodies responsible for waste management, charges for using waste disposal for all emerging and licensed types of waste are to be determined. For individual waste fractions annual basic fees and volume-based fees can be set.

The annual basic fee can be determined for the properties covered by the waste disposal management, and here depending on the number of persons in fact living on the estate. Another option is the setting of a basic fee in relation to container size and type of waste.

A complementary volume-based fee will be charged to assess the actual use of the waste disposal system. According to all experiences, the Ident System will be preferred for the documentation of the containers. The waste containers are equipped with chips that assign every emptying of the containers by the collection vehicles to the owner. Thereby the volume-based fee can be calculated from the frequency of emptying; here as well with reference to type of waste and different assessment factors. Another option is the assessment of the volume-based fee in relation to the disposed waste quantity. In this case the collection vehicles are equipped with scales that enable the weighing during the emptying process.

Depending on how strong the volume-based component is implemented in the assessment of the charges, more or less considerable incentives to keep waste fractions separate are given for both, households and other waste producers. With an according consultancy, these incentives can also be given to prevent waste. By accompanying controlling, consultancy and measures to raise the awareness, citizens are to be motivated to support the system according to the rules.

Systems, like described above, are introduced with an intensive supervision in densely populated living spaces.

Initiators and addressees

The determination of the waste charging system takes place on a municipal level, respectively on the level of public law bodies, by a decision of the municipal parliaments. The individual Federal States can summon public law bodies responsible for waste management with binding regulations for the introduction of waste charges on a polluter-pays basis, to respect the aspect of waste prevention in the arrangement of waste management statutes and statutes waste charges in terms of a fee assessment on polluter-pays basis and accompanying consultancy. In Baden-Württemberg, according to data of the State waste balance (Landesabfallbilanz 2010), 50 % of the regional administrative bodies have an assessment of waste charges on a polluter-pays basis, either by weight determination, banderol or Ident System.

In the end the measure aims directly on the individual waste producer liable for the fee payment.

Waste prevention potential

The disposal of the individual waste fractions, dry reusable material, organic waste, residual waste, bulky waste) is directly combined with an ecological use which usually exceeds the

burdens of the waste disposal. The ecological use of the waste prevention lays, like mentioned a few times before, in reducing the burdens of waste disposal from the manufacturing of products that become waste.

Hence, the measure aims less on decreasing in the burdens from disposal. Main objective is the decrease of the environmental burdens that are connected to the production and distribution of the consumption goods and other products, and therefore as well are connected to the waste quantities.

According to data of the Federal Statistical Office (Statistisches Bundesamt)³³³ the average waste volume was around 455 kg/E*a, where 199 kg/E*a were household and bulky waste, 143 kg/E*a dry reusable material and 111 kg/E*a from organic and green waste.

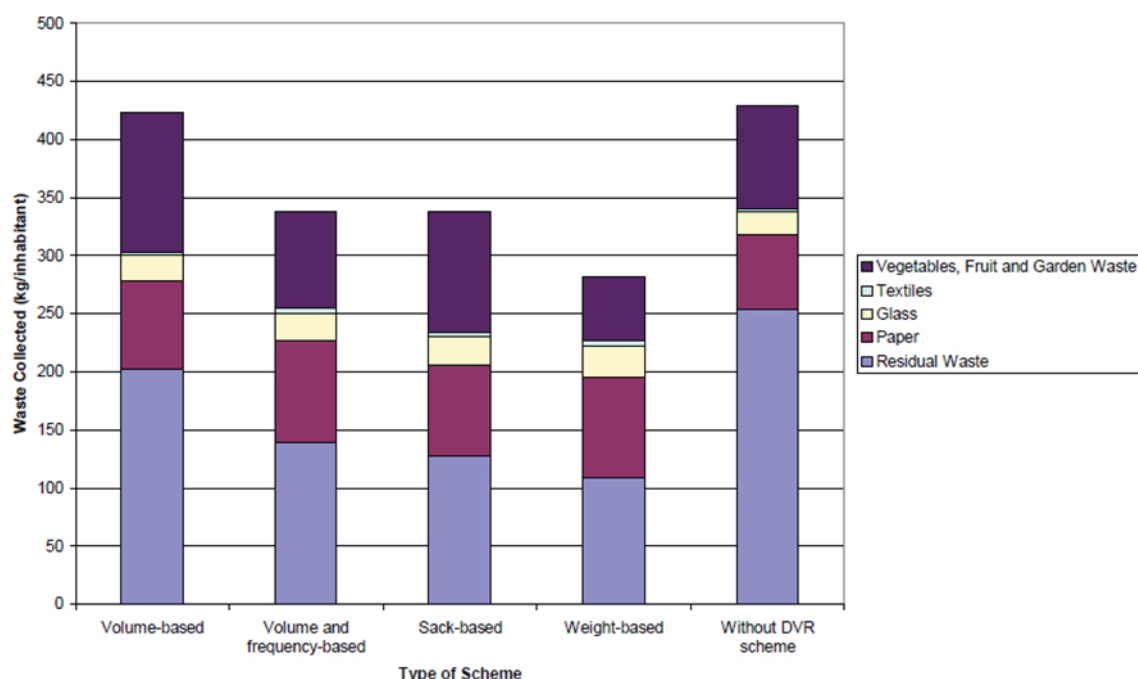


Figure 8-6: Relation charging system and waste volume (source: Hogg et al. 2011)

In many regional administrative bodies the fees are already charged on a polluter-pays basis, though in different forms and with a varying incentive potential. The specific circumstances in the regional administrative bodies cannot be presented in detail here. Figure 8-6 shows the average waste quantities in relation to the charging system on a European level and reveals that particularly systems on a weight basis lead to both, a better sorting, but as well to a reduced overall volume.

If one assumes a general average reduction potential of 10 kg/E*a throughout the Germany, and assumes at the same time conservatively that this potential was already collected in 2/3 of the regional administrative bodies, by ways of calculation an annual waste prevention potential of 271,570 tons residual waste remains. If one assumes a prevention of only 5 % of the average quantity of household waste, the potential would be increased to nearly 600,000 t/a.

Environmental impacts

The reduction of the waste volume should particularly affect the residual waste disposal. For the estimation of the environmental impacts this is assumed to 100 %. The disposal of residual waste is for the most part related to an ecological use, since the thermal treatment generates an energy surplus which can provide electricity or heating. The substitution successes that can be gained from residual waste usually exceed the burdens resulting from the collection of the waste, as well as the direct environmental impacts from the incineration.

On the other hand, the prevented residual waste is composed of all kinds of waste products where the environmental pollution from the production has to be included into the balance. To the most part it is the volume of waste products that can be described as dry reusable material that can be influenced by the household.

Since the prevention of the expenditures for the manufacturing of all possible kinds of products that have a potential to become part of the residual or bulky waste cannot be balanced here, as a simplified example the relief from greenhouse gases by the reduction of plastic product from LDPE is calculated in rough estimation. The incineration of 270,000 t plastic waste leads to an emission of 816,000 t CO₂ equivalents due to the fossil origin of plastic (modelling according to IFEU). By incineration electrical and thermal energy is won which can substitute conventional German power and heating. The production of a corresponding mass of energy would be related to 497,000 t CO₂ equivalents, so that those deducted from the above quantity of emissions, a net emission of 317,000 t CO₂ equivalents from the incineration of 270,000 t plastic waste result (modelling according to IFEU). The production of 270,000 t plastic (on the example of LDPE foils) is related to a burden of 635,000 t CO₂ equivalents (APME 2005).

Hence, the prevention of 270,000 t plastic leads, by way of calculating, in the total of prevented production expenditures and prevented disposal emissions to a relief of 950,000 t CO₂ equivalents.

Indicators

As an indicator of the waste measure the development of the waste volume of all residual waste in kg/E*a can be seen; although the specific volume is influenced by several factors. For an estimation of the successes of the measure the data on the overall residual waste volume of the county councils with and without charging system on polluter-pays basis should be compared.

Additionally the shares of waste management companies regulated by the public law who have changed their charge statutes to a fee assessment on polluter-pays basis, and the share of citizens who are connected to these systems, are to be registered.

Social impacts

With the introduction of waste locks in densely populated residential areas, the population there can save waste disposal charges when separating and preventing waste. Without such systems this “privilege” remains reserved to living areas with mainly detached houses or multiple dwelling units. If Ident Systems are introduced, they should also be applied in densely populated living spaces.

Economic impacts

If successfully implemented in combination with an intensive waste prevention consultancy³³⁴, the measure gives an indirect economic incentive to prevent waste can be given.

Together with other waste prevention measures this can cause a reduction of the consumption good output, as well as a reduction of the waste volume for disposal. In both cases this might be related to economic impacts in these branches.

For the waste producer the reduction of the waste emergence with a waste disposal charging system with the components of basic and volume-based fee leads to a reduction of the disposal costs.

The reduction of the residual waste quantity can lead to a relief of charges for those households which support the system actively.

Conclusion

Although the main purpose of the measure is the promotion of the separate collection, and therefore in the waste recycling, by giving financial incentives, the effectiveness of other waste prevention measures can be supported.

The impurity rate in the reusable material fractions could increase with insufficient information and consultancy of the population. Experiences proof that the reductions in the residual and overall waste quantity are possible without litter pollution in the landscape as well as in the reusable material fractions. For this accompanying consultancy and awareness raising campaigns have to be sustained beyond the introduction phase and controlled, at least in spot checks.

Recommendation

The example measure is recommended under the reference that the main purpose of this measure is the promotion of the separated collection and therefore in the waste recycling.

Example measure C VIII 1.1: Design of charges in line with the polluter pays principle, for instance through weight- or volume-based waste charges, accompanied by advice on waste prevention	
Objectives	The measure involves an adaptation of the municipal statutes on waste charges in reference to a volume-based component and aims, beside the separated collection, at least indirectly on a reduction of the waste volume.
Characterisation	There are different ways how a calculation of charges on a polluter-pays basis can take place. Beside the assessed basic fee (usually per estate), a component can be applied that charges a fee per emptying (Ident System), by weight (weighing of the containers at the vehicle) or depending on the container size freely to be chosen to a certain extent. Above this waste lock systems for the precise charging of the waste disposal fees per apartment are necessary in the densely populated living area.

³³⁴

Here it does not matter, if the chip of the Ident System calculates the waste volume through the frequency of emptying or by additional weighing of the mass. In the densely populated living space additional systems to split the charges between the tenants are necessary, e.g. by using waste locks on the waste containers!

Example measure C VIII 1.1: Design of charges in line with the polluter pays principle, for instance through weight- or volume-based waste charges, accompanied by advice on waste prevention	
Link to measures set out in Study I	(12): Establishment of volume based waste fees (22): Introduction of variable litter bin sizes for residual waste (202): Waste fees based on weight with the help of ID Weighing Systems
Link to Annex IV WFD	12. Economic instruments
Instrumental character	Charges on the polluter-pays basis
Initiator	With the measure the individual Federal States as highest waste authority stimulate the bodies responsible for waste management to arrange the charging statutes in a way that households (and commercial clients) receive a fee assessment according to the polluter-pays principle.
Addressees	Addressee is the body responsible for waste management, respectively after all the housing industry and the citizens, respectively the commercial waste producer.
Waste prevention potential	The prevention potential cannot be quantified and is particularly difficult to be differentiated from effects from the separated collection or other treatment (like self-composting). If one applies 10 kg/E*a by way of example, and assumes that die measure is already implemented in 2/3 of the local bodies, by way of calculation a prevention potential of approximately 270,000 tons residual waste remains.
Environmental impacts	Assumed that this potential would mainly be of (packaging) plastics, from the reduced disposal quantity and the reduced production expenditures for the related consumption goods an environmental relief effect of approximately 1 million t CO ₂ -eq per year is the result.
Indicators	Development of the waste volume of all residual waste in kg/E*a and comparison of the local bodies with and without charging system on a polluter-pays basis. Share of the public law bodies responsible for waste management who have changed their charging system according to the polluter-pays principle. Share of citizens who have access to the charging system on a polluter-pays basis.
Social impacts	No negative social impacts to be expected. Creation of fee assessment on a polluter-pays basis also in the densely populated living area.
Economic impacts	No negative economic impacts to be expected. The reduction of the residual waste quantity can lead to a relief from fees for the individual household.
Conclusion	Even if the ecological use of this measure stays limited, but has a greater significance due to the direct effect on the individual citizen as waste producer. Even if not all of the waste reduced by this measure can really be prevented, still the awareness for waste will be increased and partly the consumption patterns will indeed be questioned. Therefore the measure will lead to a prevention of waste.
Recommendation	The example measure is recommended for the implementation provided that the main purpose of this measure lays in the promotion of the separated collection and therefore in the recycling of waste.

8.3.2 Measure C VIII 2: Support for private and non-profit markets and exchanges for discarded products

Background

Commodities not necessarily become waste only when they cannot be used any further because their functionality is lacking. In many cases it is for instance a question of design or the wish for a change that causes the owner's will to give the commodity to the disposal.

Because in Germany the level of prosperity is generally rather high, in most of the households a high degree of provision with commodities has been achieved. As well it is the case that household liquidations do not meet a high demand of a stagnant population, so most of these commodities become waste.

In many cases the demand for used articles does not follow a financial need. In some regions, and for certain groups of consumption goods, the support of public administrations in creating platforms, where at least a part of these articles can find a market, and accordingly the demand, is necessary. This should always be in relation with a corresponding public-relation work.

At the same time, waste-preventing disposal decisions in relation with the reuse of waste products have an international dimension. Relevant material and resource flows are exported into countries of the global south, through legal, but in particular also through illegal channels. Parts that still function are often dismantled there; the rest ends up as illegally dumped waste. Surveys about the socio-economic impacts of electronic waste are particularly for Ghana and Nigeria available (Prakash/Manhart 2010, Manhart et al. 2011).

On one hand the local, and mostly informal, recycling and reprocessing industry constitutes an important source of income, whereas great social harm, health and economic and environmental damages are related on the other hand. Waste prevention measures that start here, have to consider these factors. Suitable frame conditions have to be developed, for an environmentally compatible and socially acceptable export of waste products which are neither preventable nor recyclable in Germany by measures aiming at the production process, despite the many WP measures described, like e.g. in this study. In particular this effects the promotion and support of both, efficient as well as socially, economically and ecologically harmless structures in the addressed countries.

Facing these considerations, the example measures described in the following lay at hand:

- technical, organisational and financial support of exchanges for second hand articles and
- reuse of second hand articles in the third countries – establishing environmentally compatible and socially acceptable frame conditions.

8.3.2.1 Example measure C VIII 2.1: Technical, organisational and financial support for second-hand exchanges and shops

Background

Generally the classical second hand department store is a non-profit institution that collects used devices, but as well textiles, books and similar item, and sell these for a small price. An example is the Markthaus Mannheim³³⁵ existing as a social enterprise since 1997, or the Second Hand Kaufhaus Neufundland at Frankfurt where, beside others, used electronic devices are sold. This enterprise as well is at the same time socially committed by qualifying long-term unemployed.

³³⁵

<http://www.markthaus-mannheim.de/web/bmarkth.htm>

Beside the regional support of second-hand department stores, the nation-wide networking of organisations and their collaboration in particular, is to be promoted and intensified. In order to reach this, already existing associations and networks, like the Verband Second-Hand vernetzt e.V.³³⁶, the Bundesarbeitsgemeinschaft Arbeit e.V.³³⁷ and other networks of this field, are to be included. To the experiences of the KVK network from Belgium it can be referred to as well (see also chapter “Measure C VIII 3: Supporting reprocessing structures”).

With the general spreading of new media though, also new markets using the internet have developed, where goods are offered and sold on private initiative. In supra-regional internet market or exchange places these are products that can be sent by mail comparably easy. Since costs are related, the exchange of the goods is related to the purchase most of the times.

In regional exchange markets products are also given away or swapped for collection. One of many examples of this kind is the Tausch- und Geschenkmarkt Berlin (swap and give-away market) that was established by the Berliner Stadtreinigungsbetriebe (waste management) for the Berlin citizens, and which is online through the website of the Berliner Stadtreinigung (BSR)³³⁸. In the free of cost online exchange for second hand goods, wanted advertisements or offerings for furniture or other commodities placed and edited.

Another option is the mutual exchange of different items. Under the motto “Reuse instead of Through-away” the prevention of waste in the State Berlin shall promoted, and a contribution to save resources is made.

Another example for regional networking in the second-hand area in Berlin is the magazine and internet platform “Zweite Hand”³³⁹ acting since 1983 as broker for second-hand goods and other classified advertisements. At first wanted advertisements and offerings were published only in form of a magazine, and since 1995 the portal is online as well. The want ads and offerings cover selling, giving away and swapping.

A second-hand exchange on a federal level is to be created, e.g. by the above described network of department stores and retailers, that closes the gap between the regional, often not well known exchange markets and the commercial internet agent ebay. The objective of such an internet exchange should be:

- professional orientation and market penetration referring to the model of ebay and similar commercial e-marketplaces;
- prevention of malpractice (stolen articles, wrong or incomplete characterisation of articles etc.) by clear regulations that are reliable and increase protection of both, the supplier and the purchaser than this is the case on most of the commercial e-marketplaces;
- good offerings of used products for sale on a commission basis, respectively acquisition of used products for the resale in order to draw as well those consumers who avoid to advertise and sell on their own behalf on an internet marketplace;

³³⁶ <http://www.secondhand-online.de/>

³³⁷ <http://www.bagarbeit.de>

³³⁸ <http://www.bsr.de>

³³⁹ <http://www.zweitehand.de>

- networking between second-hand department stores and providers on a commission basis;
- if applicable the use of a network of second-hand department stores as collecting and take-away points as additional option beside the postal delivery. As an offer creating trustworthiness this could be related with the possibility to check there, whether the product is in accordance to the characterisation.

A new idea can also be the consumption shelf, i.e. a “shelf” placed in the public streets that, protected from the weather allows the exchange of goods. The rules are extremely simple. Every person can bring goods for the free collection and every person can take from the offered goods. The goods exchange market / shelf spaces are usually accessible at any time. The problem of such freely accessible “shelves” could be the littering of the rooms or spaces, or the misuse, like illegal collections and improper exploitation of electrical devices. The approach is based on a certain social control in order to prevent littering and misuse. For electrical and electronic devices this variation is to be rejected for the reasons mentioned.

An alternative are the so-called “Umsonstladen” (free-shops)³⁴⁰ where, usually on a voluntary basis, the maintenance of the product range and the examination of the items is organised. Thereby the problems of misuse of such approaches in the segment of electronic and electrical waste products by illegal commercial collecting, and the exploitation of reusable devices, are preventable. For this purpose, it has to be guaranteed that the maintenance staffs are sufficiently trained, and that the terms of employment have a binding character.

An approach being very different from the initial position but in principle similar, is the soil, construction rubble and component markets like ALOIS³⁴¹. This exchange market is a current, cheap, interactive market place with the aim, to provide recycling for soil, rubble and various components. In doing so the exchange is concerned to bring offerers and seekers of these materials fast and effectively in contact. Beside others the following materials can be offered or wanted: soil, wood (windows, doors, staircases etc.), plastics (windows, doors etc.), metal (cable, radiators etc.), insulating material, stones (roofing tiles, flagstones, clinker bricks, tiles, bathroom ceramics etc.). The exchange started in 1995. The system was established and updated by the States Hessen, Rhineland-Palatinate and North Rhine-Westphalia. The exchange is freely accessible for everybody and free of charge, so for instance for private, commercial and industrial constructors, awarding authorities, real estate developers, architects, transportation companies etc. A nation-wide expansion, and therefore a significant increase of the knowledge level are desirable.

Another positive effect of a well-known and respected network of second-hand traders could be the stronger reliability into the guarantees given, if it is the network that stands-up for the guarantees, so the customer has no need to worry about that the retailer might not be existing any more, when the warranty is claimed at a later time, like this is prevalent e.g. in the internet branch.

³⁴⁰ Cf. on this <http://www.umsonstladen.de>

³⁴¹ <http://www.alois-info.de>

Objectives

The broad support of second-hand exchanges and department stores, particularly on a regional level, shall increase the name recognition and raise the customer's acceptance. At the same time the financial and organisational frame conditions are to be supported. Thereby the share of reuse and further use of second-hand goods is to be increased, whereas the new production rate of these articles is reduced.

This target is to be supported by a nation-wide network of second-hand retailers with social and ecological approach, and the municipal actors like the enterprise responsible for the collection of bulky waste, and the municipal administrations for environment.

Characterisation

The municipalities initiate private and non-profit second-hand exchanges, respectively, in case they are already existing, support them financially and organisational. What platforms are suitable to be supported in which way, results from the individual local necessities and the specific requirements of the various commodities.

A network on federal level of second-hand department stores and markets, as well as the promotion of regional and nation-wide associations, shall increase the reliability of the stakeholders for the customers, and strengthen the market penetration. For potential suppliers and customers the effort for searching and transactions shall be reduced.

Initiators

With the measure private and non-profit initiatives shall be supported by public administrations, in case this is necessary. Networking and expansion on a federal level should be initiated by the Federation and the Federal States, where the ministries for environment, economy, and social and labour affairs should collaborate here.

Waste prevention potential

The measure aims on a wide range of products and goods that accrue in households for disposal, but are still serviceable. For instance this can be household articles and commodities, or furniture, textiles, but just as well books.

Those commodities are given to the bulky waste or residual waste collection in general. The potential cannot be quantified closer. When offered for the reuse, the lifespan of the products will be prolonged. An estimated evaluation of the waste prevention potentials and the environmental impacts of the prolongation of the lifespan are carried out for some examples in the chapter "Waste prevention potential and environmental impacts of lifespan prolonging measures".

Environmental impacts

Particularly the production of textiles is related to high environmental burdens. This applies for both, the cotton production with a high use of water resources and pesticides, as well as for processing cotton and the manufacturing of textiles, which both are related with a high energy input and the pollution of waste water. Per cotton shirt with 250 g production weight, 14 kg CO₂ emissions, 49 g NO_x and 32 g SO₂ are indicated (see for as well data base Ecoinvent, respectively Steinberger et al. 2009). For the manufacturing of chip boards that

are an important resource for wooden products (e.g. furniture), data is as well available from the Ecoinvent data base and Frühwald et al. (2000). The pollution from the production and the credits for disposal balance more or less out. For this reason the leverage factor is rather unimportant for waste prevention measures in wooden products.

A study of the Öko-Institut (cf. Quack 2003) reveals that in the field of construction, particularly in the segment of used components, reuse has a high potential to save energy and reduce CO₂ emissions, when the provisions are considered. The saving potentials for most of the components are around 60 %. For 144 m² windows savings of 164 GJ primary energy and 5.3 tons CO₂ were calculated for the examined construction component exchange market (Quack 2003). In these premises it is inevitable to plead in maintaining and expansion of component reuse.

Altogether, establishing swap and give-away markets (like e.g. second-hand department stores or bicycle exchanges), as well as portals for trade and auctions (on the internet), provides the opportunity for a more sustainable consumption. Reselling used products and commodities of various kind, gives “useless” items a new value, and therefore reduces the waste volume (e.g. of bulky waste and electronic and electrical devices) significantly.

Indicators

As indicator for this measure the chronological sequence of the share of second-hand trade in the overall turnover in certain products and product groups is suggested. Product groups, beside others, in question are: electronics, furniture, clothing, books and sports equipment and construction components. It has to be taken into account that the particular data will have to be collected.

Social impacts

Negative effects are not expected by implementing this measure. By the combination with social initiatives, e.g. the qualification of long-term unemployed, on the other hand special synergy potentials can be developed.

Economic impacts

If this kind of reuse spreads to an extent that losses in the sales of new products are to be expected to a significant extent, it seems useful to include the producers into the measure. For instance the reconditioning for the reuse would make sense to go back to the responsibility of the producers.

Conclusion

A well-functioning second-hand market can be a relevant contribution to the waste prevention.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 2.1: Technical, organisational and financial support for second-hand exchanges and shops	
Objectives	The broad support of second-hand exchanges and department stores, particularly on a regional level, shall increase the name recognition and raise the customer's acceptance. At the same time the financial and organisational frame conditions are to be supported.
Characterisation	Initiation and financial support, as well as networking of second-hand department stores and markets on a federal level, promotion of regional and nation-wide associations, and the support of trustworthiness, market penetration, plus the reduction of the efforts for the search and the transactions.
Link to measures set out in Study I	<p>(30): Establishment of exchange and gift markets (Berlin)</p> <p>(51): Promotion of charitable and commercial collection points for used furniture, old electronic and electrical devices and similar items</p> <p>(55): Establishment of agencies and coordination for construction materials and building components (building material markets)</p> <p>(73): Kringloop Reuse Centres</p> <p>(84): Recycling market OWL</p> <p>(85): Workshop for bicycles "Make one out of three"</p> <p>(86): Collection and reuse of used clothes "FairWertung"</p> <p>(97): Exchange for bulky waste, etc. in cooperation with non-profit institutions.</p> <p>(103): Transfer of movable property</p> <p>(110): Registration and agency for used furniture in Bavaria</p> <p>(123): Pilot project for optimizing the collection of used furniture in Bavaria</p> <p>(138): Exchange for soils, components and building rubble (ALOIS) (Hessen, Rhineland-Palatinate, North Rhine-Westphalia)</p>
Link to Annex IV WFD	12. Promotion of reuse and/or repair
Instrumental character	Economic and organisational promotion
Initiator	Public authorities on municipal and federal level
Addressees	Associations, private second-hand structures
Waste prevention potential	Prevention of bulky waste, residual waste, prolongation of lifespan (see exemplary estimation of potential 7.3.3.3 at some example products)
Environmental impacts	An estimated evaluation of environmental effects through the prolongation of lifespan is carried out in chapter 7.3.3.3 at some exemplary products.
Indicators	Chronological sequence of the share of second-hand trade in the overall turnover at certain products and product groups.
Social impacts	Social additional use of the (vocational) education measures and inexpensive supply with necessary second-hand articles.
Economic impacts	Qualification of employees, promotion of regional value-added chains, in particular of SME.
Conclusion	A functioning second-hand market can significantly contribute in waste prevention.
Recommendation	The example measure is recommended for the implementation.

8.3.2.2 Example measure C VIII 2.2: Reuse of second-hand goods in third countries – creation of environmentally and socially acceptable framework conditions

Background

The legal export of electrical and electronic used goods and the illegal export of not properly functioning waste products are in the focus of the national and international reporting.

International conventions, like e.g. the Basel Convention³⁴² take account to the hazards for health and environment from illegal export of waste from industrial countries for the population of the recipient countries.

Despite intensive waste prevention measures in Germany, there are appliances which are still reusable without potential costumers inside Germany, or where the technical reprocessing in Germany is economically not possible, because the labour costs are expensive. With a revised version of the WEEE Directive³⁴³ illegal exports of waste devices are expected to become considerably more difficult. This target will be met by the reversal of the burden of evidence when in future the exporter of waste devices has to proof that the appliance is functioning, and not like – as to date – the control authorities have to proof that it is not functioning. The legal, and therefore in terms of waste prevention desirable exports of waste appliances which are not used in Germany any further, will be complicated though as well.

Objectives

High quality waste devices from Germany which are not reused there should be recycled in an environment-friendly manner in third countries.

Characterisation

To promote recycling in third countries, standards for exports functioning goods from Germany worth supporting could be defined (in a guideline for instance). In the course of implementing the requirements on the amended version of the WEEE on the prevention of illegal exports of waste electro devices the standards for supportable exports will be defined. In particular these are exclusions for devices like refrigerators and CRT screens that are not to be reused for their high content of hazardous materials, or high energy consumption.

A close cooperation between the stakeholders of second-hand department stores and recycling in Germany should be aspired. With suitable frame conditions in relation with the development collaboration integrated structures for repair and recycling can be supported. This is going to be implemented by developing and expanding an integrated value-added chain which combines preparation (see chapter “Measure C VIII 3: Supporting reprocessing structures”), spare part supply, tools and production material, inclusive (vocational) education options, and as far as development and expansion of local markets and exchanges for used and repaired goods.

Institutions of the development collaboration, like the Deutsche Gesellschaft für Entwicklungszusammenarbeit (German Society for International Cooperation (GIZ)), initiate – with support of the federal ministries for environment and development – in cooperation with the waste management industry in the sending countries frame conditions that address private exporters on one hand, but as well local actors in the receiving countries. Cooperation on the European level is aspired.

³⁴² Basel Convention on Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, see as well BGB I. II., S. 2704 ff. of 14. October 1994

³⁴³ Directive 2012/19/EC of the European Parliament and the Council of 4. July 2012 on Waste Electrical and Electronic Equipment, ABI. L 197 of 24.7.2012, p. 38



Figure 8-7: Imported second-hand products in Lagos, Nigeria, source: Manhart/Buchert 2011

Initiators and addressees

The Federation initiates the implementation of suitable regulations in the EU law.

The countries intensify the execution to prevent illegal exports of E-scrap.

Waste prevention potential and environmental impacts

The measure effects prevention of waste directly in Germany by developing reuse options for suitable end-of-life products in third countries for those products that are not reuse in Germany any longer.

Indicators

In order to control the success, the quality of the exported appliances, or the circumstances of the handling of imported end-of-life products in the receiving countries, can be considered.

Social impacts

The measure can implement significant increases in the health, environment and social standards in the receiving countries. The combination of environmental and social requirements with the created jobs opens up income sources that can function as role models also for other branches and sectors.

On one hand, frame conditions that lead to an integrated value-added chain, will influence the arrangement of jobs, and therefore reliable sources of income, that are healthy and socially acceptable. On the other hand, goods that are urgently needed can be offered, whose production integrates into the local economic structures, and orients towards the existing demands. This will as well help to prevent that the measure harms the local production and markets by handing out alms, so that international relationships of dependency are perpetuated.

Economic impacts

Relevant strengthening of local economies by supporting favourable frame conditions for an integrated regional value-added processes, the creation of jobs, and the qualification of employees by (vocational) trainings.

Conclusion

The prolonged use of functioning appliances or devices that can be repaired for functioning in third countries will be achieved. Additionally a high social additional benefit will be achieved.

Recommendation

The example measure is recommended with the reference that an important focus of the measure is set on the development of socially acceptable and environmentally compatible labour conditions in the field of material recycling in third countries of the “global south”.

Example measure C VIII 2.2: Reuse of second-hand goods in third countries – creation of environmentally and socially acceptable framework conditions	
Objectives	Waste prevention Germany by reuse in third countries, as well as increased quality of the frame conditions in the reuse of second-hand goods in third countries.
Characterisation	Frame conditions affect the improved control and monitoring of exports in order to stem illegal exports and to increase the quality of exported second-hand goods. At the same time also on the development of integrated value-added chains for second-hand goods, and a better recovery of resources, plus a better control and monitoring of the exports in order to minimise illegal exports.
Link to measures set out in Study I	-
Link to Annex IV WFD	16. Support of reuse and/or repair
Instrumental character	Economic and organisational promotion
Initiator	Federal Ministries, institutions of the development collaboration
Addressees	Exporters, local actors in the receiving countries, private waste management industry
Waste prevention potential and environmental impacts	Prevented are burdens for environmental and healthiness, for one part by reducing the purchases of new devices in third countries. For the other part burdens for environment and health are prevented which still arise in the receiving countries from the handling of the waste “prevented” in Germany.
Indicators	Control of the circumstances during the export of devices, and in the handling of the imported end-of-life products in the receiving countries.
Social impacts	Increase of the health, environmental and social standards in the receiving countries; reduction of international relationships of dependency.
Economic impacts	Strengthening of the local economy by supporting favourable frame conditions for integrated value-added processes.
Conclusion	The measure effects directly the prevention of waste in Germany by creating reuse options for end-of-life products in third countries. But particularly the environmental burdens from waste of Germany will be reduced in these countries. Additionally a high social added value will be achieved.

Example measure C VIII 2.2: Reuse of second-hand goods in third countries – creation of environmentally and socially acceptable framework conditions	
Recommendation	The example measure is recommended with the reference that an important focus of the measure is on the development of socially acceptable and environmentally compatible labour conditions in the field of material recycling in third countries of the “global south”.

Explanation of the situation in the third countries

The socio-economic impacts of the export of industrial and household waste are a central challenge for the European policy on waste management. According to calculations, in the 2008 up to 216,000 t of used electronic end-of-life products were exported, where according to Ökopol (2010) an essential share was not fully or not at all functioning, serves as a source of spare parts, or has only left a short duration. Beside the exports that are at least in the “grey area”, overlapping into the illegality, there are well working export relations even today. Here the environmental and social standards are as far as possible met (Manhart et al. 2011).

The ecological, social and economic consequences of an inefficient, health harming and environment damaging waste handling reveal concentrated in many slums of the big cities of the global south, like in Lagos or Accra. For instance, in the so-called “backyard recycling” where raw materials from electronic and electrical end-of-life devices and old cars are won with most primitive methods, and under high health as well as environmental risks. The volume of scrap in those countries increases from both, the use of new, as well as end-of-life devices, no matter, if these were imported legally or illegally (Prakash/Manhart 2010, Manhart et al. 2011, Manhart/Buchert 2011). The waste volume are insufficiently registered on the one hand, on the other hand, they are currently handled with methods that are far behind the European minimum standards (Ökopol 2010, Manhart et al. 2011).

Experiences from various, partly still running projects on the handling of electro scrap, and electrical and electronic devices in Africa show that the share of not functioning articles is significantly lower than previously assumed³⁴⁴. The marketing of used electronic and electrical devices is an important economic and social factor in many African countries. According to Abiola (2008), the reprocessing sector for imported electronic end-of-life products, and particularly for computers, is one of the rare promising economic development areas in Nigeria.

With measures on more the effective fight against illegal waste exports, these can be differentiated more easily from legal exports of second-hand goods. Frame conditions for cross-border cooperation between the import and export countries have to be created, respectively intensified, here, and the cross-border transport of electrical and electronic end-of-life products is to be monitored and controlled stronger already in the sending countries.

³⁴⁴

In Ghana approximately 85 % of the imported new and second-hand articles is functioning, respectively easy to be repaired (UNEP NEWS CENTRE 2012).

8.3.3 Measure C VIII 3: Support for reprocessing structures

Background

Not all the generally reusable items can be reused without previous professional reprocessing and/or repair. With this measure institutions for the marketing of second-hand products are to be supported, respectively they are to be supported in the repair and reprocessing of the products. The measure aims on a wide range of consumption goods. The repair and reuse became less important in the recent decades. Beside others the reasons are increased complexity of mainly electronic products, and the innovation cycles becoming constantly shorter which leads to a fast decline in the products value. The significance of the reuse of goods became explicitly stronger by the new 5-level waste hierarchy. Article 11 obliges the member states to promote suitable measures of supporting the reuse and repair, and, besides others, the establishment and support of repair and reuse networks.

The focus herein is less on the development of suitable technologies of handling, than on a better cooperation of the different stakeholders in the networks. Spitzbart (2009) for instance, comes in an analysis to the conclusion that the small share of – brought to reuse – electronic and electrical devices, is due to the absence of networking in this field. This is schematically illustrated in the following:

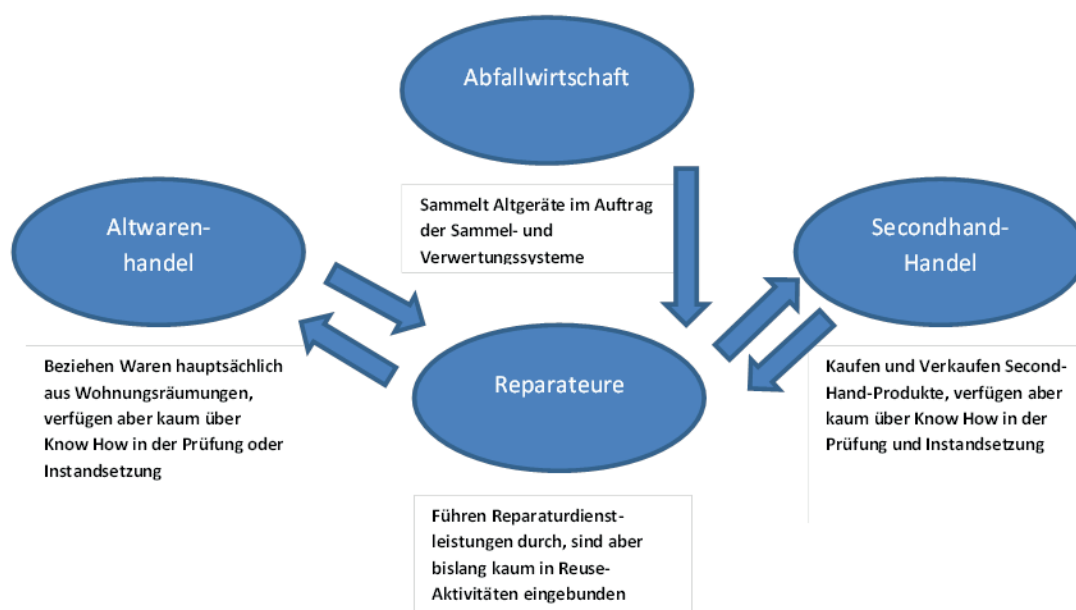


Figure 8-8: Potential networks in the second-hand area (Spitzbart 2009)

Additionally there is the aspect of “upcycling” in the reprocessing, what describes the concept of bringing materials and products to an utilisation of equal or higher grade in an equal or higher quality at the end of their life-cycle. An example for this would be the production of purses from used tyres, or the use of recycled spare parts from the waste car exploitation³⁴⁵ (cf. Reith 2011). The “downcycling” on the opposite, stands for a downgrading of utilisation and quality of a material, or product, in the handling at the end of its

³⁴⁵

This is to be classified as recycling in reference to the “parts”, and not as waste prevention.

life-cycle. An example for this would be the down-grading in use and quality in the recycling of printing paper to toilet paper³⁴⁶.

The reprocessing, and most of all the financial support of such institutions, has to consider the local commercial situation as well. It is pointless, to compete with repair workshops and craftsmen.

Facing these considerations the example measure described in the following seems to be suitable:

- support of repair networks,
- development of quality standards for second-hand goods.

8.3.3.1 Example measure C VIII 3.1: Support for repair networks

Background

Special programmes for the financial support of repair and spare part networks should be developed as component of a national waste prevention programme. Model for such a measure could for instance be the focus programme “sustainable management” of the BMBF (Federal Ministry for Education and Research) where, beside others, the project “ecomoebel” was promoted. The central thought of “ecomoebel” is the high-quality reprocessing of used furniture with the aim of reuse. Supporting this project, the BMBF promotes a central research project that strengthens the concept of closed cycles, creates qualified jobs, and protects the environment. The ecomoeble idea has found partners in eleven cities and regions in Germany by now who collect and reprocess used furniture. For many other European metropolises and centres the project has pilot character. All ecomoebel furniture is tested on harmful substances, i.e. the potential buyer can have security that the ecomoebel furniture has a low content of heavy metal and formaldehyde, and for the reprocessing only eco-compatible products are applied. For the testing of possible formaldehyde contents, ecomoebel uses a special testing appliance for every piece of furniture which was developed in the course of the research project³⁴⁷.

Another Best Practice example is the citizen centre “Kempodium” at Kempen (Allgäu) which basically is a meeting point for people with interest in creative handicrafts, and collaborates like a network with various actors, groups, enterprises public institutions (cf. Kopytziok 2007). In the year 2003, in the citizen centre of Kempen, called “Kempodium”, the so-called “brauchBAR” was established, a second-hand shop with amateur workshops. People can deliver their old used articles here free of costs. The special and innovative moment in these strategies of utilisation intensifying is that the used commodities cannot only be bought in the different workshops, but as well be tried out, repaired and modified from the buyers themselves. For this the trained staffs of the workshops offers supportive assistance, and helps with words and deeds in pottering about. Furthermore various courses, e.g. on topics like wood and metal work, are offered, and workshops are given. Last but not least, the “Kempodium” participates in public events, and organises bicycle bazaars and readings.

³⁴⁶ Independent of the real use of this waste recycling, this is not to be classified as waste prevention.

³⁴⁷ <http://www.placesathome.com/einrichten/recycling-moebel-auf-dem-vormarsch-aus-alt-mach-neu-200.html>

With the complex combination of recycling and subsequent use, with education, leisure activities, art, and public relation, the project became widely known, so it is very well received from the citizens. Beside others, the “Kempodium” is promoted by the Zweckverband für Abfallwirtschaft (association of waste management) Kempen.

Target products of such networks can be different high-value consumption goods where the repair could be worth it compared to the new purchase. In the choice of the products it should be recognised that negative effects, e.g. on the average energy efficiency of device categories are avoided.

Objectives

Establishing and supporting nation-wide repair networks (when indicated even only one) is to increase the effectiveness of the reprocessing and repair of used goods, and the return of products that need repair or reprocessing into a second life-cycle. Reprocessed products are to be better received. The nation-wide collaboration is to help to overcoming the challenges of the second-hand retail, like for instance the one year of warranty for second-hand goods.

Characterisation

Repair and spare part networks, as well as reprocessing networks will organisationally and financially be supported. A form of promotion is the support in the creation and implementation of quality labels (e.g. ecomobel furniture that are harmless to the health).

Initiators and addressees

The measure is the public (Federation, Federal States, municipalities) support of private and non-profit initiatives, if necessary.

Waste prevention potential and environmental impacts

The measure aims on a wide range of products and goods that are accrue still usable for the disposal from private households. Limitations are only where the reuse of either outdated devices with high energy consumption, or devices with harmful contents can no longer stay in the utilisation stage.

The waste prevention potential and the ecological effects of such a measure depend on the chosen target products. In view of the above described precursor project on used furniture, it can be stated that in Germany annually seven million tons of waste accrue from furniture. 90 % of that ends up in the incineration plant. Only 10 % find a new owner or are recycled³⁴⁸. Altogether Reith (2011) concludes that products which are offered in the course of reprocessing can be produced with merely 65 % of the energy that is necessary to manufacture a new product. According to his estimations the worldwide volume of saved energy from recycling and subsequent use of products or product parts is approximately 126 to 422 PJ; the material saved is about 14 million tons.

³⁴⁸ <http://www.placesathome.com/einrichten/recycling-moebel-auf-dem-vormarsch-aus-alt-mach-neu-200.html>

That recycling of waste electrical devices and other products could be ranking far higher can be seen from the example of the KVK network in Belgium³⁴⁹. 1995 in Flanders numerous joint projects existed in the ReUse segment, which operated independent from each other. Researches then revealed that the recycling potential in Belgium in collections and sales should have been far higher than the actual figures reflected.

To change this, in 2002 the non-profit organisation “Koepel van Vlaamse Kringloopcentra”, in brief “KVK” was founded. In that time, the organisation led around 60 second-hand shops to a non-profit network to generate synergies in the field of procurement, reprocessing and sales. The uniform brand identity of the shops took place under the name “De Kringwinkel”, which basically means cycle shop, and communicates the recycling.

Ever since the development in Flanders was extraordinary successful, turnover and volume has multiplied in that time. In the meantime the network KVK has approx. 90 % of all social integration enterprises of the ReUse segment in Flanders. Beside a row of articles (furniture, textiles, books etc.) the sale of used electrical and electronic devices are fixed in the product range. In eight of the total 31 ReUse centres they are reconditioned, tested, and labelled with a “Revisie” quality label that was developed specially for this purpose, before they are offered for sale in the 112 ReUse shops (Kringwinkel)³⁵⁰.

The evaluation of the KVK data shows as well that since existing, the shop turnovers increased stronger than the recycled masses what precipitates in higher per ton prices, and in an optimised product range, and indicates a better acceptance on the costumer's side. Annually around 3.8 million customers come into these shops, the annual turnover amounts approx. 19 million Euros. The share of recycled devices in Flanders is today for instance in cooling appliances 111 %, in other electrical devices 20 %, and in small devices 12 %³⁵¹. In opposite to this, the German statistics of the collected, and as whole devices recycled masses illustrate that there is still a significant potential – by now altogether only less than 2 % of the waste devices in Germany are recycled.

Indicators

The implementation of this measure can only indirectly, and referring to individual product groups be examined. Especially for the segment of electronic devices the indicator can be the share of reused devices, the way it has also to be raised in the course of the WEEE Directive.

Social and economic impacts

Through reprocessing and recycling of consumer goods, from the consumers' point of view relevant cost reductions can be achieved, if the repair costs are lower than the purchase costs of the new products. Considering reuse from the perspective of the post-utilisation phase of products, table 8-8 shows the possible revenues from the recycling compared to disposal. This comparison shows that an appliance which can be recycled, contributes to a

³⁴⁹ www.dekringwinkel.be/kw/over-ons/organisatie_20.aspx

³⁵⁰ Figures from: http://www.dekringwinkel.be/kw/over-ons/organisatie_20.aspx and http://www.dekringwinkel.be/kw/over-ons/sector-in-cijfers_94.aspx

³⁵¹ Cf. KERP 2009, p. 11

clearly higher extent to the regional value added, than in the course of waste treatment to the material recovery. The comparison cannot lead at all to the conclusion that through the sales prices, the total of the collection costs can be covered as well. Rather it is such that the ReUse activities very often are carried out from social-economic enterprises where the returns from the product sales only partly cover the cost for testing and recovering.

Table 8-7: Reuse of end-of-life electro devices in Germany, 2008, figures in tons (source: Eurostat 2012)³⁵²

	Exploitation	Recycling
	tons	tons
Large household appliances	242,491	1,725
Small household appliances	75,695	624
IT and telecommunication equipment	142,471	4,246
Consumer equipment	137,215	678
Lightning equipment	88	157
Gas discharge lamps	not specified	0
Electrical and electronic devices	20,135	256
Toys, sports and leisure equipment	7,036	147
Medical devices	2,732	514
Monitoring and control instruments	1,615	76
Automatic dispensers	4,994	365

At the same time the field of recycling also has relevant potentials for the labour market. Particularly in the reprocessing of waste electrical devices EU wide there are already 40,000 persons employed on a regular basis, and approximately 110,000 persons are employed in other forms (mainly long-term unemployed, handicapped or people at risk)³⁵³.

Table 8-8: Comparison of the sales revenues for the ReUse appliance sales / fraction revenues in the course of the initial treatment for the material recovery (source Kerp 2009, p. 11)

	Average weight	Estimated average retail price in recycling		Fraction revenues minus disposal costs in the treatment for the material recovery
	[kg/pcs.]	[€/pcs.]	[€/t]	[€/t]
Washing machine	70	100	1,429	100
PC	10	30	3,000	500
VDU (CTR)	25	5	200	50

³⁵² <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/weee>

³⁵³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2008:2933:FIN:EN:PDF>

Conclusion

The market for second-hand goods is crucially supported by this measure.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 3.1: Support for repair networks	
Objectives	By establishing and supporting nation-wide repair networks the effectiveness of the reprocessing and repair of used goods, and the return of products that need repair or reprocessing into a second life-cycle, is increased.
Characterisation	Repair and spare part networks, as well as reprocessing networks will organisationally and financially be supported. A form of promotion is the support in the creation and implementation of suitable quality labels (e.g. ecomoebel furniture that are harmless to the health).
Link to measures set out in Study I	(29) Ecomoebel - increasing the rate of recycling old furniture (92) ReDesign of furniture (226) Refurbishing
Link to Annex IV WFD	16. Support of reuse and/or repair
Instrumental character	Financial and organisational support
Initiator	Federation, States, municipalities
Addressees of the measure	Non-profit organisations, associations
Waste prevention potential	In Germany annually seven million tons of wastes occur from furniture. 90 % of that ends up in the incineration plant. Only 10 % are recycled with or without previous reprocessing.
Environmental impacts	Used products can be prepared with merely 65 % of the energy that is necessary for the manufacturing of a new product. Annually the worldwide volume of saved energy from recycling and subsequent use of products or product parts is approximately 126 to 422 PJ; the material saved is about 14 million tons.
Indicators	In the field of waste electrical and electronic devices the share of reused devices can be used.
Social impacts	Social added value from trainings and vocational education measures related with the structures, and from the reasonable supply of needed second-hand goods.
Economic impacts	Qualification of employees, support of regional added value chains, particularly of SME.
Conclusion	The market for second-hand goods is crucially supported by this measure.
Recommendation	The example measure is recommended for the implementation.

8.3.3.2 Example measure C VIII 3.2: Development of quality standards for reuse

Background

A central obstacle for the reuse of repaired used devices is the uncertainty about the quality of these products on the consumer's side. While consumer rights in respect of warranty and product defects are described very detailed in the field of new products, the whole second-hand sector suffers from lack of uniform quality standards. Up to now the segment of reuse is mainly characterised from the fact that devices are bought without warranty, or are used

for spare parts. Potential access to reusable electrical and electronic devices is also given for the end-of-life product business, respectively the second-hand shops. All these stakeholders have in common that only few of them have knowledge in the field of testing / repair of electrical and electronic devices. Most of the repair services having this specific know-how, on the contrary often only repair devices for their clients, and are not related to the national ReUse activities. The development of corresponding standards would increase the legal certainty on both sides considerably, and therefore contribute to the waste prevention by reuse³⁵⁴.

In Austria such a guideline for the reuse of electrical devices was developed in the course of creating a ReUse platform which – initiated by the Lebensministerium (Ministry of Agriculture, Forestry, Environment and Water Management) – developed suggestions to increase the reuse of such devices during a one-year discussion process. It was the aim of the ReUse platform to analyse the current situation of the topic reuse of waste electrical devices, taking the different concerned stakeholders into account, and through an exchange of information and interest about minimum standards for ensuring quality throughout the whole process chain. The ReUse guide EAG is directed to all those who are involved into the reuse of electrical and electronic devices and waste electrical devices. In the formulation of minimum standards the main focus is on reuse as a waste managerial treatment process (preparation of reuse)³⁵⁵. The case of free delivery of electronic devices for the purpose of reuse, where the delivered electronic devices stay outside the waste regime, is explicitly treated as gift as well. These guides comprise the collection and provision, as well as the testing / repair up to marketing of electrical and electronic devices. The core aspect is the compilation of technical, economic and legal frame conditions for this field. In doing so, the frame conditions for the consolidation of current projects and businesses – e.g. increasing the legal certainty – are to be improved, and the constitution of further initiatives and ReUse collaborations shall be supported.

In Belgium the network Kringwinkel developed a label “Ecoscore” for reprocessed electrical and electronic devices³⁵⁶:

- The Ecoscore label is a measure for ecological and economic efficiency of devices which were reprocessed by the Kringwinkel Centres. It is determined by comparison of the annual costs of a new and a used, respectively by KVK reprocessed, device. The annual costs are calculated over a period of ten years on the basis of the purchase price, the current costs (electricity / water) and the estimated duration of the device.
- And hence, a used device with high Ecoscore (3 or 4 of max. 4 stars) is not only more favourable, but as well ecologically more efficient.

³⁵⁴ http://www.kerp.at/fileadmin/_dokumente/ReUsePlattform_Intern/ReuseLeitfadenEAG.pdf p. 7 SEITE NICHT GEFUNDEN

³⁵⁵ Strictly spoken in legal terms it is not reuse, when devices have already become waste. But in fact, these measures are not different to the following waste prevention measures in consequence of a “gift”!

³⁵⁶ http://www.dekringwinkel.be/kw/energie-en-hergebruik-de-kringwinkel-engageert-zich/ecoscore--veelgestelde-vragen_90.aspx

(Additionally the information of Ecoscore give a much more specific idea of the following energy costs than this is enabled by energy labels (A+, A, B, ...).

- Thanks to the quality check related with Ecoscore, the consumer gets the same guarantee as if while buying a new device.

A similar project is the project “Second Life”, started in 2008, which has been carried out by the Fachgruppe Arbeit und Umwelt FAU (competence group Work and Environment) of the BAG Arbeit (Federal Agency Working Group Labour) in cooperation with the Deutsche Umwelthilfe (German Environmental Aid), and which was supported and attended by the Umweltbundesamt (UBA) and the Ministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU)³⁵⁷.

In the course of the project quality criteria for the reuse of used E-devices were examined and set up, and the foundations for the implementation of a quality label were established. Target was here, to create a foundation for high-quality qualification of less-favoured social groups in, at first, social enterprises for qualification and employment. And in consequence of this, the target was to create an exchange in order to increase the reliability for consumers in used electrical devices, and to increase the sales of these devices. Beyond this, an important aspect of the project was to secure and expand ways of procurement for reused devices under the given circumstances of the ElektroG (Act Governing the Sale, Return and Environmentally Sound Disposal of Electrical and Electronic Equipment) by social enterprises, and the relevance of reuse as an active contribution to climate protection. Further participants in the project were the FAU member enterprises Werkstatt Frankfurt and Recyclingboerse Herford. At the operating sites of these enterprises the effects from the use of mobile testing facilities for E-device on the improvement of services and procurement were examined. During the project a network of recyclers, reusers, associations, administrations, and scientific institutions was set up. This network can spread the subject reuse in the public in a sustainable manner on the example of used E-devices.

Through well prepared, high-quality used devices particularly the “cheap” new devices are replaced, which leads to several advantages at the same time:

- Since “cheap” new devices in general stay under the average in their duration, the effect of the related savings is often even stronger;
- high quality used devices are normally rather worth repairing than “cheap” new devices;
- usually the costumer receives a higher value from well prepared high-quality used devices than from a “cheap” new device.

For consumer electronics, particularly of HiFi devices, numerous suppliers can be found who offer guarantees after extensive reprocessing that is clearly above the legal warranty period of one year. Therefore they claim that through the renewal of the most important ware parts, and intensive maintenance (reconditioning of soldering joints etc.) almost the (sound) quality and the durability of a new device is reached³⁵⁸.

³⁵⁷ Cf. on this the information page about the project at <http://www.duh.de/index.php?id=1941>

³⁵⁸ Cf. e.g. <http://ftbw.de/index.html>

Objectives

The development of uniform quality standards for reuse is to increase the acceptance for second-hand goods trade, and to offer possibilities for the stakeholders to create and document high quality standards.

Characterisation

By developing quality standards and guidelines for used goods, minimum standards are defined that describe how used products have to be described, and for which requirements they have to qualify. Thereby uncertainties on the side of sellers and consumers will be reduced effectively, and the reliability will be increased. At the same time the competences of the repair networks shall be strengthened.

Initiators and addressees

Such guidelines and standards have to be developed specifically for each sector, even if, in particular in reference to questions of legal warranty, comprehensive solutions are to be developed. The initiative should therefore come from the stakeholders of the reuse segment, like the European Repanet network, and be supported from BMU and UBA.

Addressee of the measure would accordingly be the diverse stakeholders, usually working very isolated by now in the product repair segment.

Waste prevention potential and environmental impacts

The waste prevention potential and the environmental impacts of this measure cannot be quantified. The measure is an important module in supporting reuse, and therefore the extension of life-span and utilisation of products of any type. Exemplary estimations of individual products are listed in chapter 7.3.3.3.

Indicators

The implementation of this measure can only be examined indirectly and in relation to the individual product groups. Particularly for the field of waste electronic devices, the share of reused devices, like it also has to be collected for the WEEE directive, can serve as indicator.

Social and economic impacts

Through reprocessing and recycling of consumer goods, from the consumers' point of view relevant cost reductions can be achieved, if the repair costs are lower than the purchase costs of the new products. The development of uniform standards will bring a more conflict-free manner into the trade for used goods.

Conclusion

It has to be ensured that uniform quality standards are valid and observed. The reuse of either outdated devices with too high energy consumption or devices with harmful substances has to be excluded.

In acting so, the reliability for the consumers in consumer goods can be increased.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 3.2: Development of quality standards for reuse	
Objectives	The development of uniform quality standards for reuse is to increase the acceptance for second-hand goods trade, and to offer possibilities for the stakeholders to create and document high quality standards.
Characterisation	By developing quality standards and guidelines for used goods, minimum standards are defined that describe how used products have to be described, and for which requirements they have to qualify. Thereby uncertainties on the side of sellers and consumers will be reduced effectively, and the reliability will be increased. At the same time the competences of the repair networks shall be strengthened.
Link to measures set out in Study I	-
Link to Annex IV WFD	16. Support of reuse and/or repair
Instrumental character	Support by creating frame conditions
Initiator	Governmental authorities
Addressees of the measure	Non-profit organisations, associations, commercial trade of used goods.
Waste prevention potential and environmental impacts	The waste prevention potential and the environmental impacts of this measure cannot be quantified. The measure is an important module in supporting reuse, and therefore the extension of life-span and utilisation of products of any type.
Indicators	In the field of waste electrical and electronic devices the share of reused devices can be used.
Social impacts	Social added value from trainings and vocational education measures related with the structures, and from the reasonable supply of needed second-hand goods.
Economic impacts	Qualification of employees, support of regional added value chains, particularly of SME.
Conclusion	It has to be ensured that uniform quality standards are valid and observed. The reuse of either outdated devices with too high energy consumption or devices with harmful substances has to be excluded. In acting so, the reliability for the consumers in consumer goods can be increased.
Recommendation	The example measure is recommended for the implementation.

8.3.4 Measure C VIII 4: Support for strategies to prevent food waste

Background

In the course of the EU Resource Efficiency Roadmap, food was identified as one of three central key sectors for sustainable consumption. According to this, 17 % of the greenhouse gas emissions, as well as 28 % of the resource consumption result from drinks and foodstuff. Nevertheless annually approximately 90 million tons, or per capita 180 kg, food is disposed. The greater part of this would still have been fit for human consumption. Also in view of the extremely high water consumption in the production of food, the prevention of waste in this field can contribute to the security of food supply on a global level (European Commission 2011). Additionally, for the consumer high costs are related with food waste: according to English researches, an average family annually discards food which is still fit for consumption worth 814 Euro (WRAP 2012).

The Commission has addressed the objective to reduce the resource consumption in the food value-added chain by 20 % up to the year 2020. In order to reach this target, in 2013 a “communication on sustainable food” is to be developed. Beside this, food waste shall explicitly be mentioned in the national waste prevention programmes. In view of these contemplations, the example measures described in the following lay at hand:

- Support of non-profit food bank concepts,
- Support of concepts on the prevention of food waste in supply chains.

8.3.4.1 Example measure C VIII 4.1: Support for the distribution of surplus food to the needy

Objectives

The measure aims on the increased exhaustion of waste prevention potentials through financial and organisational support of providers of food bank concepts. Thereby, the volume reused food is to be increased, and hence, the waste prevention potential in the food sector as well.

Characterisation

Germany has, starting from the first initiative at Berlin in the year 1993, almost 900 food bank initiatives, which are organised in the Bundesverband Deutsche Tafel e.V.³⁵⁹. Food donations of impeccable quality that accrued for disposal in the distribution and in chain stores are collected, and passed on to needy persons. The passing-on takes partly place directly in shops and charitable transmission points. Partly, the food is also directly processed by kitchens and cafeterias.

According to the Bundesverband Deutsche Tafel e.V. nation-wide more than one million needy persons are supported with food every day. According to the self-conception of the initiatives, it is an idea from which everyone participating benefits. “Food retailers and producers assume social responsibility, and save waste disposal costs above this. And needy people get high-quality food for little money, or even for free – as well as motivation for the future. And in the daily course of doing so, the emerging waste reduces to the benefit of the environment, plus, precious resources are protected.”³⁶⁰

The practice of the initiatives is controversial, particularly in respect of the original objective. According to a research of the “Forschungsgruppe Tafelmonitor” (research group food bank monitoring), which surveyed the role of the food bank institutions and other food suppliers on behalf of the Caritas in the context of sustainable and structural poverty alleviation, these institutions are misused as deficiency guarantor instead of an basic social security provision.³⁶¹

The second point of criticism aims on the motivation of the sponsors. A significant share of the foodstuff accrues in the supply chain between the producer and the consumer in form of food products being waste. The estimations go as far as 50 %. Only a small share of these foodstuffs can be used via the food banks, and hence prevent waste. The reference to the

³⁵⁹ www.tafel.de/

³⁶⁰ Translated from the German original www.tafel.de

³⁶¹ <http://www.ehrenamt.net/de/index.php?id=360>

supply of food banks though, distracts these shortcomings, and thus as well the actual problem in terms of waste prevention.



Figure 8-9: Distribution of the initiatives organised in the Bundesverband Deutsche Tafel e.V. in Germany (source: BVDT 2012)

This waste prevention measure formulates financial and organisational support for the food bank initiatives through public administration actors.

Initiators and addressees

Food banks are shouldered by social initiatives mainly working with voluntary involvement. The measure aims on their support through public administrations that could be initiated by ministries on the federal and states level, or even institutions on a local basis.

Waste prevention potential

The measure targets the reduction of commercial food waste accruing in the preliminary steps of marketing and distribution. The Bundesverband Deutsche Tafel e.V. presents collected and distributed food donations worth 2.3 million Euro for the year 2010 (BVDT 2010).

A relevant share of the produced food never gets to the consumer, whereby the quantity can only roughly be estimated to date. Most clearly is the situation obviously concerning bakeries. Here, according to a report of 17.02.2011, 10 to 20 % of the daily production is disposed. For Germany this amounts to annually emerging 500,000 t of bread. The Bundesverband des Deutschen Lebensmittelhandels (BVL) (Federal Association of the German Retail Grocery Trade) recites calculations in an article of 20.09.2011 that the losses of fruit and vegetables in the retail vary between to 3.4 and 7.0 %, those of meat and sausages between 0.7 and 3.3 %, those of dairy products between 0.9 and 3.4 %, those from baking stations/bakery shops between 3.8 and 9.6 %, and those of the dry foods between 0.2 and 0.7 %. The FAO (2011) comes to similar amounts in a study for Europe and Russia.

The related per capita consumption in 2007/2008 of fruits was around 123 kg fresh fruits (and 6 kg tinned fruit, 1.6 kg dried fruit, plus 24.5 l juices and fruit nectars); of vegetables it was 95.5 kg (58 kg fresh and 37.5 kg processed vegetables), of meat 88.5 kg, dairy products 6.0 kg for crème, and up to 119 kg of cheese, of bread around 85 kg.

Environmental impacts

The manufacturing of food and its distribution are related to far higher environmental burdens than its ecological value from recycling as part of bio waste.

For instance the production and storage of apples in a regional plantation is related to a global warming potential of almost 0.25 kg CO₂-eq/kg apples. For bread it is 0.4 CO₂-eq/kg bread, milk almost 1 kg CO₂-eq/l milk, and beef around 20 kg CO₂-eq/kg meat (Reinhardt et al. 2009). Dairies add up to 1.2 kg in the case of yoghurt, and to around 8 kg in the case of cheese, and to around 23 kg CO₂-eq/kg butter. Wasting food has another ecological consequence, like for instance demanding resources like water and ground etc., as well as impacts on the biodiversity.

Facing these figures the relevance of preventing food waste becomes apparent also from the ecological point of view. The ecological use of recycling food waste is incommensurate with the burden of production. The surplus of food should accordingly be avoided at all costs.

Indicators

Number of food banks supported by public administrations, and overall funding volume.

Social and economic impacts

An important social additional use is achieved by this measure, because especially needy groups of the society, affected by poverty, will profit. However, there is also the risk of misusing governmental charity institutions to conceal the problem of structural poverty.

Conclusion

Preventing waste in the food segment should from the ecological point of view be a central field of action of any national waste prevention programme. With different example measures in this field, pollution can be prevented, while additional social use is generated.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 4.1: Support for the distribution of surplus food to the needy	
Objectives	Increased waste prevention through support of "food bank concepts", and the financial and organisational support from public administrations.
Characterisation	The quantity of distributed food is to be increased, and the providers of food bank concepts are to be supported financially and organisationally.
Link to measures set out in Study I	44,142

Example measure C VIII 4.1: Support for the distribution of surplus food to the needy	
Link to Annex IV WFD	16. The promotion of the reuse and/or repair of appropriate discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse-centres and networks especially in densely populated regions.
Instrumental character	Financial, organisational
Initiator	Governmental authorities
Addressees of the measure	Non-profit providers of food banks
Waste prevention potential	2010 food worth 2.3 million Euros was supplied for recycling.
Environmental impacts	Environmental impacts cannot be collected in a concrete manner.
Indicators	Number of supported food banks, overall funding volume
Social impacts	Support of needy persons
Economic impacts	-
Conclusion	Preventing waste in the food segment should be a central field of action not only from the ecological point of view.
Recommendation	The example measure is recommended for the implementation.

8.3.4.2 Example measure C VIII 4.2: Support for approaches to prevent food wastes in the supply chain

Objectives

The measure is to prevent waste that would accrue in form of surpluses, production and packaging failures, or because of short remaining lifespan (minimum durability). Voluntary collaborations among the foodstuff industry, retailers and charity organisations (e.g. food banks) are supported by this measure targeting the improvement of logistics between the stakeholders. Besides, also food is to be supplied to a sensible use when it is not exploitable for commercial use in the short term.

Characterisation

Different current researches point out that mainly in the supply chains of food relevant potentials exist to prevent waste. A survey at 316 production sites of the “Food and Drink Federation” (FDF) in England have revealed that only here approx. 600,000 t food waste are generated. As table 8-9 makes clear, reducing this quantity of 10 % would mean a cost reduction of approx. 35 million Euros. In addition to this, further saving potentials are to be found in the food segment packaging, in using food which is no longer saleable.

In order to prevent such waste a specific measure would be to support and promote concepts such as the food banks Aachen. Based on the charter of the European food banks they act as agents between the industry and the retail. In very short periods of time they are able to collect surpluses, goods with packaging or production failures, or products with short remaining durability, and thus to prevent the disposal of food waste. These goods are supplied to humanitarian organisations, which again give them for free to needy people. The product range accepted by the Foodbank comprises i.a. meat and sausages, pastries, snacks, frozen pizza, bread, and yoghurt. Dependent on the volume donated to the

Foodbank, the goods will either be distributed to charity organisations, or passed on by pallets to the approx. 60 partners throughout Germany (Lebensmittelbank 2012).

Table 8-9: Waste prevention potential in the food sector

Resource efficiency opportunity	Total waste arising (tonnes)	10% savings opportunity (tonnes)	Savings per tonne (value)	10% savings opportunity (value)
Food waste	604,883	60,488	£500	£30.2 million
Packaging	94,900	9,490	£1,666	£15.8 million
Mixed food and packaging	134,819	13,482	£558	£7.5million
Reused food*	506,898	50,690	£430	£21.8 million
Total	1,341,500	134,150	£561	£75.3 million

Source: WRAP 2011

The participation of the industry is motivated in this case on one hand by cost savings for the waste disposal, on the other hand by the possibility to position as social and sustainable involved enterprise. Another voluntary, but binding approach is the Courtauld Commitment, where the 53 largest food producers, as well as wholesale and retail companies, of Great Britain have agreed on a self-obligation. In the second phase of the agreement, which was appointed in 2011 (phase 1 was mainly focussed on packaging waste), the prevention of food waste along the supply chain is the central field of action. Until 2013 this waste is to be reduced by 5 %. The implementation of this objective was developed in collaboration with the Waste & Resource Action Programme, and in reference to different case studies that are supposed to demonstrate best practices, and most important give economic incentives, for the different fields of action (WRAP 2011).

Initiators and addressees

Both approaches are based on the voluntary commitment of the industry. Accompanying these approaches, BMU and BMELV could stimulate the interest in participating.

Addressees are in general all stakeholders along the value-added chain of the food sector, from production to logistic companies, wholesalers and the retail.

Waste prevention potentials

According to information of the BMELV in Germany approx. 20 million tons of foods end up in the waste per year³⁶². Different research projects currently carried out, examine how the quantities divide into the individual steps of the value-added chain. Beside households, also distribution is of crucial importance³⁶³. Table 8-10 presents the shares of food accruing in the retail.

³⁶² BMELV 2012, cf. http://www.bmelv.de/SharedDocs/Standardartikel/Ernaehrung/Wert-Lebensmittel/Verderb_verhindern/LMWegwerfenTippsAID.html

³⁶³ http://www.kompost.de/uploads/media/1_Kranert.pdf, p. 6

Indicators

Number of companies of the food branch and other participating organisations participating in the WPM.

Table 8-10: Depreciation due to breakage and spoilage at full-range food retailers in % of the respective purchase of goods

Product group	Range	Average
fruit and vegetables*	3.40 to 7.01	5.12
meat and sausages*	0.67 to 3.33	2.10
dairies*	0.87 to 3.38	1.55
bread and pastries without returns*	0.77 to 1.36	0.95
bread and pastries including returns	7.94 to 13.24	10.42
bakery stations/bakery shops/bakery*	3.84 to 9.55	6.52
total fresh food (*) without returns	2.13 to 3.61	2.89
other foodstuff/dry food	0.20 to 0.72	0.48
frozen food	0.27 to 0.96	0.45
drinks	0.09 to 0.38	0.15

Source: University Stuttgart 2012

Social impacts

See for example measure C VIII 4.1.

Economic impacts

See for example measure C VIII 4.1.

Conclusion

This measure is of significance, especially because of the possible prevention of losses in still edible foodstuff – also in regard of social aspects.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 4.2: Support for approaches to prevent food wastes in the supply chain	
Objectives	Prevention of food waste and improvement of voluntary cooperation in order to recycle food that is no longer exploitable in the commercial trade, and to use is sensible.
Characterisation	Governmental administrations support stakeholders' cooperation among food industry, retail and charity organisations in order to develop suitable logistics for the reuse of food surpluses.
Link to measures set out in Study I	44,142
Link to Annex IV WFD	16. The promotion of the reuse and/or repair of appropriate discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse-centres and networks especially in densely populated regions.
Instrumental character	Financial, organisational
Initiator	Governmental authorities
Addressees of the measure	Associations, industry, retail, charity organisations
Waste prevention potential	According to information of the BMELV in Germany approx. 20 million t of food end up in the waste per year. Concrete assessment of the resulting waste prevention potential is not possible on the currently available data basis.
Environmental impacts	Environmental impacts cannot be collected in a concrete manner.
Indicators	Number of companies of the food branch and other organisations participating in the WPM.
Social impacts	See for example measure C VIII 4.1.
Economic impacts	-
Conclusion	This measure is of significance, especially because of the possible prevention of losses in still edible foodstuff – also in regard of social aspects.
Recommendation	The example measure is recommended for the implementation.

8.3.5 Measure C VIII 5: Information and awareness-raising of consumers to promote reuse

Background

Already today a variety of projects broach the issue of waste prevention in its different aspects, which partly lead to innovative implementations (cf. Dehoust et al. 2010). The different approaches though do not reach the critical mass yet that would be necessary to initiate the public debate on how urgent the matter waste prevention is. General public-relations of the individual stakeholders on the subject waste prevention are difficult to carry through, facing the variety of news and information, to raise enough awareness. A concerted action of all stakeholders and institutions of the public administration could help to change this situation. Supporting the interaction of different approaches in creating a common framework would also carry the subject to a broad public.

The European Commission has started a broad debate about suitable concepts in publishing its ideas about a strategy on sustainable utilisation of natural resources (EU Commission 2003). Hereby efforts to change consumer's behaviour usually aim on the utilisation phase. On one hand, purchase decision for new products are to consider durability and repair options, so higher purchase prices are justified regarding economised follow-up costs. On the

other hand there are a number of regional projects desiring to maintain the value of consumer goods, which go beyond the traditional second-hand commerce. On their websites many of them point out the advantages of going local and concrete possibilities of reusing and repairing “end-of-life products”. In opposite to the market for used cars, or auction offers on eBay, these regional actors of repair options and second-hand retail only reach a very limited attention. On one hand, many of these projects are linked to job initiatives of the third job market, which gives them a certain image. On the other hand, it has to be stated that professional reprocessing of end-of-life products is related to employment costs that are too high to run the business profitable without funding. Under the perspective of resource conservation and waste prevention regional approaches are, however, very welcome. One possibility of support is the preparation of professionally designed, Germany-wide information platforms connecting the regional pages. In providing this, interested people can inform themselves about the possibilities to reuse products, and the awareness for its advantages will be raised. The consumer is approached in this connection as both, disposer and buyer.

Facing these considerations the example measures described in the following lay at hand.

- Concerted action on all governmental levels at the European Week for Waste Reduction
- nation-wide information platform about utilisation and possibilities of reuse

8.3.5.1 Example measure C VIII 5.1: Concerted action at all levels of government to mark the European Week for Waste Reduction

Background

The European Week for Waste Reduction (EWWR) took place in November 2011 for the second time, and was launched as a 3-year project supported by the LIFE+ Programme of the European Commission until July 2012. For Germany the NABU had organised for the in 2011 on behalf of the BMU an independent contribution. However, in total only a little more than 100 of 7000 contributions came from Germany³⁶⁴. The number of submitted contributions was rose by more than 60 % compared to 2010.

An – at least broad – evaluation of the individual projects and measures, and the prevention successes that were obtained, could work as eligibilities for the competition. If financial support would actually be granted, more detailed qualification criteria on the evaluation of the projects and measures should be developed.

Objectives

The measure is to raise public awareness for the subject waste prevention in general, and for possibilities of reuse and recycling in particular. Especially those target groups are to be sensitised which are not to be reached with traditional waste consultancies.

³⁶⁴

http://www.bmu.de/pressemitteilungen/aktuelle_pressemitteilungen/pm/47968.php

Characterisation

The Federation initiates in cooperation with the States that in future the European Week for Waste Reduction is used to include as many local initiatives as possible in order to launch a joint campaign. The campaign will be broadly organised, so the subjects “waste prevention” and “resource conservation” are placed prominently in the public perception.

For this reason several incentives are to be given. Those could be integrated in the EWWR activities on European level, if a budget beyond 2012 can be found for the week.

- Possibilities to present all participating activities on the internet (cf. as well example measure C VIII 6.2) in order to link the activities to each other, and to show local participation options. A possible form of presentation could be a map of Germany displaying all participations, as is was created by the NABU for the EWWR 2011.³⁶⁵
- Offering an award for project that are particularly to be highlighted, which should be presented to the project participants in the course of a public event.

During the EWWR 2011 different categories were awarded with such prizes (public administrations, NGOs and associations, enterprises, educational institutions, others, and the jury's favourites).

These prizes were to be presented by the EU Commissioner Janez Potcnik, who unfortunately though had to cancel his participation, but congratulated via video message. The awarding ceremony took place in the course of an international conference about waste prevention.

- Possibilities for a one-time co-funding of individual projects or approaches.
Such funding could orient towards the model “Trenntstadt Berlin” (homophony pointing to both, city that separates waste and being trendy). The model project funds innovative projects of the waste separation and prevention area since 2010 with a total volume of 2.7 million Euro sourced by the supplementary DSD fees. The eligibility principles are intended to support mainly creative approaches to reach target groups impossible to reach with normal instruments of the waste consultancies (youngsters, migrants, cultural and educational institutions, commercial enterprises)³⁶⁶ Granting the support and appraisal of the applications is carried out by the Stiftung Naturschutz (Foundation for Nature Protection).

Initiators and addressees

Initiator is the Federation which includes existing initiatives of the local and regional level, and take care that that the results lead to a concerted action, or rather public relation campaign, on the subject. The BMU could coordinate this in future either on its own behalf, or put out a tender for instance in connection with the evaluation of the measures within the framework of the UFO (environmental research plan).

³⁶⁵ <http://www.nabu.de/aktionenundprojekte/abfallvermeidung/14286.htm>

³⁶⁶ http://www.stiftungnaturschutz.de/fileadmin/img/pdf/Foerderung/Trenntstadt/Foerdergrundsaeetze_Juni_2010.pdf, p. 1

Addressees of the measure are on one hand the already active actors in the field of waste prevention, but above this also the broad public who is to be interested for the subject, and in this connection in particular those target groups being hard to reach.

Targeted waste and products

The measure includes all waste and product mass flows. Funding through the DSD supplementary fees would focus on packaging waste. In future, after implementing the recycling bin throughout Germany, also non-packaging waste of similar materials would be included. Awarding prizes in different categories should, if possible, consider all kinds of relevant waste streams and points of leverage, whereby it is recommendable to set an annual focus. One option would for instance be to award a special prize for preventing food waste.

Waste prevention potential

Because of the high number of different projects, the actual waste prevention potential cannot be quantified in advance.

Environmental impacts

Successful public relation work will surely support to a certain degree behavioural changes of private persons as well as of industry and Commerce, and therefore it has positive ecological impacts. Through lining the different measures and building exchange networks for best practices, also new actors can be interested for the subject.

The measure supports almost all other, partly much more specified measures.

Indicators

Number of individual projects participating in the campaign. If suitable also the specific waste prevention successes of the contributing projects.

Social and economic impacts

Counteractive social and economic effects are not obvious. The contacts among the individual projects can create interactions remaining beyond the campaign.

Conclusion

An institutional frame like the EWWR on European level, or a comparable action on the national level is a suitable instrument to prevent waste: it supports both, already existing actors through showing them the BMU's appreciation for their activities. And, at the same time it offers a suitable communication platform to sensitise private persons, companies etc., who are less ecologically motivated, for the subject. Besides an intense networking of currently rather fragmentary activities is created, which enables learning effects in order to implement, or communicate, waste prevention more efficiently in future.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 5.1: Concerted action at all levels of government to mark the European Week for Waste Reduction	
Objectives	Increasing the awareness for waste prevention, especially on options of reuse and recycling. Another target is to offer creative communication measures about the subject for target groups that cannot be reached by normal waste consultancies.
Characterisation	Concerted action in the course of the Week of Waste Reduction with the option to present the large variety of projects on waste prevention to broad public. Awarding of prizes and funding for creative projects.
Link to measures set out in Study I	-
Link to Annex IV WFD	16. The promotion of the reuse and/or repair of appropriate discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse-centres and networks especially in densely populated regions.
Instrumental character	Financial, organisational
Initiator	Public administrations, bodies responsible for waste management
Addressees	Projects on waste prevention, particularly on reuse and recycling, special target groups.
Waste prevention potential	Not to be specified.
Environmental impacts	Not to be specified.
Indicators	Number of individual projects participating in the campaign, or the specific waste prevention successes of those projects.
Social impacts	Counteractive effects are not obvious.
Economic impacts	Counteractive effects are not obvious.
Conclusion	An institutional frame like the EWWR on European level, or a comparable action on the national level is a suitable instrument to prevent waste
Recommendation	The example measure is recommended for the implementation.

8.3.5.2 Example measure C VIII 5.2: Nation-wide information platform on the benefits and opportunities of reuse

Objectives

The measure aims on increasing the general appreciation of goods, and on changing the image of used goods in the context of reuse and recycling. To reach particularly also younger cohorts, the measure uses modern communication channels and well-designed web presences.

Characterisation

The measure structures in the following parts:

- a) web-publishing a new platform
- b) giving new internet presences content and long term maintenance
- c) evaluating and categorising offers, respectively initiatives

a) On behalf of the BMU or the BMWi an advertising agency should professionally design a web presence, where on one hand ecological, economic, and social advantages of reusing

products are presented. On the other hand the concrete regional possibilities are to be found quickly. LCA data, e.g. the “ecological backpack” or the product-related ecological CO2 footprint, is to emphasize the high ecological value of every day products. Due to the very low product prices, the appreciation got lost for many products of our society. With objectively sound information this situation is to be counteracted. In the result also those members of the population who are less well situated, and therefore less open for the options of longer product utilisations, are to be reached. Horst Köhler was right when he reminded in this “Berlin Speech” of 24.3.2009 that “thriftiness shall become an attitude of decency – not for the sake of cheeseparings, but for mindfulness for our fellow men, and for the world we live in”. The internet presence is to appeal a broad range of clients, in order to appeal people for the most different reasons to use the possibilities of reuse. While the so-called “LOHAS”³⁶⁷ are committed to a culture of conserving values for social and ecological reasons, and therefore reuse products, expanding reuse options enables less fortunate parts of the population to lessen the social exclusion. For instance, there are many inhabitants of inner city districts who live in difficult economic and social circumstances. Often a many of them has to rely on public transfer payments to ensure their living, and many of them have migrant background. Since the middle class moves out of those districts, education level and purchasing powers declines constantly. Budget or even free offers of usable consumer goods that are still serviceable, would enable these persons to get closer to the social status comparable to the rest of the society. Both, the option to take serviceable items from the bulky waste, as well as establishing regional second-hand markets, support beyond this the communication between the different ethnic groups in those neighbourhoods. For instance the project “NUTZbar - a neighbourhood develops its resources” in Berlin's district Moabit met great response when it offered consumer goods for reuse, and repair of bicycles (Kopytziok 2008).

b) After a nation-wide internet platform about benefits and possibilities of reusing goods is established, fulfilling the above mentioned requirements, in a second step a non-governmental institution is to be contracted by using public funds to fill the web presence with contents and maintain it in the long term. Point of leverage can be the portal for repair workshops and flea markets³⁶⁸. Actors of 18 cities in Germany and 9 other cities of neighbouring foreign countries are listed here. A list of more than 200 exchange rings and their activities in Germany is available at <http://www.tauschring.de/adressen.php>. Furthermore, there are eight links to be found leading to exchange rings in Europe and five links to addresses in overseas. Other initiatives on reuse (exchange services, free-gift-shops, second-hand departments and furniture markets) are collected by the Berlin NUTZbar project³⁶⁹. The same project had presented an exhibition with photos of objects made by artists and designers who took the task to give new value to presumably valueless items by redesigning them. See on the link to moabiter ratschlag below. The expression Re-Design comprises pieces of art as well as redesigned commodities. The information platform is to list such creative works of reuse.

³⁶⁷ LOHAS means Lifestyle of Health and Sustainability and labels a generation of consumers with a new lifestyle, focussing on these subjects. More on that at Wenzel et al. 2007

³⁶⁸ See on this: <http://www.reparatur-verleih.de>

³⁶⁹ <http://moabiter-ratschlag.de/nutzbar/brauchbar>

It has to be assumed that only a small part of in the net available reuse-initiatives is listed on the internet pages mentioned here. For this reason a comprehensive internet-based research is necessary to find if possible all initiatives. There will presumably also exist charity or church-related initiatives, not being online by now. These as well have to be collected by a separate research. Finally it is crucial for the collected reuse-initiatives being able to present themselves free of cost on the internet platform to be established. This is what the nation-wide platform about possibilities and benefits of reuse is for. And it needs the possibility to include new stakeholders, and new offerings any time into the web presence.

c) Also offerings of used products have to maintain security standards, allow guaranties, and offer quality standards. The internet platform to be created has to offer basic information on this as well as on legal warranties for repair services. Additionally procedures for rating are to be developed to enable appropriate categorisation of the initiatives that shall be presented. For instance it makes a difference whether used furniture for sale origin from bulky waste without pre-treatment, or were elaborately restored by a professional. Equally important is the technical check of, for example electrical devices or toys, on functionality and security aspects before public offering. Initiatives disregarding the minimum standards should not be published on the new internet platform.

Initiators and addressees

Initiator of the measure is the Federation.

Addressees of the measure would be the stakeholders of a value preserving culture as sellers, and the broad public as consumers of the reuse offers.

Waste prevention potential

The measure refers to commodities. In active regions up to now approx. 10 % of the bulky waste emergence was prevented with individual measures (Kopytziok 2006). Through better information and image improvement, this potential might be doubled in a short term.

Environmental impacts

Because commodities usually are related to a large “ecological backpack a prolongation of the lifespan leads to savings in natural resources, and to a reduction of water, ground and climate pollution.

Indicators

The regional bulky waste emergence can be used as an indicator in the long term. Evaluating the measure needs secure and adequate information on the regional bulky waste emergence provided by the public bodies responsible for waste management. The maintenance and the further care of the internet platform could, after a sufficient start-off period, be connected to the proof that the bulky waste emergence is diminished.

In the short and medium term, the number of accesses to the internet platform is a suitable indicator.

Social and economic impacts

Supporting reuse favours the creative and precarious entrepreneurship, and contributes in doing so to a culture of preserving values while it has positive impacts on fringe groups of our society by improving their chances to participate equally in the social life.

Negative economic impacts are not to be expected.

Conclusion

Professionally organised networking and expansion among regional initiatives of product reuse will lead to a stronger utilisation of existing offerings, plus it will improve the image of measures concerning reuse. Additionally measures qualifying for repairs and a creative handling of end-of-life products are favoured, as well as the return to the true values in dealing with everyday commodities.

The implementation of a nation-wide information platform on benefits and option of the reuse is of material, as well as of immaterial value.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 5.2: Nation-wide information platform on the benefits and opportunities of reuse	
Objectives	Appreciation of goods, and change of image of used goods through internet presences and the use of modern communication channels.
Characterisation	Designing a new internet platform and maintaining it in the long term will advertise commodities and prepare the offering mainly for under privileged parts of the population. At the same time the quality control of the purchased goods takes place by corresponding labels.
Link to measures set out in Study I	-
Link to Annex IV WFD	16. The promotion of the reuse and/or repair of appropriate discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse-centres and networks especially in densely populated regions.
Instrumental character	Informational
Initiator	Public administrations
Addressees	Consumers, particularly being affected by poverty.
Waste prevention potential	In individual measures up to now approx. 10 % of the bulky waste emergence was prevented.
Environmental impacts	Not to be specified.
Indicators	Short and medium term: the number of accesses to the internet platform. Long term: development of bulky waste emergence.
Social impacts	Important additional usefulness because of social participation in the used goods.
Economic impacts	Counteractive effects are not obvious.
Conclusion	Higher consumption of used goods and repair offerings through image improvement and change of values in respect of (consumption) goods comprises an important waste prevention potential. At the same time a high social value is related.
Recommendation	The example measure is recommended for the implementation.

8.3.6 Measure C VIII 6: Support for research and development of measures to increase utilisation intensity

In the beginning of the last decade new utilisation strategies became a key area of the BMBF (BMBF 2004). The NaNuMA example project examined sustainable utilisation concepts of machines and facilities. Target was to use machines more efficiently, and to reduce the raw material input. The lifespan of products were to be prolonged. Care taking of customers during the utilisation phase of purchased products by the producers ought to extend the durability.

During the same time the BMBF also has supported another key area of funding called “Possibilities and limits of new utilisation strategies; Regional approaches.” The supported projects of utilisation prolongation, utilisation intensification, intermediaries, and accompanying researches were coordinated and linked by the UBA (Rabelt 2007).

8.3.6.1 Example measure C VIII 6.1: Support for research & development on measures to extend lifespan

Background

Models as the “Second Life” project (DHU 2012, see as well measure C VIII 2) supported by the UBA count on a prolonged utilisation of products in form of resale or passing-on. This is continued in observations of those seeing in a paradigm shift: “from the throw-away-society to the auction culture” (Brohmann 2011). These stakeholders are also called “prosumers” in terms of the increased importance of the internet (Blaettel et al. 2011).

Many goods need maintenance, and from time to time repair, or rather exchange of components. Not only since the documentation report “*Kaufen für die Müllhalde*” (buying for the dump site³⁷⁰) (ARTE 24.01.2012) planned obsolescence is a subject that reveals many facets. No matter whether it is printers, stopping the service after a certain number of copies, or using cartridges more expensive than buying a new printer, whether it is a TV where the exchange of a high voltage component costs more than a new TV or many other products with similar conditions – limited durability and bad repair options are “in”. But not all of the citizens, companies and enterprises follow that trend. Nevertheless, often is the effort of researching the “how” and “where” is much higher than the repair itself, or the spare part. On the other hand, there is no possibility to influence the product policy of international groups with productions sites often far from Germany.

Not only the individual citizen as being consumers, but also within the so-called B2B sector, can state significant shifts towards the complete exchange of products, and towards one-time-only usable products.

In connecting to the Austrian project “RePaMobil” and the current project “Repa & Service Mobil” at Vienna (Fabrik der Zukunft 2012) focal points of action could be identified, and be realised in precursor projects.

Findings from research projects on the sustainability of repair-friendly constructed electrical and electronic devices could be included.

One subject of research could be criteria to demarcate “planned obsolescence” from regular wear and use in different product areas.

³⁷⁰

Translated from the German original

Other focuses should concentrate on enterprises, companies and institutions as users and clients. Because each of these sites has large quantities, points of leverage are given that create simpler conditions for the prolongation of lifespan of products. Obstacles for the increased reuse of products have to be analysed, whereas approaches to overcome these obstacles should be implemented in form of supported precursor projects.

The tasks for the research projects working in close cooperation with practitioners are i.a.:

- to demonstrate the problems of the operators of repair and reprocessing companies (warranty for used goods, supply of spare parts etc.)
- find solutions for these problems
- expansion on further products, and focussing especially of commercial utilisation and users
- improvement of knowledge and acceptance of the population
- support of networks among organisations and stakeholders.

Objectives

By supporting research and development, governmental administrations initiate/promote new concepts and implementation measures for the prolongation of product life-cycles, and for waste-preventing repair and reuse of second-hand products. Collaborating with stakeholders of this field will optimise and expand running measures, and create networking.

Characterisation

By supporting research and development, governmental administrations initiate/promote new concepts and implementation measures for the prolongation of product life-cycles, and for waste-preventing repair and reuse of second-hand products. Having new technical and organisational possibilities available to prolong the lifespan/durability of products creates new business models, and hence offers corresponding measures to the consumers. A model that supports this approach is e.g. "Second Life" (DUH 2012), and continues in the further development of different approaches of auction culture, which respond to the different habits of potential customers (Brohmann 2011 and Trendbuero et al. 2008).

Initiators and addressees

Initiator is the Federation (BMU, UBA and BMBF) creating funding programmes and providing financial support. Also the States can get active in certain support focuses. The municipal level can stimulate local networks for repair and reuse, and support these accordingly. The Federation can furthermore create low-interest loans and funding programmes for certain focal points through programmes and key areas of the KfW Bankengruppe.

Addressees in regard of waste prevention and resource conservation in the product development are mainly industrial enterprises and SME willing to optimise their production processes, as well as to renew their products in terms of easier reparability.

Addressees in regard of waste prevention and resource conservation through products with prolonged lifespan are mainly trade and service companies, and interest groups striving for

sustainable development of living and consumption habits. Indirectly also companies as being customers and the citizens are addressed to change their future demand patterns.

Waste prevention potential

Quantitative information on the overall prevented waste cannot be derived from the carried out supporting projects on knowledge transfer from demonstration projects for technology development. Using reprocessed products in the medical segment is to have a waste prevention potential of 80 % compared to non-reusable products (Fabrik der Zukunft 2012).

Generalising this information i.a. in regard of waste prevention seems to be impossible due to the significant differences of the products, and to the effect of lifespan prolongation of products.

Environmental impacts

The waste prevention potential might be offset by higher resource consumptions (e.g. higher energy demand compared to new appliances) in the utilisation phase. Without labelling the waste emergence and energy demand related to the product manufacturing, the estimation of advantages and disadvantages cannot be carried out on a clear basis. However, the efforts related to a new production should be clearly higher than those of repair and further utilisation.

It was stated for example that the resource saving potential of using reprocessed products in the medical segment is significantly higher than the waste prevention potential of 80 % compared to non-reusable products (Fabrik der Zukunft 2012, project part: reprocessing and reuse of non-reusable medical products). According to Reisinger, Krammer (2007) lifespan prolongation of 50 % in the average has a waste prevention and resource saving potential of 33 % per product. Other examples can be found in chapter “Waste prevention potentials and environmental impacts of lifespan prolonging measures”.

Indicators

As indicator for an individual demonstration project, the extent of the prolongation of lifespan of the target products is useful.

Indicator for the overall support programme can be the amount of funds used for the field of prolongation of lifespan.

Another indicator is the number of the supported demonstration projects in the field of prolongation of lifespan.

Social impacts

Negative social impacts are not to be expected from research and implementation of measures to prolong the lifespan of products, and of waste-preventing repair and reuse of end-of-life products.

Partly also projects will be supported that create jobs for less-qualified workers, and contribute to job qualification, and also contribute to the provision of eco-friendly goods for low income groups.

Economic impacts

Support programmes in the field of prolongation of lifespan can contribute to the socio-scientific discourse. This makes economic impacts of changing the utilisation behaviours transparent and recognisable at an early state.

The alleged conflict of interests between targeting economic growth in the industry and trade by selling new products, and prolonging the lifespan should be approached in an open and proactive manner in terms of a sustainable society.

Conclusion

Through a support programme in the field of prolongation of lifespan new technical-organisational possibilities are created for both, citizens and companies or enterprises, which decide to prolong the lifespan/durability of their products. In many cases also significant quantities of waste are prevented, as well as resources are saved.

A support programme in the field of prolongation of lifespan could enrich the socio-scientific discourse on the topic of sustainable consumption.

Recommendation

The measure is recommended for the implementation.

Example measure C VIII 6.1: Support for research & development on measures to extend lifespan	
Objectives	New concepts and implementation measures to prolong the lifespan of products, and the waste-preventing repair and reuse of end-of-life products are developed and supported.
Characterisation	Governmental administrations initiate/support research and development of new concepts and implementation measures to prolong the lifespan, and for the waste-preventing repair and reuse of end-of-life products. To prolong the durability/lifespan of products through available new technological-organisational possibilities creates new business models, and therefore offerings for consumers to use corresponding measures.
Link to measures set out in Study I	(232): Promotion Programme „Fabrik der Zukunft“: reprocessing and reuse of non-reusable medical products (Austria) (258): Promotion Programme „Fabrik der Zukunft“: Repa & Service Mobile (Austria)
Link to Annex IV WFD	16. The promotion of the reuse and/or repair
Instrumental character	Provision of financial support
Initiator	Federation/Federal States/municipalities
Addressees	Directly: research institutions, industry, trade, service providers Indirectly: Consumers
Waste prevention potential	In individual examples on prolongation of lifespan of the past, data revealed 80 % prevented waste. Generalising this information seems to be impossible due to the significant differences between the products, and the effect of prolongation of lifespan i.a. in regard of waste prevention. It seems to be a acceptable estimation that in general an effect, or waste prevention potential, of more than 10 % to 20 % is possible.

Example measure C VIII 6.1: Support for research & development on measures to extend lifespan	
Environmental impacts	Generalising information of individual cases seems to be impossible due to the significant differences between the products, and the effect of prolongation of lifespan. But often the efforts related to new production should be clearly higher than those related to repair and reuse.
Indicators	Extent of prolongations of lifespan, Amount of usually granted financial support of research, Number of supported demonstration projects in the field of prolongation of lifespan.
Social impacts	Negative impacts are not to be expected.
Economic impacts	Through contributing in the socio-scientific discourse, economic impacts of implementing changed utilisation behaviour will in the long term become transparent and recognisable at an early state.
Conclusion	A support programme in the field of prolongation of lifespan could significantly support the socio-scientific discourse on the subject of sustainable consumption.
Recommendation	The example measure is recommended for the implementation.

8.3.7 Measure C VIII 7: Institution of food wastes as a research priority

In different researches it has become apparent that in the *field of prevention of rejects and waste potentials are to be raised at both, the production as well as the consumption... The nutrition sector is one of the most resource intensive sectors* (MARESS AP1 2010)³⁷¹. Different studies and practices show that food is disposed along its entire value-added chain (Schneider, Lebersorger 2010). In Germany, annually 20 million tons of foods end up in the waste (BMELV 2012). In the agricultural sector research aims towards the limitation of fertilizers and chemical substances as well as to online quality analyses. Also the after-yield losses from transport and spoilage are addressed [BMBF 2004]. In the nutrition segment, e.g. the high-pressure process for conservation of foodstuff which works free of waste is examined.

8.3.7.1 Example measure C VIII 7.1: Support for research on the prevention of food waste

Background

Recent activities on the Federal and the European level have highlighted the topic of food waste on all levels of agriculture from the production – which is not subject of the following considerations – the industrial processing, and the trade up to the consumer. The BMELV *“works on a comprehensive study that is for the first time to deliver concrete and reliable figures on type and volume of food which is disposed in Germany year by year. Also the reasons for disposal rate increasing world-wide are to be examined. In the first quarter period of 2012, first results are to be available. However, the consumers and the industry can make an important contribution to prevent food waste”*³⁷² (BMELV 2012).

Instruments like the Courtauld Commitment in Great Britain, a voluntary agreement among the largest supermarket enterprises in Great Britain and the “Waste & Resources Action Programme” (WRAP 2012) can be transferred for this research programme. The alleged

³⁷¹ Translated from the German original

³⁷² Translated from the German original

conflict of interests between the targets of economic growth of the food retail and the prevention of food waste by careful and reasonable handling of food should be approached in an open manner. More useful alternative to special offers like “take 2, pay 1” should be developed, and be secured in the long term by suitable agreements among the stakeholders.

The research programme should be supported by an advisory working group of representatives from all relevant stakeholders. This way, interdisciplinary work-packages can be developed in cooperation, as well as the parallel discussions on conservation of society values can be supported objectively. Also the conception of an evaluating programme should be a matter of the research activities. This way, the implementation of objectives will be verifiable and accessible for political actions in terms of adjusting segments which are in deficits. Best practice examples on the prevention of food waste should be advertised, and incentive systems developed for enterprises.

The research programme should comprise a module extra for canteen kitchens and restaurants.

The documentation of the generation of food waste and its presentation via DeStatis should be revised.

An overarching strategy could supported e.g. through a common word and figurative trademark for completely regionally developed and implemented prevention measures.

In the framework of the research focus developed advertising and information materials (see e.g. WRAP 2012 or YTV 2008) for waste-preventing consumption of food could e.g. be offered for a small nominal charge to public bodies responsible for waste management and housing associations.

Objectives

The research aims on examining the individual steps of processing and distributing all kinds of foods throughout the whole value-added chain, and on developing solution strategies, and as the case may be also to fund technical and organisational solution approaches in particular for SME.

Characterisation

The research aims on both, the food branch and therefore on optimising the production processes to diminish production-specific waste, as well as on trade and supply to prevent production waste. The agricultural production would thereby not be a matter of this research focus.

Referring to food production, comparable instruments and processes of waste prevention are to be used as in reference to production optimisation and reduction of product waste.

Referring to consumption it is to be examined how long-term behavioural changes towards a waste-preventing and sustainable way of nutrition can be enabled. Relevant incentives should be identified and supported (MARESS AP1 2010).

Initiators and addressees

The research programmes are published by the Federation and the Federal States, where also funds for the applied research are provided. A joint approach of BMVEL and BMU would be particularly useful.

Addressees in regard of waste prevention and resource efficiency in the research focus of food waste are on one hand the industrial companies and SME which are willing to renew and optimise their production processes.

On the other hand addressees are mainly the trade including the importers and the lobby groups working on sustainable development of lifestyle and consumer's behaviour.

Furthermore addressees are enterprises as being customers, and citizens whose future demand patterns are to be changed.

Waste prevention potential

Roughly considering the losses per product for Austria, for fruit or vegetables approx. 16 % losses are shown (Schneider, Lebersorger 2010). In the food processing products which have exceeded their shelf life and preserved food for instance accrue, which are partly disposed under the corresponding waste code numbers. In the food trade every day relevant quantities of enjoyable food is disposed from chain stores and discounters (i.a. according to Schneider, Wassermann 2004). Single, committed catering companies get the approval of their contractors, before they pass dishes or rolls that were not served on to social institutions.

“Every year in the European Union 89 million tons of perfectly enjoyable and healthy foods end up in the garbage. Cut down on all consumers it results in 179 kilogrammes, or in other words: per day one pound (500 g) of meat, fruits, vegetables or fish is not eaten, but carelessly disposed. Not included in this calculation are losses during the production.” (Hohlmeier 2012)³⁷³

The overall waste prevention potential is to be estimated as significant. Concrete estimations for individual segments are possible not sooner than after the presentation of the study of the BMELV. Facing reports stating that i.a. in *“the EU 30 % to 50 % of all food is ordinarily disposed in fabrication plants, in the trade, in restaurants, and in households”* (WELTAGRARBERICHT 2012)³⁷⁴, a likely target of food waste prevention could be around 25 %.

Environmental impacts

Facing the ecological burdens of food manufacturing, measures of waste prevention in the food processing, and the distribution of food until it is consumed, are of high relevance.

³⁷³ translated by the German original

³⁷⁴ translated by the German original

56 % losses within the food chain

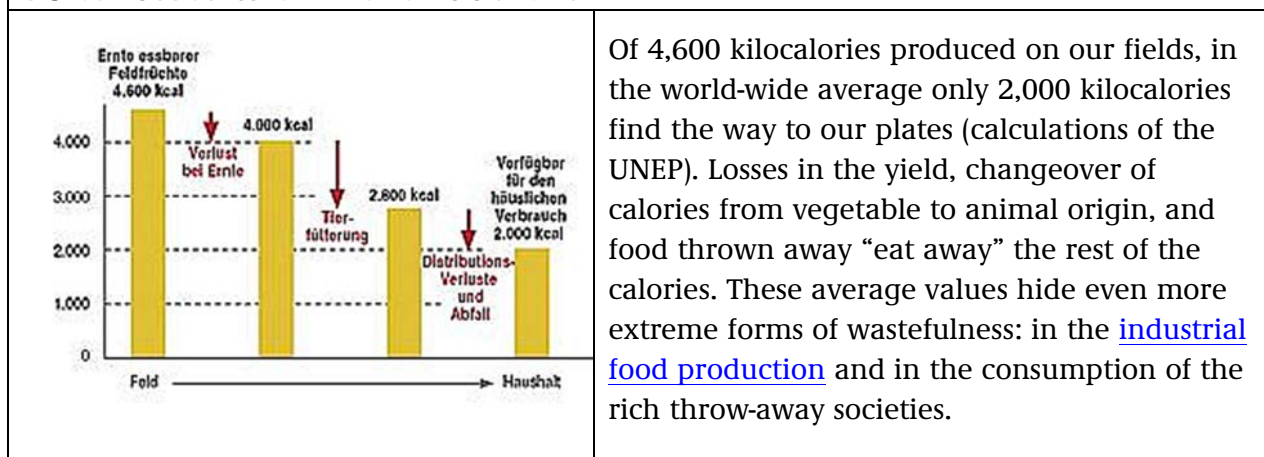


Figure 8-10: Losses within the food chain (WELTAGRARBERICHT 2012)

Indicators

As indicators for funding programmes in the food segment waste, the quantity of the prevented waste including rejects and losses within the food chain, could be used for the individual demonstration projects.

Indicator for funding programmes for the overall segment waste prevention could be the amount of financial support.

Another useful indicator is the number of funded demonstration projects in the area prevention of food waste.

Social impacts

Funding programmes on demonstration programmes on technology usually have no direct social impacts on larger parts of the population. Most of the times they are connected to an improvement of job conditions for the employees of the directly affected companies.

In the framework of the research focus, attention should particularly be paid to the secure provision of institutions like food banks.

Funding programmes can stimulate effects way less conflictive than taxes or other steering levies.

Economic impacts

Funding programmes in the field of food waste prevention during the consumption of food could contribute to, and support the, social-scientific discourse. In the long term this makes economic impacts of changing the utilisation behaviours transparent and recognisable at an early state.

The alleged conflict of interests between targeting economic growth in the industry and trade by selling new products, and the prevention of food waste through careful and appropriate handling of food, should be approached in an open and proactive manner in terms of a sustainable society.

Supporting technology development in SME of the food processing sector takes the limited financial possibilities of these structures into account.

Conclusion

A funding programme in the field of food waste prevention could significantly support the social-scientific discourse about sustainable consumption.

Funding programmes in the field of technology development to prevent food waste that support demonstration projects in a large scale can stimulate sustainable impulses in the production process and in the competition.

Recommendation

The example measure is recommended for the implementation.

Example measure C VIII 7.1: Support for research on the prevention of food waste	
Objectives	Through research the individual steps of processing and distributing all kinds of foods throughout the whole value-added chain is to be examined on potentials of optimisation. The solution strategies to be developed, and also technical and organisational solution approaches are in particular to support SME, and include the consumption level.
Characterisation	The research aims on both, the food branch and therefore on optimising the production processes to diminish production-specific waste, as well as on trade and distribution to prevent production waste. The agricultural production would thereby not be a matter of this research focus.
Link to measures set out in Study I	-
Link to Annex IV WFD	2. The promotion of research and development into the area of achieving cleaner and less wasteful products and technologies and the dissemination and use of the results of such research and development.
Instrumental character	Provision of financial support
Initiator	Federation, Federal States
Addressees	Directly: research institutions, industry, trade, service providers Directly and indirectly: Consumers
Waste prevention potential	The waste prevention potential in total is to be estimated as relevant. Concrete estimations for individual fields within the food production chain and food utilisation are not sooner possible than the currently under way BMELV study is presented. From today's point of view, a medium-term, sophisticated, but realistic objective of the food waste prevention could be around 25 %.
Environmental impacts	Facing the ecological burdens of food manufacturing, measures of waste prevention are of high ecological relevance.
Indicators	Extent of prolongation of lifespan, amount of usually granted financial support of research, number of supported demonstration projects to prolong the lifespan of products.
Social impacts	Negative impacts are not to be expected.

Example measure C VIII 7.1: Support for research on the prevention of food waste	
Economic impacts	<p>The alleged conflict of interests between targeting economic growth in the industry and trade by selling new products, and the prevention of food waste through careful and appropriate handling of food, should be approached in an open and proactive manner in terms of a sustainable society.</p> <p>Supporting technology development in SME of the food processing sector takes the limited financial possibilities of these structures into account.</p>
Conclusion	<p>A funding programme in the area of food waste prevention could significantly support the social-scientific discourse about sustainable consumption.</p> <p>Funding programmes in the field of technology development to prevent food waste that support demonstration projects in a large scale can stimulate sustainable impulses in the production process and in the competition.</p>
Recommendation	The example measure is recommended for the implementation.

9 Conclusions

A final comparative assessment was performed on the basis of the previous analyses of the various waste prevention measures, their anticipated waste prevention potentials and the anticipated environmental effects. Legal, economic and social aspects were taken into account as far as possible; in the scope of this study, however, they were not examined in depth and only in specific cases.

The available data do not permit a quantifiable, purely objective prioritisation. As set out, qualified appraisals of waste prevention potential and environmental impacts can usually only be performed at product level and may vary greatly from product to product. It will therefore continue to be only possible for specific implementing measures to conduct an assessment of waste prevention measures that is at least partially quantified. It is to be hoped that a substantially better data availability will be provided in this field by the experience gathered when implementing the waste prevention programme and the individual waste prevention measures and, notably, during their review and evaluation in the coming years.

In the following the measures are grouped in three categories:

- Recommended
- Conditionally recommended / further appraisal needed
- Not recommended

Measures were "recommended" (unconditionally) if they indicate a relevant waste prevention potential or if they have a positive influence on the framework conditions for waste prevention, e.g. through information and awareness-raising or through economic effects. Furthermore, no ecological, social or economic effects should be perceptible in their implementation that could run counter to the measures.

A measure was categorised as "conditionally recommended / further appraisal needed" if the examination revealed that the measure can only exploit its waste prevention potential if

- further supportive socio-economic and statutory preconditions are met or
- other supportive measures need to be taken or
- the effectiveness or the most varied effects of the measure first need to be appraised.

A measure was categorised as "not recommended" if no waste prevention potential could be identified or the associated reduction of environmental pressures is overcompensated by other effects. None of the measures discussed fell into this category.

The following sections summarise the assessments of the authors of this study for the examples of measures proposed. It is to be noted here that the recommendations are made on the basis of the examples of measures, as it is only for these that sufficient concretisation is available.

9.1 Field A: General framework conditions

Measures in Field A relate in particular to strategies, approaches, benchmarking, the setting of framework conditions and the provision of research promotion in relation to waste

prevention. They aim to raise awareness among and provide advice to stakeholders. By shaping economic conditions in such a way that external costs tend to be internalised, and through the producer responsibility instrument ³⁷⁵ they lay the groundwork for specific measures in Fields B and C.

Measures to increase product quality and extend warranty periods, which aim in particular to increase the utilisation intensity and lifespan of products, need to be coordinated closely with measures in Fields B and C that pursue the same purpose.

Recommended examples of measures in Field A

- A 1.1 Development of waste prevention strategies and approaches by state bodies
- A 2.1 Establishment of overarching actor cooperation throughout value chains
- A 4.1 Support for demonstration projects on waste-preventing technologies and utilisation schemes
- A 5.1 Supportive programmes and activities to implement waste-preventing strategies and technologies in product development and production process design
- A 6.1 Benchmarking at the level of public-sector waste management bodies
- A 6.2 Benchmarking at sectoral level

Conditionally recommended examples of measures (further appraisal needed) in Field A

- A 3.1 Development of an implementation strategy for an EU-wide product resource tax is recommended under the condition that an appraisal of the achievable governance effect, which yet still needs to be conducted, delivers a positive result and that the introduction of such a tax succeeds in the majority of the EU Member States.
- A 3.2 Removal of environmentally harmful subsidies and public support schemes is recommended under the condition that an appraisal, which is required in advance, indicates a relevant waste prevention potential.
- A 3.3 Abolishment of reduced value-added tax rates on meat products is recommended under the condition that an analysis of economic and social effects, and of the actually achievable waste reduction potentials, delivers a positive outcome. This recommendation is based in particular on the contribution to climate change mitigation and healthy nutrition.

9.2 Field B: Design, production and distribution phase

9.2.1 B I: Waste prevention in resource extraction

Measures to prevent waste in resource extraction naturally carry particular weight at global level.

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Product responsibility was classed as Measure A 7, but relates to specific projects in Field B.

The prime instruments here are provision of targeted information and labelling of resources extracted in "environmentally sound" processes, and statutory requirements and/or limits stipulated as conditions of permit award for resource extraction processes in Germany.

Recommended measures in Field B I:

- B I 1.1 Greater consideration of waste prevention aspects when providing efficiency advice to businesses
- B I 1.2 Extension of existing web-based advisory services to include the aspect of the procurement of low-waste and low-contaminant resource extraction
- B I 2.1 Voluntary agreement with the primary industry in the field of metallic resource processing on the procurement of resources from comparatively environmentally sound and low-waste extraction sites or on the use of secondary resources
- B I 3.1 Labelling scheme for resource-conserving concrete

9.2.2 B II: Waste-preventing production facilities

To implement waste prevention measures in relation to production processes, highly effective statutory instruments are already available in the shape of the substance restrictions and approval procedures under REACH, and the options provided by Article 5 para 1 No. 3 and Article 22 para 1 Sentence 2 of the German Federal Immission Control Act (BImSchG). To make use of this regulatory potential close alignment between waste law and other regulatory processes would be needed. In this regard, however, there is a lack of

- an approach towards the uniform concretisation of state-of-the-art requirements in sub-statutory enforcement and action guidance, and
- systematic inventories of the waste intensity of different industrial/commercial processes as a basis for setting priorities in an effective manner.

With regard to producing sub-statutory enforcement and action guidance for waste prevention – which is one of the key points of leverage for waste prevention measures in Field B II – it has become apparent that a more detailed systematic review of the current situation would be desirable from a technical perspective. The orientative assessments carried out are based, of necessity, usually on older market and structure data. An updating of the information base should be carried out here in parallel with efforts to establish and implement specific waste prevention measures.

As concerns integrating material flows within industrial parks with the purpose of preventing waste, the authors of the study found that the measure could deliver theoretical waste-preventing effects. The available pilot experience, however, indicates that the actually realisable potential depends to a very great degree upon the actual (chance) structures at a particular site. It therefore does not appear expedient to make such integration in the local-spatial context a component of an overarching waste prevention strategy.

With regard to potential synergy effects, various measures should be coordinated closely with measures in Field A:

- Measure B II 3: Provision of support to advance the state of waste prevention technology in facilities with Measure A 4: Research on waste-preventing technologies and utilisation schemes.

- Measure B II 5: Institutions and structures to advise facility operators on waste-prevention options and Measure B II 6: Provision of support for intercompany cooperation on waste prevention with Measure A 2: Establishment of overarching actor cooperation.

Recommended measures in Field B II

- B II 1.1 Initiation of a restriction proposal for cold-set offset printing dyes
- B II 1.2 Support for a restriction proposal for plastics additives (phthalates)
- B II 2.1 Updating of enforcement/action guidance for waste prevention in metal surface treatment through etching and conversion processes
- B II 3.1 Promotion, through the German environmental innovation programme, of the industrial-scale realisation of facility designs with an advanced state of waste prevention
- B II 4.1 Application of Article 22 para 1 Sentence 2 BImSchG to offset printing installations not subject to permit requirements
- B II 5.1 Nationwide expansion and networking of institutions and structures that provide advice to facility operators on Integrated Pollution Prevention and Control, with a focus on waste prevention options
- B II 6.2 Waste-preventing cooperation in value chains
- B II 7.1 Greater focus on waste prevention aspects when implementing ÖKOPROFIT activities

Conditionally recommended examples of measures (further appraisal needed) in Field B II

- B II 2.2 First production of sector-specific enforcement/action guidance for waste prevention in heat-set printing installations
is recommended under the condition that an appraisal reveals relevant waste prevention potential.
- B II 6.1 Waste-preventing integration of material streams in spatial context (industrial parks)
is recommended under the condition that an updated information base reveals that there is still a relevant waste prevention potential.

9.2.3 B III: Waste-preventing production design

The implementing measures under the EU Ecodesign Directive can be an effective instrument for universally binding waste prevention efforts. Key is a concerted cross-sectoral approach. To be able to make even better use of the implementing measures under the EU Ecodesign Directive as an effective instrument of waste prevention

- an assessment of the lifespan of products and
- a systematic assessment of aspects relating to problematic substances

should be made a mandatory element of the methodology of the "preparatory studies" under the EU Ecodesign Directive – the Methodology for Ecodesign of Energy-related Products (MEErP).

Moreover, it would be helpful if the empowerment to issue statutory provisions were extended to cover all product groups.

In order to design clusters of measures that are as efficient as possible, measures to promote waste-preventing product design in the context of implementing measures under the EU Ecodesign Directive should be coordinated with approaches to restrict substances used as feedstocks under REACH. The same applies to the dissemination of information on waste-preventing product design, and to the structures established to provide advice to facility operators.

The instrument of producer responsibility established by Article 23 of the German Recycling Management Act (KrWG) is also suited in principle to promote waste prevention. This instrument should support and, where appropriate, complement the implementing measures under the EU Ecodesign Directive, which are considered advantageous in view of their direct binding effect across the European Union.

Recommended measures in Field B III

- B III 1.1 Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive
- B III 1.2 Support for expansion of the EU Ecodesign Directive to further product groups that have waste-preventing potential (exemplified by upholstered furniture)
- B III 2.1 Dissemination of information on waste-preventing product development
- B III 2.2 Efforts to raise awareness of waste-preventing product innovations by means of public awareness activities (competitions, awards).
- B III 3.1 Extension of statutory warranty periods or of liability for defects
- B III 3.2 Giving greater attention to waste prevention aspects when setting quality standards for products

9.2.4 B IV and B V: Waste-preventing logistics and trading

Surplus quantities arising from logistics and logistics-related waste generation are relevant points of leverage for prevention measures. The prevention of logistics wastes requires – partly also because of the very patchy information base at present – very close cooperation with business actors. The optimisation potential of these fields is considered to be high, as is the willingness of retail actors to become active to promote waste prevention. The intensive interface between retail and consumers can also be utilised to disseminate information on waste prevention and raise awareness among consumers.

These life-cycle phases provide an important point of leverage for preventing wastes from foods that are still fit for human consumption. A focus should be placed on promoting regional retail structures. It is advisable to coordinate the various measures closely.

Recommended measures in Fields B IV and B V

- B IV 1.1 Voluntary agreement with the federation of retail establishments on food deliveries to stores that are tailored more closely to requirements
- B V 1.1 Support for exemplary retail establishments by means of suitable publicity activities
- B V 2.1 Collection, in cooperation with sector associations, of basic data on waste prevention in logistics and dissemination of the data through an Internet platform
- B V 3.1 Campaign to promote sales of regional products, focussing on food

9.3 Field C: Waste-preventing product purchase and use, and general education and advice for waste prevention

9.3.1 C VI: Waste-preventing purchasing decisions and uses

One of the principal objectives of waste prevention overall, and particularly of measures in the field of waste-preventing purchasing decisions and uses, is to increase the utilisation intensity and lifespan of products and packaging's. The greater the amount of resources consumed to manufacture the products in question, the more effective are efforts to increase utilisation intensity. By promoting green public procurement, the public sector can adopt a model role, while through its high volume of demand it can also assist all further measures.

As regards product labelling, the authors of the present study conclude that the German Blue Angel (Blauer Engel) ecolabel scheme is sufficiently established. The alternative of a specific waste prevention label, in contrast, would rather tend to confuse consumers. The measure of giving greater consideration to waste prevention aspects when awarding the Blue Angel label and conducting a dedicated project on this issue is recommended under the condition that an assessment finds that meaningful criteria can be defined for waste prevention and suitable product groups can be identified.

For the waste prevention measures in Field C that primarily target the consumption side, it is essential to coordinate them closely above all with individual measures in Field A. This concerns, in particular, possible taxes or levies on packaging's and waste-intensive consumer articles, which must be considered in conjunction with the economic incentive instruments in Field A. For instance, a packaging tax cannot be considered in isolation from a product resource tax. With regard to labelling, it is essential to coordinate activities closely with the initiation or support of meaningful primary material labels. At the same time, these labels should also be applicable to waste-preventing procurement.

Recommended measures in Field C VI

- C VI 1.2 Levy on disposable bags
- C VI 2.1 Internet platform for recommendations on waste-preventing purchasing
- C VI 4.1 Supplementation and concretisation of the public procurement laws, ordinances and administrative guidelines of the Federation and Federal State Governments to include waste-preventing and resource-conserving provisions

C VI 4.2 Promotion and expansion of actor cooperation and information platforms on green public procurement

C VI 5.1 Financial support for waste-preventing product service systems

C VI 5.2 Promotion of waste-preventing product service systems through provision of municipal infrastructure

C VI 5.3 Advisory and research activities and information and communication campaigns on waste-preventing product service systems

C VI 6.1 Inclusion in municipal statutes of a ban on the use of disposable tableware for events on public premises and in public areas

Conditionally recommended examples of measures in Field C VI

C VI 1.1 Packaging tax, concretised for the example of beverage containers, recommended under the condition that a legal assessment finds that such tax rates which promise an incentive effect are still permissible.

C VI 3.1 Greater consideration of waste prevention aspects in the award criteria of the Blue Angel ecolabel scheme, recommended under the condition that an assessment finds that meaningful criteria can be defined for waste prevention and suitable product groups can be identified.

9.3.2 C VII: General education measures and public awareness-raising on waste prevention

Providing information of and raising awareness among children and young people by including waste prevention in curricula and making it a part of everyday school activities are important – they are a precondition to long-term changes in public attitudes to waste prevention. Schoolchildren can act as multipliers in their families, raising awareness there of the issues surrounding waste prevention and resource conservation.

Measures in the field of communication and public participation have a long-term perspective and an indirect effect. While it is difficult to quantify their specific waste prevention potential, overall the relevance of these measures to the successful implementation of more tangible measures is considered to be high. In the field of education measures, in particular, it is important to coordinate various individual instruments carefully within the field in order to deliver maximum waste prevention effects. For instance, the adjustment of curricula should not proceed in isolation from campaigns developed for schools and universities. As efforts to raise awareness among schoolchildren and students of waste-preventing consumption patterns depend upon corresponding goods being available, there should also be coordination with measures in Field B V: "Waste-preventing retail". The measure on public participation in waste prevention strategies calls for close coordination with measures in Field A 1: "Development of waste prevention strategies and concepts".

Recommended measures in Field C VII

C VII 1.1 Review and adjustment of teacher and tutor training curricula to include issues of resource conservation and waste prevention

- C VII 2.1 Waste prevention as campaign in schools and universities
- C VII 3.1 Encourage municipalities and environmental and consumer associations to develop and implement experiential waste prevention campaigns
- C VII 4.1 Timely and comprehensive involvement of the public in the design and implementation of waste management measures

9.3.3 C VIII: Waste preventing discarding

The measures proposed in this field mainly seek to promote second-hand trade and reprocessing structures. These measures should be further supported through conducive framework conditions in the shaping of waste charges and through the incentive effects of economic instruments.

The goal is to support actors in this field and to ensure that they are well known and well accepted among consumers. The case of Kringwinkel in Belgium shows that such efforts can substantially increase second-hand sales.

A further form of support is to engage in scientific monitoring and research of the conditions that must be met in order that the second-hand trade can make substantial contributions to extending the lifespan of products and advancing the discourse in society and academia on the issues surrounding sustainable consumption patterns.

The measure to develop quality standards for reuse serves to improve acceptance and also to prevent any extension of the lifespan of outdated equipment that has very high energy consumption levels or contaminant contents. For instance, refrigeration equipment containing CFC refrigerants should not normally be included in reuse efforts.

Support for research on strategies by which to prevent food wastes is also particularly recommendable in view of the quantity of wastes arising here, the associated environmental pressures, and the fact that such food may be fit for human consumption and should therefore not be wasted.

Various interfaces with measures in Fields A and B arise in Field C VIII; these should be harnessed during implementation. Quality standards for reuse should be coordinated with the general provisions relating to the extension of statutory warranty periods or liability for defects. Support for strategies to prevent food wastes should be coordinated closely with Field B IV (Waste-preventing logistics), as that field also focuses on food waste. There must be an exchange of both fields with the proposed food waste research priority (C VIII 7). In the same vein, research activities designed to increase utilisation intensity need to be coordinated closely with measures intended to promote waste-preventing product service systems.

Recommended measures in Field C VIII

- C VIII 1.1 Design of charges in line with the polluter pays principle, for instance through weight- or volume-based waste charges, accompanied by advice on waste prevention

is recommended while noting that the main purpose of this measure is to promote segregated collection and thus waste recycling.

- C VIII 2.1 Technical, organisational and financial support for second-hand exchanges and shops
- C VIII 2.2 Reuse of second-hand goods in third countries – creation of environmentally and socially acceptable framework conditions
 - is recommended while noting that a key priority of the measure is also to create socially and environmentally acceptable working conditions in the materials recycling sectors of the countries of the "global South".
- C VIII 3.1 Support for repair networks
- C VIII 3.2 Development of quality standards for reuse
- C VIII 4.1 Support for the distribution of surplus food to the needy
- C VIII 4.2 Support for approaches to prevent food wastes in the supply chain
- C VIII 5.1 Concerted action at all levels of government to mark the European Week for Waste Reduction
- C VIII 5.2 Nation-wide information platform on the benefits and opportunities of reuse
- C VIII 6.1 Support for research & development on measures to extend lifespan
- C VIII 7.1 Support for research on the prevention of food wastes

9.4 Interplay of measures

It is important to realise that it is not individual measures that will deliver a successful waste prevention outcome, but rather the targeted interplay of an array of measures. As shown repeatedly in this study, there are measures that are mutually supportive and complementary – for these it is generally not purposeful to weigh them against each other, as they will only deliver the desired outcomes in combination.

In the following, the representative interplay of numerous examples of measures is illustrated for the case of the various measures and examples of measures that are helpful and necessary to extend product lifespan and intensify their utilisation intensity before they finally become waste – a key waste prevention objective:

First of all, there is a need for measures that help to research the basic data and linkages (e.g. *A 4.1: Support for demonstration projects on waste-preventing technologies and utilisation schemes*, *C VIII 6.1: Support for research & development on measures to extend lifespan* as well as *C VIII 7.1: Support for research on the prevention of food wastes*).

Moreover, the information must be made available, and awareness-raising and advisory services must be provided – for consumers (e.g.: *C VI 2: Greater prioritisation of waste prevention aspects in purchasing recommendations*, *C VI 3: Consideration of waste prevention as a part of meaningful ecolabelling of products*; *C VIII 5: Information and awareness-raising of consumers to promote reuse*), producers (e.g.: *B I 1.1: Greater consideration of waste prevention aspects when providing efficiency advice to businesses*, *B III 2: Information dissemination and awareness-raising for waste-preventing product design*) and retailers (*B V 1: Agreements on voluntary measures to reduce "logistics wastes"*, *B V 3: Support for low-waste, regional retail*).

In order that the information on waste prevention is effective in the long term, it is important to anchor it in education and training (*C VII 1: Inclusion of waste prevention in training curricula for teachers and tutors, C VII 2: Waste prevention in schools and universities*).

Creating framework conditions that support and promote longer lifespan of a product is just as important as efforts to raise awareness. Such conditions include economic instruments by which external costs are internalised (e.g.: *A 3.1: Development of an implementation strategy for an EU-wide product resource tax*) thus making resource consumption more expensive and thus also indirectly increasing the cost of waste generation compared to the labour factor. The purpose of this is to make repairs profitable again compared to new purchases. This equally requires a tightening of the stipulations on waste prevention under the Ecodesign Directive (*B III 1: Introduction and implementation of binding requirements upon waste-preventing product design as a part of implementing measures under the EU Ecodesign Directive*) or on product quality improvements (*B III 3.2: Giving greater attention to waste prevention aspects when setting quality standards for products*) or on extended warranty periods (*B III 3.1: Extension of statutory warranty periods or of liability for defects*) in Germany.

In order that consumers with raised awareness are in a position to actually behave in such a manner that wastes are prevented, attractive products and services must be established in connection with innovative utilisation schemes (*C VI 5: Promotion of waste-preventing product service systems*) and second-hand trade (*C VIII 2: Support for private and non-profit markets and exchanges for discarded products, C VIII 3: Support for reprocessing structures*).

Experience has shown that exchange of the necessary facts and information among the various players in the production and supply chain is a key determinant of success if any fundamental changes in product design are to be achieved (as is usually necessary for any substantial extension of lifespan). Such intensified communication often requires support, especially in sectors characterised by small and medium-sized enterprises (*A 2: Establishment of overarching actor cooperation*).

To organise the interplay of the measures well and to advance it strategically, state bodies should develop and institute strategies and schemes (*A 1.1: Development of waste prevention strategies and approaches by state bodies*), should act as models of best practice (*C VI 4: Green / waste-preventing procurement, C VI 6: Waste-preventing organisation of events in public spaces or public facilities*) and, through timely and broad involvement of the public (*C VII 4: Intensive public participation in waste prevention strategies*), should help to increase the awareness and acceptance of measures. Financial incentives can amplify signals promoting waste prevention (e.g. *C VIII 1.1 Design of charges in line with the polluter pays principle accompanied by advice on waste prevention*).

The results of measures should be monitored and communicated in a manner that attracts significant public attention already in the implementation phase (*A 6: Development and application of indicator systems*).

The 58 examples of measures described here are representative of numerous further implementation options. They display the broad range of opportunities to promote waste prevention and underscore that a substantial potential to reduce wastes is indeed available.

10 Bibliography

- Abiola 2008 Abiola, B.O.: The Otigba Computer Village Cluster in Nigeria. In: Zeng, D.Z.: Knowledge, technology and cluster-based growth in Africa. World Bank, New York 2008.
- Acker et al. 2010 Acker, H, Günther, E., Möller, M., Quack, D., Stechemesser, K.: „Umweltfreundliche Beschaffung: Schulungsskripte“, Umweltbundesamt, Dessau, Mai 2010 (Online verfügbar:<http://www.umweltdaten.de/publikationen/fpdf-l/3951.pdf>, abgerufen 14.11.2011)
- Acker, Hermann 2011 Acker, H., Hermann, A.: „Regelungen der BundesFederal States auf dem Gebiet der öffentlichen Beschaffung“, Umweltbundesamt, Dessau 2011 (Online verfügbar: <http://www.umweltdaten.de/publikationen/fpdf-l/4160.pdf>, abgerufen 14.11.2011)
- Acosta et al. 2007 Acosta-Fernandez, J., Bringezu, S. :“Sektorale Potenziale zur Verringerung des Ressourcenverbrauchs der deutschen Wirtschaft und ihre Auswirkungen auf Treibhausgasemissionen, Bruttowertschöpfung und Beschäftigung“. Projekt Steigerung der Ressourcenproduktivität als Kernstrategie einer nachhaltigen Entwicklung im Auftrag des BMBF. Wuppertal, 2007
- ACR+ 2009 ACR+: A guide for Local & Regional Authorities in support of the new Waste Framework Directive. Technical Report, Brussels (2009)
- APME 2005 Boustead, I.: Eco-profiles of the European plastics industry. Polyolefins. Brussels 2005. www.plasticseurope.org/.
- Arcadis et al. 2010 Arcadis/ VI TO (VI sion on Technology)/ Umweltbundesamt Österreich, Bio Intelligence SerVI ce: „Analysis of the evolution of waste reduction and the scope of waste prevention. Final report“. Im Auftrag von European Commission DG EnVI ronment, Framework contract ENV.G.4/FRA/2008/0112. Deume 2010.
- ARTE 24.01.2012 Kaufen für die Müllhalde, Themenabend 24.01.2012, <http://www.arte.tv/de/3714422,CmC=3714270.html>
- BCS 2011 „Jahresbericht 2010: Veränderungen fordern die Branche- wir gestalten den Wandel“, Bundesverband CarSharing e.V., (www.carsharing.de) Berlin, 2011
- BDZV 2012 Pasquay A.: Die deutschen Zeitungen in Zahlen und Daten, Bundesverband deutscher Zeitungsverleger e.V. (BDZV), Berlin.
- Bel 2010 Bel, Jean Benoit: "State of the art of waste prevention monitoring. Interreg IVC Project PreWaste, Component 4: Build up of shared indicators and web tool, Brussels, 2010.
- Berg et.al. 2010 Berg, H., Burger, A., Eckermann, F., Schrode, A., Thiele, K.: „Umweltschädliche Subventionen in Deutschland – Aktualisierte Ausgabe 2010, Umweltbundesamt, Dessau 2010 (Online verfügbar:<http://www.umweltdaten.de/publikationen/fpdf-l/4048.pdf>, abgerufen 14.11.2011)
- Bergsma 2009 Bergsma, G.: „Erfahrungen mit CO₂-Steuern auf Verpackungen in den Niederlanden“, CE Delft, Vortrag auf dem 8. Würzburger Verpackungsforum, Würzburg 2009

- Beyer/Kopytziok 2005 Beyer, Peter; Kopytziok, Norbert: Abfallvermeidung und –verwertung durch das Prinzip der Produzentenverantwortung. Detailstudie von Ecologic – Institut für Internationale und Europäische Umweltpolitik im Auftrag des Österreichischen Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (GZ BMLFUW – UW.2.1.8/0011-VI/32004) im Rahmen der Erstellung des Abfallwirtschaftsplans 2006. Berlin 2005.
- bifa 2004 bifa Umweltinstitut: “Transfer of National Experiences with Waste Prevention and Minimisation to a Trans-Regional or an International Level.” Augsburg 2004.
- bifa 2008 bifa Umweltinstitut: „Überblicksdarstellung möglicher Maßnahmen für die Erstellung eines Abfallvermeidungsprogrammes im Sinne der EU-Richtlinie über Abfälle vom 19. November 2008, im Auftrag des BMU, Augsburg 2008
- bifa 2010 bifa Umweltinstitut: „Bewertung der Verpackungsverordnung - Evaluierung der Pfandpflicht“ UBA Texte 20/2010, Augsburg, Dessau 2010
- BIOS 2009 Bio Intelligence Service: Waste Prevention. Overview on Indicators. Paris 2009
- Blättel-Mink u.a. 2011 Blättel-Mink u. a. in: R. Defila/A. Di Giulio/R. Kaufmann-Hayoz (Hrsg.): Wesen und Wege nachhaltigen Konsums, Ergebnisse sozialökologischer Forschung Bd. 13, Oekom Verlag München 2011, S. 349ff
- BMBF 2004 Bundesministerium für Bildung und Forschung: Nachhaltiges Wirtschaften – Innovationen aus der Umweltforschung (BMBF), Berlin 2004
- BMELV 2010 BMELV-Statistik 2010, Online verfügbar:
<http://www.lfl.bayern.de/iem/agrarmarktpolitik/41439/>, abgerufen 28.02.2012
- BMELV 2012 Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz,
http://www.bmelv.de/SharedDocs/Standardartikel/Ernaehrung/Wert-Lebensmittel/Verderb_verhindern/LMWegwerfenTippsAID.html, Berlin, 2012, Zugriff, 14.02.2012
- BMI 2011 Bundesministerium des Innern: Der öffentliche Dienst des Bundes, Daten zur Personalstruktur 2011; Berlin, August 2011; online verfügbar:
http://www.bmi.bund.de/SharedDocs/Downloads/DE/Broschueren/2011/personalstruktur.pdf?__blob=publicationFile
- BMU 2009 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) (Hrsg.): GreenTech made in Germany 2.0. Umwelttechnologie-Atlas für Deutschland. 2. Aufl. München: Vahlen 2009.
- BMU 2010 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Hrsg.): „Repräsentativumfrage zu Umweltbewusstsein und Umweltverhalten im Jahr 2010“, Berlin 2010
- BMU 2011 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU): „Entwurf des BMU für ein Deutsches Ressourceneffizienzprogramm (ProgRes)“, Bonn 11.10.2011 (Entwurfssfassung)
- BMU 2012 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit: Umweltinnovationsprogramm, Geförderte Projekte, 2012,

- http://www.bmu.de/foerderprogramme/investitionsfoerderung_im_inland/foerderschwerpunkte/doc/46416.php
- BMU, UBA 2011 Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Umweltbundesamt (UBA) (Hrsg.): Umweltwirtschaftsbericht 2011. Bonn/ Dessau-Roßlau.
- BMWi 2009 Bundesministerium für Wirtschaft und Technologie: Wirtschaftliche Förderung, Hilfen für Investitionen und Innovationen, Berlin, März 2009
- BMWi 2010 Bundesministerium für Wirtschaft und Technologie (Hrsg.): Der Bergbau in der Bundesrepublik Deutschland 2009, Bergwirtschaft und Statistik 61. Jahrgang 2010, Berlin 2010
- BMWi Förderdatenbank 2012 Bundesministerium für Wirtschaft und Technologie, <http://www.foerderdatenbank.de/Foerder-DB/Navigation/Foerderrecherche/suche.html?get=d3d7275e444707c8c5088971fbe1815f;views;document&doc=10528>, Zugriff 12.02.2012
- BNE 2012 UN-Dekade „Bildung für nachhaltige Entwicklung“ Weltdekade der Vereinten Nationen 2005-2014 http://www.bne-portal.de/coremedia/generator/unesco/de/01__Startseite/Startseite.html
- BREF 2001 Reference Document on Best Available Techniques in the Chlor-Alkali Manufacturing industry, Integrated Pollution Prevention and Control, European Commission, December 2001
- BREF 2006 Reference Document on Best Available Techniques in the Food, Drink and Milk Industries, Integrated Pollution Prevention and Control, European Commission, August 2006
- BREF 2007 Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals - Solids and Others industry, Integrated Pollution Prevention and Control, European Commission, August 2007
- BRINGEZU 2000 Bringezu, S.: Ressourcennutzung in Wirtschaftsräumen. Stoffstromanalysen für eine nachhaltige Raumentwicklung, Wuppertal 2000 und www.kohlestatistik.de
- Brohmann 2011 Brohmann, B. in: G. Altner et al. (Hrsg.): Jahrbuch Ökologie 2011. Die Klima-Manipulateure, Stuttgart 2011, S. 167 ff
- BSU/Ökopol 1999 Jepsen, D., Sander, K.: „Branchenleitfaden für metallverarbeitende Betriebe im Rahmen der Erstellung betrieblicher Abfallwirtschaftskonzepte“, Auftrag der Behörde für Stadtentwicklung und Umwelt (BSU) der Freien und Hansestadt Hamburg, 1998/99
- BT-Drucksache 16/8846 Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Katrin Kunert, Lutz Heilmann, Dr. GesineLötzsch, Eva Bulling-Schröter, Roland Claus und derFraktion DIE LINKE - Drucksache 16/8846 – Förderungvon Projekten im Rahmen des Umweltinnovationsprogramms, 2008
- Buchert et al. 2012 Buchert M., Manhart A., Bleher D., Pingel D.: Recycling kritischer Rohstoffe aus Elektronik-Altgeräten, Öko-Institut, Darmstadt 2012
- BUND 2011 BUND Region Hannover, download 2011 http://region-hannover.bund.net/themen_und_projekte/bergbaufolgen/kalihalden

- Bundespreis ecodesign 2012 "Bundespreis Ecodesign" offener Wettbewerb für besonders umweltfreundliche Produkte, Konzepte und Dienstleistungen", BMU/UBA 2012, <http://www.bundespreis-ecodesign.de/de/index.html>
- Bundesregierung 2008 Bundesregierung: Fortschrittsbericht 2008 zur nationalen Nachhaltigkeitsstrategie – Für ein nachhaltiges Deutschland, Berlin 2008
- Bundesregierung 2012 Bundesregierung: Deutsches Ressourceneffizienzprogramm (ProgRes) – Programm zur nachhaltigen Nutzung und zum Schutz der natürlichen Ressourcen. Beschluss des Bundeskabinetts vom 29.2.2012.
- BVDT 2010 Bundesverband Deutsche Tafel e.V.: Nachhaltigkeit im Fokus – Jahresbericht 2010, Berlin; download 2012: http://www.tafel.de/fileadmin/pdf/Publikationen/TAF_Jahresbericht_2010.pdf
- BVDT 2012 Bundesverband Deutsche Tafel e.V.: <http://www.tafel.de/die-tafel/zahlen-fakten.html>, abgerufen 2012
- BVT-Merkblatt, 2007 Beste verfügbare Techniken für die Oberflächenbehandlung unter Verwendung von organischen Lösemitteln“, Übersetzung des UBA, August 2007, http://www.bvt.umweltbundesamt.de/archiv/bvt_oberflaechenbehandlung_organische_loesemittel_vv.pdf
- Christensen 1998 Christensen, J.: Die industrielle Symbiose in Kalundborg. Ein frühes Beispiel eines Recycling-Netzwerks. In: Strebel/Schwarz (Hrsg.): Kreislauforientierte Unternehmenskooperationen – Innovative Verwertungsnetze. Reihe: Lehr- u. Handbücher zur Ökologischen Unternehmensführung und Umweltökonomie, München 1998
- CITYWEB Bergisch Gladbach 2011 Abfallwirtschaft Bergisch-Gladbach: Geschirrmobil, download 2011, <http://www.bergischgladbach.de/geschirrmobil.aspx>
- CSES 2011 „Evaluation of the Ecodesign Directive (2009/125/EC) - Draft Final Report“, Kent/Brüssel, Dezember 2011
- Davis 1994 Davis, Gary: Extended Producer Responsibility: A New Principle for a New Generation of Pollution Prevention; in C. A. Wilt, & G. A. Davis, In Proceedings of the Extended Producer Responsibility Symposium. 14-15 November 1994, Washington, D.C. (1-14). Knoxville, TN: Center for Clean Products and Clean Technologies, The University of Tennessee (1994).
- DBU 2011 Deutsche Bundesstiftung Umwelt (2011): 20 Jahre DBU - Förderung von Umweltinnovationen. (Online verfügbar: http://www.pius-info.de/files/Netzwerktagung_2011/10_Jahre_PIUS_DBU_Foerderung.pdf, abgerufen 14.11.2011)
- DBU/MUNLF-SH 2003 Großmann, D., Sander, K., Drachenberg, I.: „Regionale Stoff- und Energievernetzung im Gewerbegebiet Henstedt-Ulzburg/Kaltenkirchen“, Pilotvorhaben unter Leitung der Ökopol GmbH, mit Unterstützung des Ministeriums für Umwelt, Naturschutz Landwirtschaft und Forsten des Landes Schleswig-Holstein und der Deutschen Bundes-Stiftung Umwelt, Endbericht 2003
- de Kringwinkel 2010 de Kringwinkel: Over ons - organisatie. Online verfügbar unter http://www.dekringwinkel.be/kw/over-ons/organisatie_20.aspx, 2010

- Dehne et al. 2011 Dehne, I.; Oetjen-Dehne, R.; Kanthak, M.: Aufkommen, Verbleib und Ressourcenrelevanz von Gewerbeabfällen. UBA-Texte Nr. 19/2011, Dessau 2011
- Dehoust 2009 Dehoust, G.: Lenkungsabgabe für Getränkeverpackungen und ihre fiskalische Bedeutung – Zwischenergebnisse der Studie des NABU e.V.; Öko-Institut e.V., Vortrag auf dem 8. Würzburger Verpackungsforum, Würzburg 2009
- Dehoust et al. 2009 Dehoust, G., Acker, H., Petschow, U., Wegener, H.: "Steuern oder Sonderabgaben für Getränkeverpackungen und ihre Lenkungswirkung", Öko-Institut e.V. zusammen mit IÖW, im Auftrag des Naturschutzbunds Deutschland e.V., Berlin, Darmstadt 2009
- Dehoust et al. 2010 Dehoust, G., Küppers, P., Bringezu, S., Wilts, H.: „Erarbeitung der wissenschaftlichen Grundlagen für die Erstellung eines bundesweiten Abfallvermeidungsprogramms“, Umweltbundesamt, Dessau 2010
- Dehoust et. al. 2011 Dehoust, G., Jepsen, D., Wilts, H.: Erarbeitung von Maßnahmenvorschlägen zur Abfallvermeidung in Schleswig-Holstein – Endbericht der Phase 1; im Auftrag des Ministerium für Landwirtschaft, Umwelt und ländliche Räume des Landes Schleswig-Holstein (MLUR), Kiel 2011
- Dehoust/Ewen 2011 Dehoust, G.; Ewen, C.: Planspiel zur Fortentwicklung der Verpackungsverordnung – Teilvorhaben 3: Planspiel, Öko-Institut e.V., team ewen, im Auftrag des Umweltbundesamt, Dessau-Roßlau, September 2011; download: <http://www.umweltdaten.de/publikationen/fpdf-l/4174.pdf>
- Delft 2007 CE Delft: „Environmental indices for the Dutch packaging tax“, Delft 2007
- demea o.J. Deutsche Materialeffizienz-Agentur o.J.: Impulsprogramm Materialeffizienz – Praxisbeispiele. Berlin.
- Destatis 2010a Statistisches Bundesamt: Statistisches Jahrbuch 2010, Wiesbaden.
- Destatis 2010b Umwelt – Abfallentsorgung 2008, Fachserie 19 Reihe 1, Statistisches Bundesamt, Wiesbaden 2010
- Destatis 2011 Statistisches Bundesamt (Hrsg.), Fachserie 19 Reihe 1, Umwelt. Abfallentsorgung 2009, Wiesbaden 2011
- Detzel et al. 2002 Detzel A., Schonert M., Schmitz S., Giegrich J., Motz G., Ostermayer A., Meckel H., Schorb A.: Ökobilanz für Getränkeverpackungen II / Phase 2, ifeu und Prognos, UBA-Texte 51/02, Berlin, Oktober 2002
- Detzel, Kauertz 2008 Detzel, A., Kauertz, B. et al.: „Ökobilanz der Glas- und PET-Mehrwegflaschen der GDB im Vergleich zu PET-Einwegflaschen“, IFEU, Heidelberg 2008
- Deutscher Bundestag 2010 Deutscher Bundestag, Ausschuss für Ernährung, Landwirtschaft und Verbraucherschutz: „Angebots- und Nachfragemacht des Lebensmitteleinzelhandels und die Auswirkungen auf die Verbraucher“, Stellungnahmen der jeweiligen Sachverständigen.
https://www.bundestag.de/bundestag/ausschuesse17/a10/anhoerungen/archiv/2010/_A_5_7_2010_Angebots-_und_Nachfragemacht_des_Lebensmitteleinzelhandels_und_die_Auswirkungen_auf_die_Verbraucher_/Stellungnahmen/index.html, abgerufen am 15.April 2012

- Deutscher Bundestag 2011 Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Dorothea Steiner, Hans-Josef Fell, Bärbel Höhn, weiterer Abgeordneter und der Fraktion BÜNDNIS 90/DIE GRÜNEN – Drucksache 17/8069 –; 17. Wahlperiode, Drucksache 17/8254, vom 21.12.2011
- Deutscher Fleischerverband 2012 Deutscher Fleischerverband: „Fleischverzehr“, Online verfügbar: http://www.fleischerhandwerk.de/cms/upload/pdf/GB2011_Fleischverzehr.pdf, abgerufen am 28.02.2012
- Dinkel et al. 1999 Dinkel, Fredy et al.: Ökologische Beurteilung verschiedener Geschirrtypen mit Empfehlungen - Arbeitspapier 4/99, Basel 1999
- DIW 2011 Mattes, Anselm: „Gesellschaftliche Folgen eines Wegfalls des ermäßigten Mehrwertsteuersatzes: Simulationsergebnisse auf Basis der EVS 2008: Ein Gutachten für die Gewerkschaft Nahrung Genuss Gaststätten“, DIW econ GmbH, Berlin 2011
- Dosch 2005 Dosch, K.: „Überblick - Ressourcenproduktivität als Chance - Ein langfristiges Konjunkturprogramm für Deutschland“, Kathy Beys Stiftung, Aachen 2005 (Online verfügbar: <http://www.demea.de/dateien/fachartikel/Aachener-Stiftung-Ressourcenproduktivitat.pdf>, abgerufen 06.12.2011)
- Dradio 2011 Deutschlandradio Kultur von Pollmer, U.: Lebensmittel als Wegwerfprodukt – Wie die Deutschen Essen verschwenden, download 2011, <http://www.dradio.de/dkultur/sendungen/mahlzeit/1392539/>
- DTU 2006 Danish Technical University et al.: Waste Prevention, Waste Policy and Innovation, kgs. Lyngby, October 2006
- DUH 2012 Deutsche Umwelthilfe, Eco Second Hand Elektrogeräte, <http://www.duh.de/1944.html>, Radolfzell, Zugriff, 13.02.2012
- DWA, 2011 Merkblattes DWA-M 358 Abfälle und Abwässer aus der Metalloberflächenbehandlung durch Konversionsverfahren, November 2011
- Eckermann 2011 Dr. Frauke Eckermann, Umweltbundesamt: Royalties und Ressourcensteuern, Prinzipien, Ziele und internationale Vorbilder; Vortrag auf der FÖS-Tagung „Das Potential der Förderabgabe für Ressourcenschutz und Federal States finanzieren“ am 18.10.201 in Berlin
- Ecoinvent 2010 Online-verfügbare Datenbank zu Ecoinvent (2011), LCIA CML 2001, www.ecoinvent.org, 2010
- Ecoinvent 2012 Ecoinvent database, Swiss Centre for Life Cycle Inventories, version 2.2, <http://www.ecoinvent.org/database/> 2012
- EFFNet 2012 Effizienznetz Rheinland-Pfalz, <http://www.effnet.rlp.de/Startseite/broker.jsp?uMen=99d70e07-224c-2701-33e2-dcfc638b249d&uCon=d9a45efe-034d-231a-cb59-5fdefa5a20ad&uTem=aaaaaaaa-aaaa-aaaa-aaaa-000000000012>, Zugriff 15.02.2012
- ETC SCP 2010 European Topic Centre on Sustainable Consumption and Production (2010): Towards a Set of Indicators on Sustainable Consumption and Production (SCP) for EEA reporting. Online verfügbar unter <http://www.scp-knowledge.eu/knowledge/towards-set-indicators-sustainable-consumption-and->

- production-scp-eea-reporting, zuletzt ge-prüft am 24.4.2012. EU-Kommission 2003 Europäische-Kommission: Entwicklung einer thematischen Strategie für die nachhaltige Nutzung der natürlichen Ressourcen. Brüssel KOM 2003; 572 endg
- EU-Kommission 2005 Europäische Kommission: „Umweltfreundliche Beschaffung!- Ein Handbuch für ein umweltorientiertes Beschaffungswesen“, Luxemburg: Amt für amtliche Veröffentlichungen der Europäischen Gemeinschaften, 2005 (Online verfügbar: http://ec.europa.eu/environment/gpp/pdf/buying_green_handbook_de.pdf, abgerufen 14.11.2011)
- EU-Kommission 2012 European Commission-Environment- Waste Prevention: <http://ec.europa.eu/environment/waste/prevention/practices.htm> (download 20.02.2012)
- EU-Richtlinie 2004/17/EG zur Koordinierung der Zuschlagserteilung durch Auftraggeber im Bereich der Wasser-, Energie und Verkehrsversorgung sowie der Postdienste, vom 31. März 2004 (Online verfügbar: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0114:024:de:PDF>, abgerufen 14.11.2011)
- EU-Richtlinie 2004/18/EG über die Koordinierung der Verfahren zur Vergabe öffentlicher Bauaufträge, Lieferaufträge und Dienstleistungsaufträge, vom 31. März 2004 (Online verfügbar: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:134:0114:0240:de:PDF>, abgerufen 14.11.2011)
- Eurostat 2012 Eurostat: Elektro- und Elektronik-Abfall (WEEE). Online verfügbar unter <http://epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/weee>, 2012
- Faberi et al. 2007 Faberi S., Presutto M., Stamminger R., Scialdoni R., Mebane W., Esposito R.: Preparatory Studies for Eco-Design Requirements of EuPs – Lot 14: Domestic Washing Machines & Dishwashers, December 2007
- Fabrik der Zukunft 2012 Bundesministerium für Verkehr, Innovation und Technologie (bmvit), Wien, 2012 <http://www.fabrikderzukunft.at/about/themen.htm>
- FEFCO 2009 Fédération Européenne des Fabricants de Carton Ondulé (FEFCO): European Database for Corrugated Board Life Cycle Studies 2009. Brussels, 2009.
- fifty/fifty PLUS 2007 Klima Bündnis und Unabhängige Institut für Umweltfragen: fifty/fifty PLUS. 2007 <http://www.fiftyfiftyplus.de/home.0.html>, abgerufen am 16.02.2012
- Fös 2011 Fös-Eckpunktepapier: „Der Beitrag ökonomischer Instrumente zu einer nachhaltigen Ressourcenpolitik“, 2. Auflage, Mai 2011 (Online verfügbar: http://www.foes.de/pdf/2011-05_Eckpunktepapier_2._Auflage.pdf, abgerufen 14.11.2011)
- Fös 2012 Meyer, Eicke, Cochu, Annica: „Fös-Eckpunktepapier: Subventionen für die Produktion und den Konsum von Fleischwaren“, Berlin 2012
- Frank 2011 Frank E.: Mineralöle in Lebensmittelverpackungen – Lösungsansätze aus der Druckfarbenindustrie, BfR 22.09.2011

- FRAUNHOFER ISI 2010 Evaluierung des Programmstarts und der Durchführung des „Zentralen Innovationsprogramms Mittelstand (ZIM), Karlsruhe 2010
- Freitag.de 2011 Thurn V.: Alles Müll? Download 2011, <http://www.freitag.de/wochenthema/1107-das-bewusstsein-ist-verschwendend-gering>
- GBU 2002 Gbu mbh: Biogasanlage zur Verwertung von Speiseresten, Bensheim. 2002
- Giegrich et al. 2012 Giegrich J., Liebich A., Lauwigi C., Reinhardt J.: Indikatoren / Kennzahlen für den Rohstoffverbrauch im Rahmen der Nachhaltigkeitsdiskussion, ifeu im Auftrag Umweltbundesamt, Dessau-Roßlau, Januar 2012
- Gößling-Reisemann et al. 2009 Gößling-Reisemann, S.; Knak, M.; Schulz, B. (2009): Product lifetimes and copper content of selected obsolete electric and electronic products. Online verfügbar unter http://ewasteguide.info/files/Goessling_2009_R09.pdf, zuletzt geprüft am 24.4.2012.
- Graulich 2007 Graulich, Kathrin: „EcoTopTen- Die Verbraucher-Informationskampagne. Erstellt von Öko-Institut e.V., Freiburg 2007
- Grossmann et al. 2005 Grossmann, Ipsen & Jepsen: „Branchengutachten zur Abfallvermeidung in Anlagen der Nr 3.9 und 3.10, 4. BImSchV“, erstellt von der Ökopol GmbH für das Ministerium für Umwelt und Naturschutz, Landwirtschaft und Verbraucherschutz des Landes Nordrhein-Westfalen 2005
- Gustavsson et al. 2011 Gustavsson J, Cederberg C, Sonesson U, van Otterdijk R, Meybeck A.. Global food losses and food waste. Rome: Food and Agriculture Organization of the United Nations (FAO) 2011. (Available from http://www.fao.org/fileadmin/user_upload/ags/publications/GFL_web.pdf)
- GVM 2009 GVM - Gesellschaft für Verpackungsmarktforschung GmbH: Verbrauch von Getränken in Mehrweg- und Einweg-Verpackungen, Berichtsjahr 2007, UBA-Texte 17/2009, Dessau, August 2009
- Hamburg 1989 Stadt Hamburg: Abfallwirtschaftsplan Siedlungsabfälle 1989
- Havers et.al. 2011 Havers, K., Bleher, D., Hackbarth, T., Kröhnert, M., Noemi, D., Schmied, M., Friedl, Chr.: Green Goal: Fußball hinterlässt Spuren - Legacy Report, Abschlussbericht zur Umweltkampagne der FIFA frauen-weltmeisterschaft 2011, Öko-Institut e.V.; DFB, hrsg. vom OK FIFA, Darmstadt, Frankfurt, 2011; download: <http://www.oeko.de/oekodoc/1291/2011-416-de.pdf>
- Helferich et.al. 2009 Helfrich, Silke, Böll Stiftung Hrsg.: „Wem gehört die Welt? Zur Wiederentdeckung der Gemeingüter. Ökom Verlag 2009, (abrufbar im Netz: http://www.boell.de/downloads/Netzausgabe_Wem_gehoert_die_Welt.pdf, Stand 09.Januar 2012)
- Hermann et al. 2009 Hermann, A., Acker H., Schönherr, N., Möller, M., Quack, D., Schumacher, K., Günther, E., Stechemesser, K.: „Analyse des öffentlichen Beschaffungswesens in Deutschland am Beispiel der Bundesebene und Maßnahmen zu seiner noch umweltfreundlicheren Ausrichtung“, Hrsg. Öko-Institut, 2009 (Online verfügbar: https://www.umweltbundesamt.de/produkte/beschaffung/doks/endbericht_beschaffungswesen_deutschland.pdf, abgerufen 14.11.2011)

- Hermann et.al. 2011 Hermann, A., Acker, H.: „Regelungen der BundesFederal States auf dem Gebiet der öffentlichen Beschaffung“, Umweltbundesamt, Dessau 2011 (Online verfügbar: <http://www.umweltdaten.de/publikationen/fpdf-l/4160.pdf>, abgerufen 14.11.2011)
- Hohlmeier 2012 Monika Hohlmeier, <http://www.csu-europagruppe.de/seiten/monikahohlmeier122012.htm>, Oberfranken, 2012
- HR 2011 Hessischer Rundfunk (2011): Frisch auf den Müll – Wie verlässlich ist das Haltbarkeitsdatum, download 2011, http://www.hr-online.de/website/fernsehen/sendungen/index.jsp?rubrik=65837&key=standard_document_41320381
- IFEU 2007 IFEU-Institut Heidelberg, Ableitung von Kriterien zur Beurteilung einer hochwertigen Verwertung gefährlicher Abfälle, im Auftrag des Umweltbundesamtes (FKZ 202 35 310); Heidelberg 2007
- IFEU 2010 Hochwertige Verwertung von Bauschutt als Zuschlag für die Betonherstellung, Studie im Auftrag des Ministeriums für Umwelt, Naturschutz und Verkehr Baden-Württemberg, Heidelberg 2010
- Inglehart 1998 Inglehart, Ronald: „Modernisierung und Postmodernisierung. Kultureller, wirtschaftlicher und politischer Wandel in 43 Gesellschaften“, Frankfurt a. M./New York 1998
- IPP Bayern o.J. IPP Bayern “Integrierte Produktpolitik – ein Projekt von Staat und Wirtschaft im Rahmen des Umweltpaktes Bayern”, <http://www.ipp-bayern.de/content/content2.php?CatID=1&NewsID=65&lang=de>
- IPP Hamburg o.J. IPP Netzwerk Hamburg: „Aufbau und Pflege eines regionalen Netzwerkes zur umweltfreundlichen Produktenwicklung“, Rahmenvorhaben der Umweltbehörde Hamburg zur Umsetzung der Integrierten Produktpolitik, 2011-2013; Auftragnehmer Ökopol Institut GmbH, ecoo GmbH, ecomedia und Ingenieurbüro Arhelger, www.klima.hamburg.de/ipp
- IVM 2008 IVM (Institute for Environmental Studies [Niederlande]) et al.: "The use of differential VAT rates to promote changes in consumption and innovation", 2008. Abschlussbericht Europäische Kommission, GD Umwelt 070307/2007/482673/G1 (Online verfügbar: http://ec.europa.eu/environment/enveco/taxation/pdf/vat_final.pdf, abgerufen 14.11.2011)
- Janz/ Bilitewski 2007 Janz, A.; Bilitewski, B. (2007): Elektrische und elektronische Altgeräte im Restabfall nach Umsetzung des ElektroG. In: Müll und Ab-fall 7/2007, S. 325-327.
- Jepsen, Spengler 2012 Jepsen, D., Spengler, L.: „Kritische Prüfung der Produktbeispiele aus der CSES-Evaluationsstudie“, Teilbericht im Rahmen des Gesamtvorhabens „Integration von Ressourcenschutzaspekten in die EU Ökodesign-Richtlinie“, UFOPLAN-Vorhaben FKZ 3708 95 300,im Auftrag des Umweltbundesamtes, (laufend)
- Jepsen/Tebert, 2003 Deutsches Hintergrundpapier zum Informationsaustausch für Anlagen zur Oberflächenbehandlung durch Appretieren, Imprägnieren, Bedrucken, Tränken,

- Beschichten (STS-BREF) - Teilband II "Bedrucken", im Auftrag des Umweltbundesamtes.UFOPLAN-Vorhaben FKZ: 200 94 324, 2000-2003
- Jönbrink 2007 Jönbrink A.K.: Preparatory studies for Ecodesign Requirements of EuPs – Lot 3: Personal Computers (desktops and laptops) and Computer Monitors, August 2007
- Kahlenborn/ Freier 2005 Kahlenborn, W./ Freier, I.: Umweltmanagementansätze in Deutschland. Studie im Auftrag von UBA und BMU, Dessau/Berlin, 2005
- KEMI 2009 Jepsen, D., Luskow, H., Wirth, D., Bunke, D.Groß, R.: „REACH Trigger for Information on Substances of Very High Concern (SVHC) – An Assessment of the 0.1 %Limit in Articles“, Studie für die Schwedische Chemikalien Inspektion (KEMI); Auftrag der Kooperation der nordischen Federal States , 2009
- Kemna et al. 2011 Kemna, R., Azais, N., van Elburg, M., van der Voort, M., Li, W.: „MEErP 2011 – Methodology für Ecodesign of Energy-related Products“, Studie für die Generaldirektion Industrie der EU Kommission, Brüssel/Delft Dezember 2011
- Kerp 2009 Kerp: Leitfaden für die Wiederverwendung von Elektroaltgeräten in Österreich. Online verfügbar unter:
http://www.kerp.at/fileadmin/_dokumente/ReUsePlattform_Intern/ReuseLeitfadenEAG.pdf, 2009, abgerufen am 5.4.2012
- Kersten et al. 2011 Kersten, Antje; Hamm, Dr. Udo; Putz; Dr. Hans-Joachim; Schnabel, Prof. Dr. Samuel: „Zur Diskussion um die Migration von Mineralöl in Lebensmittel und das Altpapier-Recycling“, Beitrag des Fachgebiet Papierfabrikation und Mechanische Verfahrenstechnik (PMV) der Technischen Universität Darmstadt, 2011
- KfW 2011 KfW Bankengruppe 2011: Geschäftsbericht 2010, Seite 23, Frankfurt 2011
- KfW Förderreport 2012 KfW Bankengruppe: Förderreport 12 - 2011, Seite 162, Frankfurt 2012
- kfz.net 2011 Zahlen der Neuzulassungen im Jahr 2009, download 2011,
<http://www.kfz.net/news/neuzulassungen/>
- Klement o.J. Klement, J.: Literaturstudie zur Abfallvermeidung, Modul 1, o.J.
- KlimaNet 2012 Ministerium für Umwelt, Klima und Energiewirtschaft, Baden-Württemberg: KlimaNet. <http://www.um.baden-wuerttemberg.de/servlet/is/42140/> abgerufen am 16.02.2012
- Kopacek 2003 Prof. Dr. Dr. hc. mult. Peter Kopacek u.a.: Strategieentwicklung zur Verbreitung abfallvermeidender Produktdienstleistungssysteme im Elektro- und Elektronikbereich für Wien, Wien 2003
- Kopytziok 1992 Kopytziok, Norbert: Weiterbildung von Multiplikatoren in der Ökologischen Abfallwirtschaft. In: Büro für Umweltpädagogik (Hrsg.): Öffentlichkeitsarbeit in der Abfallwirtschaft. Dokumentation, Göttingen 1992, S. 267 - 273.
- Kopytziok 2001 Kopytziok, Norbert: Sachgebiet Abfall: Vermeidung ökologischer Belastungen. Die ökologische Wirksamkeit der Vermeidung und Verwertung von Siedlungsabfall. 2. Aufl. Berlin 2001, S. 84

- Kopytziok 2005 Kopytziok, N.: Gestaltungsrahmen der Produzentenverantwortung. In: Bilitewski, Schenkel, Schnurer, Zeschmar-Lahl (Hg.): Müll-Handbuch, Kennzahl 8504.2, Berlin 2005
- Kopytziok 2006 Kopytziok, Norbert: Weiterverwendung mit Spaß. Sperrmüll-Märkte ergänzen die kommunale Sperrmüll-Entsorgung. In: MüllMagazin, Heft 3, Oktober 2006, S. 43
- Kopytziok 2007 Kopytziok, Norbert: Von NUTZbar, brauchBAR und Recycl Bar. Rohstoff- und energiesparende Nutzungskonzepte kommen wieder in Mode. In: MüllMagazin, Heft 3, Oktober 2007, S. 41 - 43.
- Kopytziok 2008 Kopytziok, Norbert: Regionale Weiterverwendung von Gebrauchsgegenständen. Projekterfahrungen zum Ressourcenschutz in einem Berliner Stadtgebiet. In: Bilitewski, Bernd; Schnurer, Helmut; Zeschmar-Lahl, Barbara (Hrsg.): Müll-Handbuch, Kennzahl 1419, Berlin 2008
- Kopytziok 2011 Kopytziok, N.: Maßnahmen zur Abfallvermeidung vor dem Hintergrund von Lebensweguntersuchungen. In: Müll und Abfall, Heft 4, April 2011, S. 152 – 157
- Kopytziok/Pinn 2010 Kopytziok, Dr. Norbert / Pinn, Gudrun: „Abfallvermeidung und -trennung auf Märkten und Straßenfesten“, wissenschaftliche Studie im Auftrag der Stiftung Naturschutz, Berlin 2010
- LAI 2010 „Mitwirkung der Federal States beim Vollzug der IVU-Richtlinie und bei der Erarbeitung der BVT-Merkblätter“ Gemeinsamer Bericht der Bund/Länder-Arbeitsgemeinschaft für Immissionsschutz und der Bund/Länder-Arbeitsgemeinschaft Wasser, 2010
- LAI MVwV, 2005 Allgemeine Musterverwaltungsvorschrift des LAI zur Vermeidung, Verwertung und Beseitigung von Abfällen nach § 5 Abs. 1 Nr. 3 BImSchG, Stand 28.09.2005
- LAI MVwV-Phosphatieranlagen, 2003: Musterverwaltungsvorschrift des LAI zur Vermeidung und Verwertung von Abfällen nach § 5 Abs. 1 Nr. 3 BImSchG bei Anlagen nach Nr. 3.10 - neu -, Spalte 1 des Anhangs zur 4. BImSchV (vgl. auch Nr. 2.6 des Anhangs I der IVU-Richtlinie 96/61/EG vom 24.09.1996) Anlagen zur Oberflächenbehandlung von Metallen oder Kunststoffen durch ein elektrolytisches oder chemisches Verfahren mit einem Volumen der Wirkbäder von 30 Kubikmeter oder mehr (hier: Phosphatieranlagen)
- Langner 2011 Langner, T.: Klimadetektive in der Schule – eine Handreichung, Umweltbüro Nord e.V. Stralsund (Hrsg.), II. erweiterte Auflage 2011.
- LANUV 2011 Teufel J., Gattermann M., Brommer E., Stratmann B.: Grobscreening zur Typisierung von Produktgruppen im Lebensmittelbereich in Orientierung am zu erwartenden CO₂e-Fußabdruck, 2011
- Lebensmittelbank 2012 Lebensmittelbank AixEuregio Aachen e.V.: Helfen mit allen Lebensmitteln: Die Idee der Lebensmittelbank; download 2012:
http://www.lebensmittelbank.de/download.php?cat=10_Downloads&file=Flyer_Lebensmittelbank_210609.pdf
- LFL 2007 Agarmärkte Jahresheft 2007, Bayerische Landesanstalt für Landwirtschaft

- LGRB BaWü 2006 Landesamt für Geologie, Rohstoffe und Bergbau Baden-Württemberg(Hrsg.): Rohstoffbericht Baden-Württemberg 2006. Gewinnung, Verbrauch und Sicherung von mineralischen Rohstoffen, Freiburg 2006 (LGRB-Informationen 18)
- Lindhqvist/Lidrgren 1990 Lindhqvist, Thomas, Lidrgren, Karl (1990): Model for Extended Producer Responsibility. In: Umweltministerium Schweden: From the Cradle to the Grave – six studies of the environmental impacts of products. 7-44; Stockholm.
- Lindhqvist 2000 Lindhqvist, Thomas: Extended Producer Responsibility in Cleaner Production. Lund 2000
- Manhart et al. 2011 Manhart, A., Osibanjo, O., Aderinto, A., Prakash, S.: Informal e-waste management in Lagos, Nigeria – socio-economic impacts and feasibility of international recycling co-operations, Lagos/Freiburg 2011
- Manhart/Buchert 2011 Manhart, A., Buchert, M.: Ressourceneffizienz grenzüberschreitender Stoffströme: Erfahrungen aus verschiedenen ressourcenbezogenen Projekten & Überlegungen zur verbesserten internationalen Kreislaufführung von Metallrohstoffen, Bonn 2011
- Mankiw 1998 Mankiw, Nicholas Gregory: „Grundzüge der Volkswirtschaftslehre“, Stuttgart 1998
- MARESS 2010 Rohn H., Pastewski N., Lettenmeier M.: Technologien, Produkte und Strategien – Ergebnisse der Potenzialanalysen, Wuppertal, November 2010.
- MARESS AP 1 2010 Materialeffizienz und Ressourcenschonung: Dr. Kora Kristof / Prof. Dr. Peter Hennicke, Ergebnisse des Projekts „Materialeffizienz und Ressourcenschonung“ (MaRes) für die Großkonferenz „Ressourceneffizient – Motor für ein Grünes Wachstum, Berlin, 2010
- MARESS AP12 2009 Scholl, Gerd; Baedeker, Carolin; Bietz, Sabine; Kristof, Kora; Onischka, Mathias; Otto, Siegmär; Reisch, Lucia; Rubik, Frieder; Schmitt, Martina: "Konsumenten- und kundennahe Instrumente der Ressourcenpolitik", Meilensteinbericht Arbeitspaket 12 des Projekts „Materialeffizienz und Ressourcenschonung“ (MaRes), Arbeitsschritt 12.1, Ressourceneffizienz-Paper 12.1, Wuppertal 2009
- MARESS AP12 2011 Scholl, Gerd; Bietz, Sabine; Kristof, Kora; Otto, Siegmär; Reisch, Lucia; Rubik, Frieder; Süßbauer, Elisabeth: "Maßnahmenvorschläge für eine konsumbezogene Ressourcenpolitik", Meilensteinbericht Arbeitspaket 12 des Projekts „Materialeffizienz und Ressourcenschonung“ (MaRes), Arbeitsschritt 12.2, Ressourceneffizienz-Paper 12.6, Berlin 2011
- MARESS AP14 2010 Irrek, W., Jepsen,D., Reintjes,N.: „Abfallvermeidende und recyclinggerechte Konstruktion – Operationalisierbarkeit für die Ökodesign-Richtlinie“, UBA Fachgespräch März 2010, im Rahmen Arbeitspaket 14 des Projekts „Materialeffizienz und Ressourcenschonung“ (MaRes); Dokumentation unter : <http://www.umweltbundesamt.de/produkte/oekodesign/EbP-fg-recycling.htm>
- MARESS AP3 2010 Bahn-Walkowiak, B., Wilts, W., Bleischwitz, R., Sanden, J.: „Differenzierte Mehrwertsteuersätze zur Förderung eines ressourceneffizienteren Konsums“, Meilenstein zu AS3.2: Maßnahmenvorschläge zur Ressourcenpolitik zur Gestaltung der Rahmenbedingungen, Paper zu Arbeitspaket 3 des Projekts „Materialeffizienz und Ressour-

- censchonung“ (MaRess), Ressourceneffizienzpaper 3.6, Wuppertal Institut für Klima, Umwelt, Energie GmbH, Wuppertal 2010
- MARESS AP4 2010 Görlach, Stephanie; Schmidt, Mario: Feinanalysenpapier für den Bereich Public Efficiency Awareness & Performance. Arbeitspapier zu Arbeitspaket 4 des Projekts "Materialeffizienz und Ressourcenschonung" (MaRess). Wuppertal 2010.
- MARESS AP5 2010 Distelkamp, M., Meyer, B. & Meyer, M.: Quantitative und qualitative Analyse der ökonomischen Effekte einer forcierten Ressourceneffizienzstrategie. Kurzfassung der Ergebnisse des Arbeitspakets 5 des Projekts „Materialeffizienz und Ressourcenschonung“ (MaRess), Ressourceneffizienz Paper 5.2, ISSN 1867-0237, Wuppertal 2010
- McKinsey 2008 McKinsey & Company, Inc., für das BMU: Potenziale der öffentlichen Beschaffung für ökologische Industriepolitik und Klimaschutz, November 2008 (Online verfügbar: <http://www.bmu.de/files/na/application/pdf/mckinseystudie.pdf>, abgerufen 14.11.2011)
- Mineralölwirtschaft e.V. 2011 Online-verfügbare Datenbank des Mineralölwirtschaftsverbandes e.V. (2011): MWV Mineralölzahlen als Excel-Datei mit Daten zu Kapazitäten, zur Mineralölein- und -ausfuhr, zum Mineralölverbrauch, zu Preisen und zum Weltölmarkt, 2010, download 2011, <http://www.mwv.de/index.php/daten/statistikeninfoportal>
- MLUR 2011 Erarbeitung von Maßnahmenvorschlägen zur Abfallvermeidung in Schleswig-Holstein, Öko-Institut, ÖKOPOL, Stoffstromdesign, Darmstadt, Hamburg, Kiel 2011
- MWV 2009 Mineralölwirtschaftsverband (Hrsg.), Jahresbericht Mineralöl-Zahlen 2009, Berlin 2010
- nachhaltigkeit.org 2011 Hülsmann M.: Tägliche Verschwendung, download 2011, <http://www.nachhaltigkeit.org/201104257214/materialien-produkte/beitrage/taegliche-verschwendung>
- NÖ 2005 Amt der Niederösterreichischen Landesregierung: Niederösterreichischer Abfallwirtschaftsplan (AWP 2004), St. Pölten März 2005
- OECD 2000 Organization for Economic Cooperation and Development: „Strategic Waste Prevention“; OECD Reference Manual, Paris, 2000
- OECD 2001 Organization for Economic Cooperation and Development: Extended Producer Responsibility – A Guidance Manual for Governments. Paris 2001
- OECD 2002 Organization for Economic Cooperation and Development: OECD Workshop on Waste Prevention: “Towards Performance Indicators“, Paris, 2002
- OECD 2004 Organization for Economic Cooperation and Development: “Towards Waste Prevention Performance Indicators“. Workshop-Dokumentation. ENV/EPOC/WGWPR/SE(2004)1/FINAL, 2004, Paris.
- Oehme et al 2009 Oehme, I., Halatsch, A., Schuberth, J., Mordziol, S.: „Umweltgerechte Gestaltung energiebetriebener Produkte -Der Beitrag der Ökodesign-Richtlinie zu den Energieeffizienzzielen der EU, Publikation des Umweltbundesamt als Texte 21/2009, Dessau-Roßlau, Juli 2009

- Öko-Institut 2007 Öko-Institut e.V.: Treibhausgasemissionen durch Erzeugung und Verarbeitung von Lebensmitteln – Arbeitspapier, Freiburg 2007
- Öko-Institut 2011 Öko-Institut e.V.: Erarbeitung von Maßnahmenvorschlägen zur Abfallvermeidung in Schleswig-Holstein. Berlin/Hamburg 2011
- Öko-Institut 2012 Pressemitteilung des Öko-Instituts: Elektronikschrott in Afrika: Risiken und Chancen, Freiburg/Berlin, Februar 2012
- Öko-Institut/BCCC-Nigeria 2011 UNEP SBC E-waste Africa Project: Building local capacity to adress the flow of e-wastes and electrical and electronic products destined for reuse in selected African countries and augment the sustainable management of resources through the recovery of materials in e-wastes. Contribution to component 3: Informal e-waste management in Lagos, Nigeria - socio-economic impacts and feasibility of international recycling co-operations. Freiburg/Germany & Ibadan/Nigeria 2011
- Öko-Institut/ICLEI 2011 Öko-Institut e.V./ ICLEI - Local Governments for Sustainability: Umweltfreundliche öffentliche Beschaffung: Bewusstsein schärfen, Möglichkeiten kennen – Schulungsangebote zur Sensibilisierung und Stärkung der Fähigkeiten der öffentlichen Verwaltung, Gefördert durch das Umweltbundesamt mit Mitteln des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, Berlin, Freiburg 2011
- Ökopol 1999 Branchenuntersuchung „Ermittlung des Standes der Technik und der Emissionsminderungspotentiale zur Senkung der VOC-Emissionen aus Druckereien“, UFOPLAN-Vorhaben Nr. 297 44 906/01 im Auftrag des Umweltbundesamtes.
- Ökopol 2010 Sander, K., Schilling, S., Ökopol GmbH: Optimierung der Steuerung und Kontrolle grenzüberschreitender Stoffströme bei Elektroaltgeräten/Elektroschrott, Hrsg.: Umweltbundesamt, Dessau 2010
- Ökopol, Branchendatenbank DruckBranchendatenbank (mitStrukturinformationen und Stoffflussinformationen für ca. 340 Druckanlagen), unveröffentlicht
- Ökopol/B.A.U.M 1997 Branchengutachten, Untersuchung von Druckereien im Rahmen des Beratungsprogramms zur Reststoffvermeidung und Verwertung in BaWü, Handbuch 1, Abfall, Lfu. Karlsruhe
- Ökopol/vdn 1999 Jepsen, D., Wilkesmann, C.: „Entwicklung und Implementation von Abfallwirtschaftskonzepten in 18 niedersächsischen Druckbetrieben“ Kooperation von Ökopol und dem Verband der Druckindustrie Niedersachsen (vdn) im Auftrag des Niedersächsisches Umweltministerium, 1997-1999
- Ökoprofit 2011 Ökoprofit – Arbeitsmaterialien; Arbeit; Hrsg.: Landeshauptstadt München, Referat für Arbeit und Wirtschaft u. Referat für Gesundheit und Umwelt, München 2011
- Omann, Schwerd 2003 Omann, I., Schwerd, J.: „Die Materialinputsteuer – ein neues Instrument nachhaltiger Entwicklung. Konzeption, Realisierung und Wirkung“, in: Vision 2020 Arbeit, Umwelt, Gerechtigkeit: Strategien für ein zukunftsfähiges Deutschland, Hrsg. Spangenberg, J., ökom Verlag, München, 2003, S.203-220 (Online verfügbar: [http://web205.vbox-01.inode.at/Data/personendaten/sl/2003 % 20Vision%202020 % 20Lorek.pdf](http://web205.vbox-01.inode.at/Data/personendaten/sl/2003%20Vision%202020%20Lorek.pdf), abgerufen 14.11.2011)

- ÖÖC 2008 ÖÖC: „Vergleichende Ökobilanz verschiedener Bechersysteme bei Getränkeaus-schank an Veranstaltungen“, Ökologieinstitut, Wien, CARBOTeCH, Basel, Öko-Insti-tut, Darmstadt 2008
- ÖÖI 2004 Österreichisches Ökologie-Institut: Abfallvermeidung Wien-Alsergrund – Erarbei-tung eines Abfallvermeidungskatalogs und Durchführung von Pilotprojekten im Rahmen der der Lokalen AGENDA 21 im Alsergrund, Wien 2004
- Ord & DiCorcia 2005 Ord J., DiCorcia T.: Life Cycle Inventory for an Inkjet Printer, University of Michigan, Ann Arbor December 2005
- Ostrom 1990 Ostrom, Elinor: „Governing the Commons: The Evolution of Institutions for Collec-tive Action. Cambridge University Press, Cambridge 1990
- Pfaff, Hutzler,2010 Pfaff, K., Hutzler, C.: Gesundheitliche Bewertung der Übergänge von Mineral-ölen. Vortrag Workshop: „Mineralölanalytik im Lebensmittelbereich“ 10./11.06.2010, Zürich
- Pladerer et al. 2010 Pladerer, C; Meissner, M; Schweighofer, J: Abfallvermeidung und Abfalltren-nung in Schulen und Kinderbetreuungsstätten der Stadt Wien. Österreichisches Ökologie-Institut. Wien 2010
- Prakash et al. 2010 Prakash S., Brommer E., Manhart A.: Prosa Tragbare Computer – Entwicklung der Vergabekriterien für ein klimaschutzbezogenes Umweltzeichen, Studie im Rah-men des Projekts „Top 100 – Umweltzeichen für klimarelevante Produkte“. Öko-In-stitut, Freiburg, Dezember 2010
- Prakash/Manhart 2010 Prakash, S., Manhart A.: Socio-economic assessment and feasibility study in sustainable e-waste management in Ghana, Freiburg 2010
- PricewaterhouseCoopers 2011 Mehrweg- und Recyclingsysteme für ausgewählte Getränkeverpackun-gen aus Nachhaltigkeitssicht, im Auftrag der DUH, Berlin 2011
- Prognos 2009 Glöckner, U., Struwe, J.: „Evaluierung des BMU-Innovationsprogramms – Abschluss-bericht“ Berlin, Juli 2009
- Prognos 2010 PROGNO AG: Ergebnisse und Empfehlungen aus der Evaluierung des BMU-Innova-tionsprogramms 1999 – 2008, Berlin, 06. Mai 2010
- ProgRess 2011 Programm zum Schutz natürlicher Ressourcen in einer ökologisch-sozialen Markt-wirtschaft, Version 3.0 final, Berlin 2011
- Pürer, Raabe 2007 Pürer H., Raabe J.: Presse in Deutschland, UVK Verlagsgesellschaft mbH, Konstanz 2007.
- Quack 2003 Quack, D. (2003): Ermittlung der durch die Wiederverwendung von gebrauchten Bauteilen realisierbaren Energieeinsparpotenziale und CO₂-Reduktionspotenziale. Freiburg.
- Quack et.al. 2010 Quack, D., Acker, H., Günther, E., Möller, M., Stechemesser K.: „Umweltfreundliche Beschaffung: Schulungsskripte“, Umweltbundesamt, Dessau, Mai 2010 (Online ver-fügbar:<http://www.umweltdaten.de/publikationen/fpdf-l/3951.pdf>, abgerufen 14.11.2011)

- Rabelt 2007 Rabelt, Vera; Simon, Karl-Heinz; Weller, Ines; Heimerl, Angelika (Hrsg.): „Nachhaltiger nutzen : Möglichkeiten und Grenzen neuer Nutzungsstrategien“, Oekom Verlag, München, 2007
- RAL 2009 RAL gGmbH (2009): Vergabegrundlage für Umweltzeichen: Waschmaschinen für den Hausgebrauch. RAL-UZ 137. Sant Augustin
- RAL 2011 RAL gGmbH (2011): Vergabegrundlage für Umweltzeichen: Tragbare Computer. RAL-UZ 78d. Sant Augustin
- Reinhardt et al. 2009 Reinhardt G., Gärtner S., Münch J., Häfele S.: Ökologische Optimierung regional erzeugter Lebensmittel: Energie- und Klimagasbilanzen, ifeu, Heidelberg 2009,.
- Reisinger, Krammer 2007 Hubert Reisinger, Hans-Jörg Krammer: Weißbuch Abfallvermeidung und -verwertung in Österreich, Report, Bd. REP-0083, Umweltbundesamt, Wien 2007
- Reith 2011 Reith, S. (2011): Einfluss der direkten Zweitnutzung energieintensiver Materialien auf die Energiewirtschaft. Masterarbeit am Karlsruhe Institute for Technology, Karlsruhe.
- Residua Ltd. 2008 Residua Limited, Plastic Bags – Policies and practices to reduce consumption. Assessing the application of policies to lightweight single use polyethylene plastic bags, 2008
- Rüdenauer et al. 2004 Rüdenauer I., Griebhammer R., Götz K., Birzle-Harder B.: PROSA Waschmaschinen, Öko-Institut, Freiburg 2004
- Rüdenauer et al. 2005 Rüdenauer I., Gensch C.-O., Quack D.: Eco-Efficiency Analysis of Washing machines, Öko-Institut, Freiburg 2005
- RWI 2003 Clausen, H., Trettin, L.: „Förderung von Demonstrationsvorhaben im Umweltbereich – Mitnahmeeffekte und Finanzierungsoptionen“, Rheinisch, Westfälisches Institut für Wirtschaftsforschung, 2003
- Salhofer et al. 2000 Salhofer, St.; Graggaber, M.; Grassinger, D. et al.: Potenziale und Maßnahmen zur Vermeidung kommunaler Abfälle am Beispiel Wiens, Magistratstabteilung 22, Wien. Dezember 2000
- Schäfer 2004 Schäfer T.: Untersuchungen zur Dispersion und ihren Auswirkungen beim Übergang aus der Nutzungsphase in das Recycling, Diss., Aachen 2004
- Schmidt-Bleek et.al. 1995 Schmidt-Bleek, Franz.; Liedtke, C.: Umweltpolitische Stichworte, Wuppertal Papers Nr. 30, März, Wuppertal Institut für Klima Umwelt Energie, 1995
- Schneider, Lebersorger 2010 Felicitas Schneider, Sandra Lebersorger: Unterlage „Lebensmittel im Abfall“ für das Abfallvermeidungsprogramm 2011, Wien, 2010
- Schneider, Wassermann 2004 Felicitas Schneider, G. Wassermann: SoWe – Sozialer Wertstofftransfer im Einzelhandel, Wien, 2004
- Scholl 1998 Scholl, Gerd: Beschäftigungsimplikationen und ökologische Wirkungen einer Verlängerung und Intensivierung der Produktnutzung. Discussion-paper des Wissenschaftszentrum Berlin für Sozialforschung (WZB), Querschnittsgruppe Arbeit und Ökologie, Berlin, 1998

- Scholl/Winfried 2004 Scholl, Gerd; Konrad, Wilfried: Verbraucherakzeptanz von Nutzungsstrategien. Diskussionspapier des Instituts für ökologische Wirtschaftsförderung, Berlin 2004
- Schomerus/Spengler 2011 Schomerus, T, Spengler L.: Möglichkeiten und Grenzen der Berücksichtigung von nicht-energiebezogenen Ressourcenaspekten im Rahmen der Umsetzung der EU-Ökodesign-Richtlinie
- Schröter et.al. 2011 Schröter, Marcus; Lerch, Christian; Jäger, Angela: Materialeffizienz in der Produktion: Einsparpotenziale und Verbreitung von Konzepten zur Materialeinsparung im Verarbeitenden Gewerbe. Endberichterstattung an das Bundesministerium für Wirtschaft und Technologie (BMWi). Fraunhofer-Institut für System- und Innovationsforschung (ISI). Karlsruhe 2011.
- Schüler, Dittrich 2011 Schüler D., Dittrich S.: Eine nachhaltige Seltene Erden-Ökonomie für Europa, Öko-Institut, Darmstadt 2011
- Schweimer et al. 1999 Schweimer, G. W.; Bambl, T.; Wolfram, H.: Sachbilanz des SEAT Ibiza. Wolfsburg: Volkswagen AG 1999
- Secretariat of the Basel Convention 2011 Where are WEEE in Africa? Findings from the Basel Convention E-Waste Africa Programme; Basel, December 2011
- Sharp et al. 2010 Sharp, V.; Giorgi, S.; Wilson, C.: Methods to monitor and evaluate household waste prevention. In: Waste Management & Research, 2010, S. 269-280, 2010
- Spitzbart et al 2009 Spitzbart, M. et al.: ReUse-LeitfadenEAG: Leitfaden für die Wiederverwendung von Elektroaltgeräten in Österreich, Ergebnis des österreichweiten Stakeholderprozesses im Rahmen der ReUse-Plattform. Studie im Auftrag des Lebensministeriums Österreich, Wien, Oktober 2009
- SRU 2002 Sachverständigenrat für Umweltfragen: „Umweltgutachten 2002“. Wiesbaden 2002
- Stahel 1993 Stahel, Walter R.: Langlebigkeit und Materialrecycling: Strategien zur Vermeidung von Abfällen im Bereich der Produkte: Vertiefungsstudie zur Langlebigkeit und zum Materialrecycling Abfällen im Bereich der Produkte. Schlussbericht der Vulkan-Verlag, Essen 1993
- Stahl et. al. 2006 Stahl, H., Hochfeld, C., Schmied, M.: Green Goal TM - Legacy Report, Das Umweltkonzept zur FIFA WM 2006, Öko-Institut e.V.; DFB, hrsg. vom OK FIFA, BMU, Darmstadt, Frankfurt 2006; download: <http://www.oeko.de/oekodoc/293/2006-012-de.pdf>
- Stampfl 2011 Stampfl, Nora: „Generation Nutzwert: Carsharing war erst der Anfang – die Wirtschaft ändert die Spielregeln aller Branchen.“, in: ChangeX: in die Zukunft denken, Berlin 2011
- Steding 2004 Steding, Dirk: „Carsharing als umweltentlastende Nutzungsstrategie?“, in: Steding, Dirk, Herrmann, Annett, Lange, Manfred (Hrsg.): „Carsharing - sozialinnovativ und kulturell selektiv? : Möglichkeiten und Grenzen einer nachhaltigen Mobilität“, Forschungsprojekt ZUSOMO, Münster, 2004
- Steinberger et. al. 2009 Steinberger, J.; Friot, D.; Joliet, O.; Erkman, S.: A spatially explicit life cycle inventory of the global textile chain. In: International Journal of Life Cycle Assessment. Vol. 14/2009, S. 443-455, Berlin/Heidelberg.

- Stobbe 2007 Stobbe L.: EuP Preparatory Studies "Imaging Equipment" (Lot 4) – Final Report on Task 5 "Definition of Base Cases", Fraunhofer Institute for Reliability and Microintegration, IZM, Berlin, November 2007
- STS-BREF Reference document on Surface Treatment Using Organic Solvents, May 2007, <http://eippcb.jrc.es/reference/sts.html>
- Sullivan 2006 Sullivan D.E.: Recycled Cell Phones – A Treasure Trove of Valuable Metals, US Geological Survey, Fact-Sheet 2006-3097
- The Swedish Environmental Protection Agency (2005): "The Top Runner Program in Japan: its effectiveness and implications for the EU", Stockholm 2005
- Trendbüro u. a. 2008 Trendbüro u. Prof. Homburg & Partner, Herausgeber eBay GmbH: Auktionskultur: Leben im Jetzt, Besitzen auf Zeit, Hamburg-Mannheim, 2008
- TU Berlin 2000 Technische Universität Berlin: Umweltschutz im Krankenhaus – Machbarkeitsuntersuchung über nachhaltiges Wirtschaften, Berlin, März 2000
- UBA 1998 Umweltbundesamt: Vergleich der Umweltauswirkungen von Polyethylen- und Papiertragetaschen, Berlin 1988
- UBA 2007 Umweltbundesamt (UBA): „Ökonomische Bewertung von Umweltschäden: Methodenkonvention zur Schätzung externer Umweltkosten“, Dessau, 2007 (Online verfügbar: <http://www.umweltdaten.de/publikationen/fpdf-l/3193.pdf>, abgerufen 14.11.2011)
- UBA 2008 Umweltbundesamt: Plastiktüten verbieten? Dessau 2008
- UBA 2010 Umweltbundesamt (Hrsg.), Umweltschädliche Subventionen in Deutschland, Dessau-Roßlau 2010
- UBA 2012 Schlacke, Sabine, Stadermann, Michael, Grunow Moritz: „Rechtliche Instrumente zur Förderung des nachhaltigen Konsums – am Beispiel von Produkten“, UBA, Berlin 2012
- UBA Ö 2005 Umweltbundesamt Österreich, Evaluierung EU BAT Dokument „MINERAL OIL AND GAS REFINERIES, Wien 2005
- UBA/BMU 2005 Umweltbundesamt (UBA)/ Bundesumweltministerium (BMU): Hintergrundpapier zur Studie Umweltmanagementansätze in Deutschland. Dessau, 2005 (Online verfügbar: <http://www.pius-info.de/dokumente/download/504/>, abgerufen 14.11.2011)
- UBA-Texte 11/97 de Man, R., Ankele, K., Claus, F., Fichter, K.; Völkle, E.: „Aufgaben des betrieblichen und betriebsübergreifenden Stoffstrommanagements“
- UIP-Förderrichtlinie Richtlinie des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit zur Förderung von Investitionen mit Demonstrationscharakter zur Verminde- rung von Umweltbelastungen vom 04. Februar 1997
- Umweltschulen 2012 Umweltbildung-Umweltberatung Tilman Langer: Umweltschutz, Umweltbi- lung und Bildung für nachhaltige Entwicklung in Schulen <http://www.umweltschulen.de/abfall/index.html> abgerufen am 16.02.2012
- UNEP NEWS CENTRE 2012 Domestic Consumption is Main Contributor to Africa's E-Waste; download:

<http://www.unep.org/newscentre/Default.aspx?DocumentID=2667&ArticleID=9022&l=en>

- Universität Stuttgart 2012 Iswa-Institut Universität Stuttgart: Ermittlung der weggeworfenen Lebensmittelmengen und Vorschläge zur Verminderung der Wegwerfrate bei Lebensmitteln in Deutschland, im Auftrag des Bundesministeriums für Ernährung, Landwirtschaft und Verbraucherschutz, Februar 2012, Online verfügbar: http://www.bmelv.de/SharedDocs/Downloads/Ernaehrung/WvL/Studie_Lebensmittelabfaelle_Kurzfassung.html, abgerufen am 15.03.2012
- v. Gleich et. al 2004 v. Gleich, A., Jepsen, D., Brahmer-Lohss, M., Gottschick, M., Sander K.: „Nachhaltige Metallwirtschaft Hamburg - Effizienzgewinne durch Kooperation bei der Optimierung von Stoffströmen in der Region Hamburg“, Projektbericht im Rahmen der BMBF-Förderinitiative „Modellprojekte für Regionales Nachhaltiges Wirtschaften“, Hamburg 2004, <http://www.nachhaltige-metallwirtschaft.de/>
- v. Lersner 2009 von Lersner et. al: „Kommentierung des KrW-/AbfG und weiterer abfallrechtlicher Gesetze und Verordnungen“, 0123, S.8, in von Lersner/Wendenburg „Recht der Abfallbeseitigung“, Loseblattsammlung Erich Schmidt Verlag
- VCI 2010 Verband der chemischen Industrie (e.V.): Chemiewirtschaft in Zahlen, Frankfurt 2010
- VDI 2001 VDI-Richtlinie „Emissionsminderung-Rollenoffsetdruckanlagen mit Heißlufttrocknern“, VDI 2587, Blatt 1 vom November 2001 (geprüft & verlängert 2007). (In dieser VDI Richtlinie sind keine Hinweise zur Vermeidung der produktionsspezifischen Abfälle enthalten)
- VDW 2010 VDW Verband der Wellpappen-Industrie e.V., Zahlen und Fakten, Ausgabe 2010, Darmstadt
- Verbraucherzentrale Nordrhein-Westfalen 2012 Burdick, B.: Fleisch – ein kritischer Blick auf Produktion und Konsum, Verbraucherzentrale Nordrhein-Westfalen, Vortrag gehalten am 09.Februar 2012 anlässlich des Fachgespräches „Potentiale für Ressourcenschonung durch den Abbau umweltschädlicher Subventionen“, Forum ökologisch-soziale Marktwirtschaft (FÖS), Online verfügbar: http://www.foes.de/pdf/2012-02-09_AG1_Fleisch_Burdick.pdf, abgerufen am 27.02.2012
- Vorarlberg 2006 Amt der Vorarlberger Landesregierung - Abteilung Abfallwirtschaft: Vorarlberger Abfallwirtschaftsplan – 2. Fortschreibung, Bregenz 2006
- VZ BaWü 1996 Verbraucherzentrale Baden-Württemberg: „Nutzen statt Besitzen.: Mieten, Teilen, Leihen von Gütern. Ein Zukunftsmodell?“, Hrsg. Ministerium für Umwelt und Verkehr Baden-Württemberg, Heft 47 der Reihe Luft, Boden, Abfall, Stuttgart 1996
- Weltaarbericht 2012 <http://www.weltaarbericht.de/klima>; Zugriff 14.02.2012
- Wenzel et.al. 2007 Wenzel, E.; Ch. Rauch; A. Kirig: Zielgruppe LOHAS, Kelkheim 2007
- Wiedemann et al. 1995 Wiedemann, P. M.; Claus, F.; Gremler, D.: Ergebnisse des Forums ‚Abfallwirtschaft Lübeck‘, Arbeiten zur Risiko-Kommunikation, Heft 51, Forschungszentrum Jülich 1995

- Willand, Neuser 2003 Willand, Achim; Neuser, Uwe: „Rechtliche Bedingungen und Restriktionen für die Förderung neuer Nutzungsstrategien: Rechtsgutachten im Auftrag des Umweltbundesamtes“, Berlin 2003
- Wölflé & Hellwig, 2011 Wölflé, Hellwig: „Aktueller Stand aus toxikologischer Sicht“, Vortrag Mineralöle / BfR-Tagung, 22.09.2011, <http://www.bfr.bund.de/cm/343/aktueller-stand-aus-toxikologischer-sicht.pdf>
- Wolter 2011 Wolter, Hans Joachim: Die Plastiktüte - besser als ihr Ruf. Doch die EU-Kommission will sie verbieten <http://www.aktiv-online.info/Home/tabid/36/ArticleID/2429/Default.aspx> [17.10.2011] abgerufen 14.11.2011)
- WRAP 2012 Waste and Resources Action Programme: The Courtauld Commitment: http://www.wrap.org.uk/downloads/CC_Info_Sheet_12_Jan_2012.393a0af6.9220.pdf, abgerufen 28.01.2012
- WWF 2012 v. Witzke, Harald, Noleppa, Steffen, Zhirkova, Inga: „Ernährung, Fleischkonsum, Flächenverbrauch: Fleisch frisst Land“, WWF Deutschland, Berlin 2012
- YTV 2008 Waste Prevention Kit for Enterprises, Education and Households, YTV Helsinki, 2008
- Zogg 2008 Zogg, Cornelia: Plastiktaschen: besser als ihr Ruf. In: Empa-News. Die Kunden- und Publikumszeitschrift der Empa, Nr. 23, Oktober 2008
- Zollernalbkreis 2010 Abfallwirtschaftsplan des Zollernalbkreises, B S.12, 2010
- ZVEI 2008 Zentralverband Elektrotechnik und Elektronikindustrie e.V. & GfK Retail and Technology GmbH: Zahlenspiegel des deutschen Elektro-Hausgerätemarktes 2008, Frankfurt Nürnberg 2008