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Development of scientific and technical foundations for a national waste prevention programme

by

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16. Abstract This UFOPLAN project conducted by Öko-Institute and Wuppertal Institute aimed at the development of a sound data base on existing waste prevention measures by public bodies in Germany at the local, regional and federal level. It also serves as a data base for the creation of a national prevention programme, which has to be presented by the Member States until 2013 in accordance with the revised Waste Framework Directive. For this purpose existing prevention measures by public authorities at different levels in Germany and abroad are presented in tabular form ordered by their target, the level and a qualitative assessment of their prevention effect if respective data were available. Innovative public prevention policies as well as appropriate benchmarks have been identified in the scientific literature. Overall more than 290 measures in 20 countries were recorded. At the end some conclusions are drawn on possible focal points of a national waste prevention programme.		
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16. Kurzfassung

Ziel des von Öko-Institut und Wuppertal Institut durchgeführten UFOPLAN-Vorhabens war es, für Deutschland zum Komplex Abfallvermeidung eine fundierte Datenbasis über bestehende Maßnahmen der öffentlichen Hand sowie über angewandte Instrumente auf kommunaler, Länder- und Bundesebene zu schaffen. Damit wurde zugleich eine Datenbasis für die Erstellung eines nationalen Abfallvermeidungsprogramms, welche die Mitgliedstaaten gemäß der novellierten Abfallrahmenrichtlinie bis 2013 erarbeiten müssen, geschaffen.

Hierzu wurden die in Deutschland und im Ausland bestehenden Abfallvermeidungsmaßnahmen der öffentlichen Hand auf lokaler, regionaler, Landes- und Staatsebene tabellarisch dargestellt und entsprechend dem Ziel, der Ebene sowie einer qualitativen Bewertung ihrer Vermeidungswirkung, beschrieben, soweit Informationen hierfür vorliegen. Schließlich wurden neue staatliche Abfallvermeidungsmaßnahmen in der Literatur identifiziert und geeignete Benchmarks, soweit sie im Rahmen der Recherchen ermittelt wurden, beschrieben. Insgesamt wurden 296 Maßnahmen aus über 20 Ländern erfasst und erste Schlussfolgerungen für mögliche Schwerpunkte eines nationalen Abfallvermeidungsprogramms gezogen.

17.	Schlagwörter:	Abfall, Vermeidung, Best Practice, Integrierte Produktpolitik, Konsistenz		
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1 Introduction

In a new waste hierarchy the amended EU Waste Framework Directive (WFD) (2008/98/EG) confirmed the prevention of waste as a priority measure to protect the environment with regard to the production and handling of waste. Amongst others the Member States are requested to promote waste prevention. According to article 29 par. 1 WFD the prevention measures have to be planned in terms of waste prevention programmes to be created by the Member States until December 12th 2013. These prevention programmes are to describe existing waste prevention measures and set waste prevention goals. The progress is to be monitored and assessed by targeting appropriate, specific qualitative or quantitative benchmarks for adopted waste prevention measures. The programmes may be included in waste management plans or other environmental programmes. By the objectives and measures of prevention programmes the environmental impacts associated with generation of waste shall be decoupled from economic growth.

In this project within the Environmental Research Plan (UFOPLAN) the vast number of public sector measures, which do already help to reduce waste in Germany, are presented according to the parameters specified in Annex IV of the Waste Framework Directive and are complemented by corresponding measures from abroad or measures taken from the literature as a basis for the national prevention programme in Germany.

2 Objective

The aim of the research project is to provide a well-founded data base on existing measures for waste prevention by public authorities in Germany as well as instruments used on the local, state and federal level. It provides the first part of the basis for the creation of a national waste prevention programme (WPP), which has to be elaborated by the member states until 2013 according to the WFD.

Existing national waste prevention measures on the national, state, regional and local level in Germany and abroad are recorded and structured considering voluntary, regulatory, economic, and eco-specific instruments.

The systematic presentation of the measures and instruments is based on the classification of exemplary measures in Annex IV of Directive 2008/98/EC:

- Measures that could affect the framework conditions related to the generation of waste;
- measures that could affect the design and production and distribution phase and
- measures that could affect the consumption and use phase.

The measures are presented as tables and are described with regard to the target, the level and a qualitative assessment of their impact on waste prevention if there is information available for this purpose. No separate reviews of the measures on this issue have been conducted.

Finally, new public waste prevention measures are identified and appropriate benchmarks are described, if they have been identified in the research.

First, in the following chapter the terms "waste prevention" and “public sector measures" are specified on the basis of the WFD to provide a definition for this study and to make a distinction between these terms and measures regarding the recovery of waste or private measures.

3 Definition of “public waste prevention measures“

In this chapter the concepts of public measures and waste prevention are described for the use in this study.

To do so, the concepts of public measures and waste minimization are determined. Furthermore, this study discusses some relevant special cases.

3.1 Public measures

In this context the authors define measures as targeted actions or activities that are appropriate for achieving the objectives of waste prevention.

Public sector is the collective term for the entire public authorities, in particular the administrative bodies (federal, state, local, community associations) as well as the public institutions and corporations (Löser 2008). In this context the term is understood in an expanded way, also including public companies.

Public waste prevention measures are defined as measures carried out by the federal government, the Federal States or communities avoiding waste in the public sector itself. On the level of federal states the term includes all measures that are initiated by state authorities, even if they come from district governments. The municipal level includes local associations, Federal States, cities and municipalities.

These have to be distinguished from private actions, i.e. those carried out by industry, trade and private organizations, or persons without the participation of public authorities.

If private waste prevention measures are initiated or funded by public authorities or are supported for example by Public Relations, promotion or support, these measures are also classified as prevention policies by public authorities.

In Annex 4 of the WFD examples of waste prevention measures are listed.

3.2 Waste prevention

To clarify the concept of waste prevention it has to be made clear from the beginning what is meant by the terms of waste, waste prevention, recycling, reuse and preparation for reuse and how waste prevention has to be distinguished from recycling.

The definitions and distinctions are carried out on the basis of the WFD and are, if necessary, specified for use in this study. Article 1 WFD defines its purpose and scope as „measures 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.”

It regulates the handling and the avoidance of waste in general. However, some exceptions are defined in article 2.

In addition to the requirements of the WFD existing benchmarks in the German waste management law (Kreislaufwirtschafts-/Abfallgesetz, KrW-AbfG) and, briefly, the relevant regulations in the EC-Directive 2002/96/EC Waste Electrical and

Electronic Equipment (WEEE Directive) (because of the particular importance for re-use) have also been analysed.

3.2.1 Definition of waste

According to article 3 par. 1 WFD waste is defined as any substance or object which its holder discards or intends to discard or is required to discard.

In addition to that, § 3 par. 1 KrW AbfG states that waste is defined as movable property, "which the holder discards, intends to or is required to discard". According to § 3 par. 2 KrW-AbfG "it is a discard in terms of of par. 1, if the owner of a movable property supplies it to recovery ... or disposal. ... or gives up the actual physical control over it under omission of any other purpose."

§ 3 par. 3 KrW-/AbfG determines more precisely when "the will to discard such movable property is to be assumed in terms of par. 1". This is especially true if

1. the property is generated in the thermal transformation, manufacturing, processing or use of substances, products or services, without being the purpose of the action, or
2. its original purpose is omitted or abandoned, without a new purpose taking the place.

For the assessment of the purpose the perspective of the producer or owner under consideration of the prevailing public understanding has to be taken into account.

§ 3 par. 4 KrW-/AbfG specifies that the owner has to discard a property, if it is no longer used for its original purpose and if it threatens or will threaten the general public interest , especially the environment, due to its specific condition and whose hazardous potential can only be excluded by a proper and safe recycling or disposal based on the actual legislation.

3.2.2 Waste hierarchy

In article 4, par. 1 WFD ("waste hierarchy") the following order of priority is taken as an underlying order with regard to legislation and policies in waste prevention and management:

a) prevention;
b) preparing for reuse,
c) recycling;
d) other recovery, for example energy recovery;
e) disposal.

By applying the waste hierarchy the Member States should promote those options which provide the best overall environmental performance. If it is justified by life cycle thinking on the overall impacts of the production and management of waste - that is particular according to the results of LCA-material flow analysis - it is obligatory to deviate from the hierarchy for specific waste streams.

Member States shall take into account two aspects. This is on the one hand that the development of waste legislation and policy is a fully transparent process, and on the other hand the general environmental protection principles of precaution and sustainability, technical feasibility and economic viability, protection of resources as well as the overall environmental, human health, economic and social impacts (article 4 par. 2 WFD).

If waste prevention measures are not the preferred treatment in the waste hierarchy based on life cycle thinking or life cycle analysis, yet they remain waste prevention measures and are listed as such in this study. If there are indications, that recycling could be the more environmentally friendly measure, this is pointed out in the description of the measures.

Measures for reuse are not explicitly mentioned in the waste hierarchy, whereas the preparing for reuse is.

3.2.3 Waste prevention

In accordance with article 3 par. 12 WFD, the term "prevention" includes measures, which are taken before a substance, material or product has become waste and which reduce the following:

a) the amount of waste by reusing the products or extending their life time;
b) the harmful impacts on the environment and human health of the waste produced or
c) the content of harmful substances in materials and products.

Under a), reusing the products and extending their life expectancy are cited as an example of preventive measures to reduce the amount of waste. The list is not to be regarded as concluding. Any use of products, that have not become waste yet, for any other than the original purpose can be regarded as waste prevention provided that the quantity of waste is reduced.

According to § 4 par. 2 KrW-AbfG measures for the prevention of waste are "in particular, the plant-intern management of substances, low-waste product design as well as consumption patterns addressed to the acquisition of low-waste and non-polluting products." It is not explicitly mentioned that these measures should only be classified as waste prevention, when the substances have not become waste yet, but this can be reasoned from the examples listed. Problems of distinction cannot be excluded particularly with regard to the plant-internal recirculation.

In article 3 c) of the WEEE Directive prevention is defined as "measures to reduce the quantity and the harmfulness of waste electrical and electronic equipment and materials and substances contained therein."

Regardless of the fact that the WEEE Directive aims not only at prevention measures which apply before the electronic equipment has become waste, the definition corresponds with the spirit of the requirements in the WFD.

3.2.4 Preparing for reuse

As defined in article 3, par. 16, for the WFD "preparation for re-use" means any recovery method of checking, cleaning or repairing, by which products or components of products that have become waste are prepared so that they can be reused without further pre-treatment.

Consequently, only the preparation for reuse of waste is consistently classified as a measure of waste-management. Since products that are waste cannot be reused, as defined in article 3, par. 13 of the WFD, but waste can be prepared for reuse as stated in article 3, par. 12 of the WFD, it can probably be assumed that the waste will lose its waste quality by this kind of preparation according to the WFD.

This has to be distinguished from procedures for testing, cleaning and repairing, allowing for the reuse of materials that have not become waste yet. These procedures can be prevention measures, when they meet the criteria of article 3 par. 12 WFD.

3.2.5 Reuse

Article 3 par. 13 WFD describes reuse as "any process in which products or components that are no waste are used again for the same purpose they were originally designed for." This definition restricts the classification for reuse in two ways:

- Only if the materials to be recycled are not waste and
- if they are used for the original purpose,

reuse as defined in accordance with the Waste Framework is involved.

According to the WFD reuse is only assumed if the products are not waste. This limitation corresponds with the restriction in the definition of waste prevention. Consequently, reuse is always classified as prevention of waste. However, if waste is treated in any another form, then it is recycling or recovery of waste according to the WFD.

The reuse of electrical and electronic equipment and its components, subassemblies and consumables (article 1 and Recital 18) is one of the priority objectives of the WEEE-Directive as well as the prevention of waste.

According to article 3 d) WEEE-Directive, "reuse" can be interpreted as any measure, "which uses the electrical and electronic equipment or components thereof for the same purpose for which they were conceived, including the continued use of equipment or components thereof which are returned to collection points, distributors, recyclers or manufacturers". For the WEEE-Directive it is irrelevant how the collection systems etc. gain possession of the equipment.

To promote prevention, in particular the reuse of devices and components, the WEEE Directive stipulates the following measures:

- Article 4 states that the "Member States shall encourage the design and production of electrical and electronic equipment which take into account and

facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials. In this context, Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements."

- According to article 5 par. 1 the "Member States shall adopt appropriate measures in order to minimise the disposal of WEEE as unsorted municipal waste and to achieve a high level of separate collection of WEEE."
- According to article 10 par. 1 the Member States shall ensure that users of electrical and electronic equipment (EEE) in private households receive the necessary information. This concerns, for example, the requirements not to dispose of WEEE as unsorted municipal, to collect such WEEE separately, information on the return and collection systems available for them and the potential effects on the environment and human health as a result of the presence of hazardous substances in electrical and electronic equipment.
- According to article 11 par. 1 the Member States shall take the necessary measures to ensure that producers provide reuse and treatment information for each type of new EEE within one year after the equipment is put on the market. This information shall identify the different EEE components and materials as well as the localisation of dangerous substances and preparations in EEE. This shall support the correct and environmentally friendly treatment of waste electrical and electronic equipment - including maintenance, upgrade, refurbishment and recycling.

3.3 Other terms of reference by the WFD

3.3.1 Recovery

According to article 3 par. 15 WFD recovery means any operation with the principal result of waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function.

In Annex II of the WFD, a list of recovery treatments is listed, which is expressly designated as "not exhaustive". Accordingly, recovery also includes the preparation for reuse, recycling and also other forms of recovery, including for example thermal recovery or the use of waste for backfilling.

3.3.2 Extended producer responsibility

In article 8 WFD possible measures to promote waste prevention, reuse, recycling and other forms of recovery of waste by means of an extended producer

responsibility are described. These measures explicitly mention legislative and non-legislative acts that may address to all persons who develop, produce, process, sell, treat or import commercial products.

The following measures are specifically listed:

- acceptance of returned products and of the waste that remains after these products have been used,
- the subsequent management of the waste and financial responsibility for such activities,
- obligation to provide publicly available information as to which extent the product is re-usable and recyclable and
- appropriate measures to encourage the design of products in order to reduce their environmental impacts as well as the generation of waste in the course of the production and the subsequent use of products,
  - that are suitable for multiple use,
  - that are technically durable
  - and that are, after having become waste, suitable for proper and safe recovery and environmentally compatible disposal.

The proportionality and overall environmental impacts have to be taken into account.

3.3.3 Promotion of reuse

In article 11 par. 1 WFD, the Member States shall take appropriate measures to promote recycling and the preparation for reuse such as

- Promotion of the establishment and support of reuse and repair networks,
- Use of
  - economic instruments,
  - procurement criteria,
  - quantitative targets.

In addition to that, article 11 par. 2 WFD states requirements for the promotion of recycling, which are not relevant in the context of this study.

3.3.4 Polluter-pays principle

According to art 14 WFD the costs of waste management shall be borne by the original waste producer or by the current or previous waste holders. This shall take into account the polluter-pays principle.

The consistent implementation of the polluter-pays principle can, among other advantages, also have a promoting effect on the prevention of waste. Thereto the

costs must be specifically transmitted to the actor, who himself has an influence on the design, manufacture or selection of products or packaging, which subsequently become waste.

Article 14 WFD leaves it to the Member States to implement the polluter-pays principle or not by a general formulation: „Member States may decide that the costs of waste management are to be borne partly or wholly by the producer of the product from which the waste came and that the distributors of such product may share these costs.“

3.3.5 Waste management plans

Waste management plans, which have to be established by the competent authorities according to article 28 WFD, shall analyse the current waste management situation in the entire geographical territory of the Member State concerned, as well as provide the measures to be taken to improve environmentally friendly preparation for re-use.

The minimum requirements listed in article 28 par. 3 WFD for the content of the plans do not relate to prevention measures. Article 28 par. 4 WFD lists also optional provisions such as contents of a general nature, thus concerning also waste prevention:

b) an evaluation of the usefulness and suitability of the use of economic and other instruments to handle / to deal with various waste problems,

c) the use of awareness campaigns and information provision directed at the general public or at a specific set of consumers

General guidelines for implementation

According to article 30 WFD, waste management plans and waste prevention programmes have to be evaluated at least every six years and revised if required.

The European Environment Agency shall include a review of progress in the completion and implementation of prevention programmes in its annual report. Member States shall ensure that relevant stakeholders and authorities and the general public have the opportunity to participate in the creation of the waste management plans and waste prevention programmes. They shall provide the plans and programmes on a publicly available website.

3.4 Distinction between prevention and recovery of waste

Based on some examples the following chapters discuss aspects concerning the distinction between prevention and recovery of waste.

3.4.1 Home composting

The composting of organic waste from the kitchen and the garden in private garden is not classified as re-use, because the production of compost has another purpose than the previous use of the waste. Whether it is waste prevention or not is an

independent question, because the identification of another purpose is sufficient to deny a classification as waste, too.

The appropriate classification depends essentially on the purpose relevant for the owner. If the composting has the main purpose of getting rid of the organic waste, the composting is clearly a measure of waste treatment. The assessment is independent of the question whether this is the most environmentally friendly type of treatment based on life cycle thinking.

If the purpose of the composting is mainly the production of compost as fertilizer for the garden, no intention to discard the waste can be assumed at first. However, if the classification as waste prevention or recovery depends on the treatment of materials by composting and classifies this treatment according to Annex II of the WFD and Annex II B of the KrW-AbfG as a recovery procedure, it is automatically a process of discarding in accordance with § 3 KrW-AbfG. Following this assessment, the self-composting has to be regarded as waste recovery in any case.

In this study, such "grey areas" for the classification of measures could not be clarified, but they have been listed in case of doubt.

3.4.2 Plant-internal circulation

The site-oriented management of substances is expressly described as an example for a prevention measure in § 4 par. 2 KrW-/AbfG. However, following the classification of procedures listed as recovery treatments in Appendix II-KrW AbfG according to § 3 par. 2, the plant-internal recirculation of materials has to be classified as waste recovery, because normally treatment procedures are required, which are listed in Annex II.

As described above, this study does not attempt to classify measures for plant-internal circulation. They are mentioned indicating the open questions of classification to allow for further evaluation.

3.4.3 Re-use of furniture, electronic devices, etc.

Based on the provisions of the WFD the re-use of furniture or electrical devices which were collected as bulky waste and then repaired in preparation for reuse, can not be classified neither as reuse nor as prevention, because they have become waste because of the provision as bulky waste anyway. If the same products are offered directly from the previous owner to a (private or public) repair shop, this process would have to be classified as waste prevention (in this case no discarding is involved).

A promising prevention measure could be a regulation which requires that the reusability has to be examined before the classification as waste (discard) (cf., eg article 11 par. 1 WEEE Directive), because such a system could contribute to reducing the amount of waste.

The promotion of reusable systems, preventing the generation of waste from disposable packaging, is considered as another form of reuse and waste prevention.

The use of waste or used products for another purpose than the original one is not possible to be classified as re-use. However, projects in which products similar to the original product are made out of several pieces of, for example, furniture or bicycles, which are useless as a whole, are considered as waste prevention measures in this study, provided that they were tendered to repair services before they became waste.

There are also cases in which the reuse of products does not make sense from a general environmental perspective. This includes for example old appliances with such a high energy consumption in the use phase, that a proper disposal could be more environmentally friendly. An evaluation is only possible if the measures and their effects are recorded and evaluated.

If the use of products clearly contradicts applicable law or is clearly classified as harmful to the environment, this cannot be classified as waste prevention measures as the products have already become waste according to the definition of waste because the owner is obliged to discard these products (see Chapter 3.2.1). This category includes inter alia the following examples:

- the reuse of equipment containing substances, that are prohibited to be put on the market (eg CFC-refrigerators, PCB-capacitors),
- the export of old vehicles no longer roadworthy or malfunctioning electrical appliances etc. into countries where no environmentally sound disposal is possible[1].

3.4.4 Reducing the harmful impacts of waste

Measures that serve to reduce the harmful effects of waste production are defined as prevention by the WFD only if they are taken "before a substance, material or product has become waste." It is true that measures such as the separate collection of hazardous waste in small quantities or within the implementation of the Battery Act reduce the harmful effects of waste disposal and are often a prerequisite for high quality recycling. However, they do not aim at preventing pollutants, but at their separation and proper disposal. The classification as waste of these noxious materials remains, in contrast to the reuse of old furniture, equipment etc. from the garbage.

If these measures in comparison aim at the reduced use of harmful substances in the production (eg regulation on substances that deplete the ozone layer, ChemOzonSchichtV), they are measures for qualitative waste prevention.

[1] Their export to other countries is not prohibited. However, in terms of this study a prohibition of these measures is not compulsory to prevent them from being classified as waste prevention if the measures are clearly harmful to the environment. In contrast, the exportation of roadworthy used vehicles, which would become waste otherwise, is to be classified as waste prevention measure.

3.4.5 Indirect prevention effects of recovery and recycling measures

According to article 3 par. 15 WFD “recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.”

Recycling is defined in article 3 par. 17 WFD as “any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations”.

Normally recycling measures indirectly also prevent waste, which would have been generated in the production or processing of primary raw materials if they had not been replaced by secondary raw materials, fuels, or building materials. These indirect effects do not cause a classification as waste prevention measures in this study. Otherwise no meaningful distinction between waste prevention and recycling would be possible. The same applies to measures to promote the separation of waste, if it only aims at increasing the recyclability of the waste.

However, if the prevention is explicitly listed as target of such general measures (e.g. in article 11 par. 1 WEEE Directive) and corresponds to the above mentioned definition of waste prevention, they are included in this study.

If measures aim at an increased use of recycled materials and if their focus is on avoiding waste in the production by substitution of primary raw, they are classified as waste prevention projects, too, because the use of recycled materials, which are themselves assigned to recovery, avoids waste in the production of primary raw materials (e.g. mining waste or residuals from the processing of waste).

3.4.6 Fees and costs of disposal

Measures, which aim at reducing the amount of waste by increasing the price of the disposal of residual waste, e.g. due to higher requirements for disposal or through charges on the disposal of waste, can indirectly prevent waste. However, these activities are generally non-specific with regard to the reduction of waste quantities, either through recycling or waste prevention. As practical experience has shown the influence of waste prevention is usually not significant. These measures will therefore only be classified as waste prevention measures, if this is an explicit objective of the measure.

A different case is the systematic influencing of waste disposal fees by specific charging systems based on volume or weight, particularly in cases where these are accompanied by targeted public relations measures. Studies have shown that such

measures may also have relevant effects on prevention. They are therefore included as waste prevention measures[2].

3.4.7 Classification of general measures

General measures such as information and motivation of the population, often only aim at environmental protection in general or, if there are measures of waste management, as well at waste prevention as recycling of waste. For the purposes of this study, such measures shall only be considered as waste prevention measures if the prevention is designated as an explicit or recognizable objective of the action.

This means, for example, that the promotion of credible eco-labels according to Annex IV WFD (e.g. the environmental label "Blauer Engel") is only classified as waste prevention, if the extension of the durability or the saving of resources is explicitly or indirectly a criterion of the logo. For example low energy consumption in the utilisation phase alone is not sufficient for a classification as prevention, even though it may indirectly reduce the generation of waste associated with the production of fuels.

Other examples of waste prevention measures deal with the support for environmental aspects in the (public) procurement. If these measures set criteria such as long service life, ease of repair, reuse or low-emission products, they are classified as waste prevention measures as defined in this study.

3.4.8 Waste prevention in combination with charitable projects

Often also social projects and measures such as job creation measures or measures to supply the needy with food (German “Tafel”, www.tafel.de) or commodities serve directly or indirectly the purpose of preventing waste.

Measures to repair and reuse furniture, clothes and equipment are often conducted as social projects (e.g. recycling exchange Herford, www.recyclingboerse.org).

Those and similar projects have also been listed if the waste prevention is not the main purpose, but if it is named as a goal of the action anyway.

Social actions of this kind are often conducted with the support or cooperation of the public sector. In this case, the implementation or promoting classifies them as "public waste prevention measures." As a working hypothesis it is assumed that this is the case with all these projects, even if they are supported by job creation programmes.

[2] However, evaluating the prevention effects of such measures it is important to take into account an increased littering should the situation arise.

4 Methodology for the research of waste prevention measures

As part of this research project 296 different measures for prevention were researched and analysed by a uniform classification scheme (see Chapter 6) In the following the procedure of the research and the most important sources are described. The presentation is based on the original division between actions in Germany, abroad and in the literature, of course with some unavoidable overlaps (for example, if there were references to international publications in German projects).

4.1 Measures in Germany

First, the most relevant ongoing and completed research projects on waste management, resource policy and protection in Germany carried out by UBA, BMU and the BMBF were evaluated in particular with regard to the description of public policies applied and instruments used. This includes completed or ongoing research projects in the area of labelling, information and motivation, accompanying environmental-specific research to product development, green procurement and substitution of dangerous substances.

The Öko-Institute and the Wuppertal Institute based their research on their own extensive preliminary work [3]. In addition to their own experience in the development of prevention programmes on the federal state level, in particular expert interviews with representatives from municipal, waste management companies have been particularly important to provide information on prevention measures.

An additional source for the research of public policies and instruments for waste prevention in Germany were waste management plans of the Federal States in which according to § 29 KrW-/AbfG (at least) since 1999 the aims of prevention are presented every five years. Also older reports have been included because the importance of waste prevention has rather declined in recent years.

In the field of prevention measures regarding individual plants mainly studies and programmes in the context of § 5.1.3 of the federal immission control regulation (Bundesimmissionsschutzgesetzt, BImSchG) (implementation of waste prevention and recycling) have been evaluated, even if their implementation has been some year ago. The analysis of industry approaches to prevention has been another focus in this area was, even if the distinction to recovery of waste has not always been clear. Amongst others concrete specifications in legal environmental requirements

[3] E.g.: „Vermeidungskonzept für das Saarland“, Darmstadt 1996; „Strategieentwicklung für die Erstellung eines Sonderabfall-Vermeidungs- und -Verminderungsplanes für Niedersachsen“, Darmstadt 1991; „Vergleich verursachergerechter Abfallgebührenmodelle und bundesweite Recherche zu Abfallvermeidungs- und Abfallverwertungsprojekten“, Darmstadt 1998; „Ökologisierung der Abfallwirtschaft“, Freiburg/Darmstadt 2000

affecting quantitative and qualitative prevention of waste have also been described and evaluated.

Another very important source in Germany was a query among the responsible authorities for the issue of prevention in all 16 federal states conducted in agreement with the Federal Environment Agency. This resulted in a vast number of references on current or past projects, which were pursued either via internet research or personal contact with the responsible persons for the project. After the delivery of the interim report to the federal states, there has been a further series of references to specific individual measures that were included in the catalogue of measures.

4.2 Activities abroad

For the evaluation of public policies in foreign countries a comparable depth of research as in Germany has not been possible.

However, waste prevention measures from over 20 European and non-European countries have been taken into account by a combination of the following steps:

- Use of existing contacts and networks of Öko-Institute and Wuppertal Institute (European Topic Centre on Sustainable Consumption and Production, European Environment Information and Observation Network, International Panel for Sustainable Resource Management, UNEP Collaboration Centre on Sustainable Consumption, EUROSTAT etc.)
- Evaluation of relevant EU directives
- Evaluation of relevant publications of the state governments and environmental ministries
- Particular consideration of identified countries with a special commitment to waste prevention and resource management (eg, Austria , Switzerland etc.)
- Pursuing of leads gathered from the research for Germany and the parallel literature review

Important sources have been ACR+, an association which developed a study on benchmarks for waste prevention, as well as a study on waste prevention funded by the European Commission (see BIOS 2009). Diverse valuable information on European waste prevention projects have been gained by participating in the conference "Waste prevention - aiming high", 11/30/2009 in London, organized by the Resource Recovery Forum.

4.3 Literature research

In addition governmental measures on waste prevention have been identified in the literature with the help of a structured database research. The selection of research

databases consulted both, general and scientific directories as well as subject-specific internet portals.

The results have shown, however, that the issue of waste prevention has attracted no special attention since the mid-90s in the specialised press. Especially concepts of integrated resource management and concept developments for fiscal incentive instruments have been taken from the literature research.

5 Indicators and benchmarks for waste prevention

Given the large number of identified measures for waste prevention that can be taken by public authorities and the limited financial resources as well as organizational capacities, there is a need for selection and prioritization. Indicators and benchmarks for waste prevention allow comparing the effectiveness of various activities and thus provide an important basis for the creation of a national waste prevention programme.

In the context of strategies for sustainable development (such as the German Sustainability Strategy) indicators offer the possibility to map effects and changes in complex systems. They provide the basis to evaluate existing and planned projects, to review the achievement of objectives and to facilitate the dialogue between policy makers and stakeholders. They allow for the comparison between different regions or cities and may therefore motivate local actors to invest more time, effort and responsibility in the objectives set (cf. OECD 2002).

Benchmarking is an instrument originally developed in business economics in order to facilitate such comparisons. The basic approach of benchmarking is to collect data and indicators for various dimensions in order to identify best practices, which can serve as a benchmark for other participants. Applied regularly, they offer incentives to learn for the regulators as well as for the regulated (cf. BIFA 2004).

The German Advisory Council on the Environment has developed the following quality criteria for indicators, which are also of relevance for the issue of waste prevention (SRU 2002):

- Consistency - the indicator must fit the subject / target of the measure
- Representativeness - the indicator has to reflect developments in the topic area appropriately
- Liability - the indicator must be designed in a way that major players can agree on its relevance for a longer-term period
- International comparability - the indicator should be comparable to other systems abroad and thus allow for international benchmarking
- Prioritization of measures - the indicator must offer the political actors information about where the highest environmental benefits can be achieved given limited resources.

5.1 Benchmarks and indicators currently used

Indicators and benchmarks for waste prevention are an internationally intensively discussed issue. A variety of models that differ significantly in topics, addressee and scope have been developed at various levels (see BIOS 2009, OECD 2000).

During the revision of the Waste Framework Directive the European Commission has commissioned the development of guidelines for the development of waste

prevention programmes. In a questionnaire currently used indicators for waste prevention in the member states were queried. Thus / According to this, the following indicators are used at the moment (cf. BIOS 2009):

- Generation of waste disaggregated to 17 main waste streams
- Generation of waste per household (kg per capita per year, total generation in households, etc.)
- Share of households with home composting
- DMI (direct material input), etc. for consumption and exports of different materials (metals, minerals)
- Avoided raw material extraction by prevention measures in enterprises and initiated by the public sector
- The share of reusable packaging in relation to the generation of packaging waste, or specifically for beverage containers
- The share of consumer products with eco-labels
- Quantity of recycled and reused goods
- Arising of advertising flyers in the households
- Benchmark for companies regarding the amount of waste within a sector
- Surveys on environmental awareness with regard to waste prevention, special surveys on the effect of prevention campaigns
- Quantity of deposited construction waste
- Quantity of deposited biowaste

With regard to waste prevention the particular problem of trying to measure something that cannot be measured directly rises. Statements about the success of a particular waste manage activity therefore always require assumptions about the kind and amount of waste that would have been generated without the measure. The current approaches therefore have a series of systematic problems (cf. bifa 2004):

- Existing indicators are generally not comparable. While qualitative information on the composition of waste can map a prevention of pollution e.g. by less hazardous waste, the total load can increase by an increasing total amount of waste, and vice versa anyway.
- Indicators for waste prevention always cause the problem, that the effects of a measure occur with a different time delay, e.g. if the products have a different useful life.

- Since prevention is always closely associated with complex patterns of consumption, even cultural changes (e.g. in environmental awareness) are an issue that cannot be mapped with the help of technical indicators in certain circumstances. This has to be considered for the international comparison of policies and their potential transferability in particular.

5.2 Status quo of indicators for waste prevention

Against the background of the case studies for waste prevention activities previously analysed in the project, two dimensions can be distinguished, which can be applied for the development of benchmarks:

Spatial dimensions

Most of the researched benchmarks apply to singular measures on the local level as for example waste prevention measures at city events, where the generation of waste is recorded throughout several years.

Another group analyses the effect of prevention measures on the level of cities or geographic regions.

In contrast to that, other measures, particularly those initiated by the federal government, aim at creating an effect of waste prevention measures on a national level instead.

Methodical dimensions

In accordance with the Pressure-State-Response model of the OECD (2000) the used benchmarks can also be distinguished as follows:

The overwhelming majority are response indicators that map the effect of public measures on the generation of waste (e.g., the effect of a regulatory measure). State indicators, which show the qualitative effects of a prevention measure on individual environmental media like air, water or soil do not exist yet. In contrast, there are some pressure indicators that attempt to display the environmental impact of waste as burden a head or in relation to GDP.

6 Methodical approach for the description of waste prevention measures

The different researched public waste prevention measures are described in a separated Excel file and summarized in an overview table to enable sorting and filtering by various accessible sources.

In Chapters 7 and 8 the measures are listed in a structured form and described very briefly, only if the title is not self-explanatory. First a description is given of the actions carried out in Germany or in individual cases also just have been proposed. The search for international public prevention measures has been conducted in two steps:

- Research and presentation of measures at European Union level (in particular legal measures),
- international research in individual states, particularly measures that go beyond the German examples or that significantly differ from those in Germany.

6.1 Classification of public waste prevention measures

To ensure a high degree of approximation of the scheme of study with the WFD, the structure is oriented on the system of the 16 bundles of measures specified in Annex 4. The differentiation into the three groups of measures will not be further considered. Some of the listed examples also affect other life cycle phases of the waste described in other groups. But also in all other possible outline methods such overlap could not be excluded completely. So the researched measures will be directly assigned to the 16 sets of measures listed in Annex IV of the Waste Framework Directive. In order to assign kinds of measures, which are not included within these 16 bundles of measure, especially legal measures, an 17th bundle "other measures" was introduced. The following list shows all bundles in a short version:

- Planning - economic instruments to promote resource efficiency,
- Promoting research and development - information - implementation programmes,
- Development of indicators for the environmental impact of waste production,
- Promotion of eco-design,
- Information on best available technology,
- Training of licensing authorities,
- Measures in facilities not to be approved,
- Sensitization - funding of specific measures - advice,

- Voluntary agreements - actor cooperation,
- Promotion of environmental management systems,
- Economic instruments, e.g. for purchasing,
- Awareness raising - information,
- Eco labels,
- (Voluntary) agreements with industry and commerce,
- public procurement – promotion of green private sector procurement,
- Informal, economic, logistic or other ways of promoting concrete measures for reuse and repair - networking,
- Other measures

Within the presentation of a bundle of measures, these measures are differentiated also in respect to the initiator of the action:

- National level/ federal government
- Federal states
- Municipalities
- Others

Aim of the measure

The aim of measures differentiates the main target of the measure:

- quantitative and qualitative prevention
- quantitative prevention
- qualitative prevention

Potential and success of a measure

The potential of a measure lists indications concerning the success for waste prevention from the researched sources (descriptions of the individual measure). If the sources contain no data concerning the prevention potential or the success of the measure and also if no comparable data can be derived from other comparable projects, own assessments have not been made in the description of the individual measures.

Research shows that as expected information on the amount of avoided waste by prevention policies are rarely possible. Exceptions are concrete measures in production processes. If such data are available, they are specified in the listing of the short titles.

7 Examples of waste prevention measures in Germany

In the following subsections, some of the investigated waste prevention schemes which are carried out or are being considered in Germany are listed. Duplicates are largely avoided. The measures are usually undertaken in a multitude of states or municipalities, but only selected individual samples are listed. Since it is not the goal of the study to name all the different initiators of a measure, the listing is only exemplary and not connected to any rating of quality. It either could not and should not be clarified who had first introduced the measure. Where possible the descriptions of specific measures also exemplarily include where else they are or have been carried out.

7.1 Planning - economic instruments to promote resource efficiency

The detailed description of this package of measures in Annex IV of the WFD is:

“1. The use of planning measures, or other economic instruments promoting the efficient use of resources.”

For this set of measures, three measures in the federal states and one in a community have been researched. In addition, two measure were included as theoretical approaches, which would be classified as measures on the national level.

The measures described here refer to financial incentives and fees, helps to implement legislative requirements and the planning of waste prevention measures. For the classification of the measures researched problems of distinction have to be noticed, in particular to the awareness raising activities in Section 7.8.

7.1.1 National level

Theoretical approaches for measures for a quantitative prevention:

1. *Material input tax / resource tax on state level*; incentive to lower material demand by registration and taxation of resource extraction. Concept of the Kathy Bey's foundation and position paper of Die Grünen.
2. Reduction of environmentally harmful subsidies, environmentally damaging subsidies distort competition at the expense of environmentally friendly techniques and products. This hinders the transition to sustainable production and consumption patterns.

7.1.2 Federal states

Measures for quantitative and qualitative prevention:

1. Guideline for operational waste management concepts and waste balances. Guidelines for practical implementation of legal requirements in North Rhine-Westphalia, including waste prevention, is available for free on the internet.
2. *Government commission on waste in Lower Saxony*, within the commissions, stakeholders from governments, NGOs and science worked on approaches to prevent and deal with waste.
3. Waste prevention as a result of negotiated reduction agreements according to 31st BImSchV. Of the approximately 2,300 plants, about 1,600 (70%) use the instrument of negotiated reduction agreements instead of a direct compliance with emission limits to reduce the consumption of solvents.

7.1.3 Municipalities

Measure for quantitative prevention:

1. *Fifty-Fifty-system for municipal bodies, e.g. schools*, money saved as a result of eco-friendly behaviour shall be available for the local facilities.

7.2 Promotion of research and development - Information - Implementation programme

The detailed description of this package of measures in Annex IV of the WFD is:

„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."

For this set of measures, 16 measures on the national level and three on the level of the federal states were researched. In particular these are research projects of the BMBF and BMU in order to switch to low-waste production processes and conceptual research on prevention:

7.2.1 National level

Measures for quantitative and qualitative prevention of industrial waste:

1. *BMBF research programme "Neue Nutzungsstrategien"*; research initiative for the promotion and implementation of strategies to restore and reuse used goods, leading to increased resource productivity and avoidance of waste.
2. *BMU programme to promote investment for demonstration purposes to reduce environmental pollution*; support for high-tech installations especially in small and medium enterprises (SMEs), with a number of detailed projects.
3. *Promotion of the introduction of a process for an environmentally friendly coating of aluminium wheels by the BMU.* Avoidance of 150 t/a waste containing chromium and 50% of paint sludge.

4. *Promotion of the implementation of a new procedure to metallise plastics.* Prevention of chromium VI-containing sludge and rinse water (without indication of quantity).

Quantitative measures to prevent industrial waste:

5. *Promotion of a system for electrochemical (galvanic) coating of bulk materials with aluminium.* 100% prevention of solvents and electrolyte waste.
6. *Promotion of a procedure for processing of aluminium alloys without the use of coolants.* Avoidance of 100% of coolants, 90% of chasteners and 98% of other hazardous wastes
7. *Support for the construction of a plant for environmentally friendly production of concrete elements.* Avoidance of 150 t/a chromium containing waste and 50% paint sludge.
8. *Support for the conversion of an electroplating operation to a new pickle procedure.* Prevention of 50-75% of waste corrosive agents
9. *Support for the construction of a plant for the commercial production of lithium-polymer batteries.* 100% avoidance of solvents, plasticizers and film.
10. *Promotion of the introduction of a new powder coating technology for wood and plastics sensitive to temperatures*. Paint sludge can be avoided to 100%, the quantity of newly arising powder paint sludge is only 10% of the original amount of paint sludge waste
11. *Realization of an innovative surface treatment procedure.* Reduction of paint sludge (without indication of quantity).
12. *Support for the construction of a plant for manufacturing environmentally friendly low-solvent paints and varnishes.* Avoidance of 82% color and paint sludge, 200,000 disposable paper bags and 4,000 containers per year.

Measures for the plant-internal processing of waste, which could also be classified as recovery:

13. *Promotion of sand preparation in an aluminium sand foundry.* Reduction of used sand to be disposed by 75%.
14. *Promotion of the preparation of ammoniacal etching solutions.* Reduction of the amounts of the etching solution and ammoniacal wastes (without indication of quantity)

15. *Support for the recovery of coating in the paper production.* Reduction of waste to be disposed by 60%, including 3,500 tons of pigment waste per year
16. *Promotion for the establishment of a pickling plant coupled with treatment plant for alkaline solutions.* Reduction of sodium hydroxide to be disposed by 90%.

7.2.2 Federal states

Measures for quantitative and qualitative prevention:

1. *Material flows related counting module for hazardous waste, Brandenburg*, development of a tool to easily get an overview of the waste-related costs in small and medium-sized businesses thus sensitization for the potential of waste prevention measures
2. *Strategy development for the creation of a hazardous waste avoidance and reduction plan for Lower Saxony.* Research project with a status quo analysis and a concept of a prevention plan.

Measure with a questionable classification as waste prevention:

3. *Waste prevention by developing and testing new technologies and procedures for rehabilitation of inherited waste.* Focus is the restoration in situ, so that no transfer of waste is needed in the cleanup and waste does not even arise in a legal sense.

7.3 Development of indicators for the environmental impact of waste generation

The detailed description of this package of measures in Annex IV of the WFD is:

“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.”

For this set of measures one measure of the federal states has been researched:

7.3.1 Federal states

Measure for quantitative and qualitative prevention:

1. *Development of regional waste balance sheets in the federal states*

7.4 Promotion of eco-design

The detailed description of this package of measures in Annex IV of the WFD is:

„4. The promotion of eco-design (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).“

For this set 16 measures of the Federation and each one of the federal states of the communities have been researched. These measures refer in particular to legal requirements of the Federation, which directly or indirectly work towards an eco-design (in particular, prohibited substances for qualitative prevention) and to some consulting programmes.

7.4.1 National level

Measures for quantitative and qualitative prevention:

1. *Rights and obligations of immission control officers according to § 54 par.. 1 No. 1 BImSchG*
2. *Measures for operational waste prevention according § 4 par.. 2 KrW-/AbfG*
3. *Product responsibility according to § 22 KrW-/AbfG*
4. Rights and obligations of waste management officer according to § 55 par.. 1 No. 4 KrW-/AbfG (160)
5. *Product design for electrical and electronic equipment according to § 4 of the Electrical and Electronic Equipment Law*
6. *Second Life*. Within this UBA-project quality criteria for the reuse of used electronic devices are analyzed and defined in order to create the bases for the introduction of a quality label.
7. *Resource Top Runner.* Requirements for a minimum share of recycled of materials used for certain products. As the use of recycled materials causes significantly less environmental rucksacks, a larger percentage of recycling makes a significant contribution to waste prevention, especially in the field of mining.

Measure for qualitative prevention:

8. *Prohibition of substances for electrical and electronic equipment according to § 5 of the Electrical and Electronic Equipment Law*
9. *Prohibition of certain batteries according to § 3 Battery law.*
10. *Limitations for pollutants in packaging materials according to § 13 VerpackV*
11. *Reduction of pollutants in vehicles and vehicle parts in accordance with § 8 AltfahrzeugV*
12. *Prohibition of production and use of certain materials according to § 18 GefStoffV*

13. *Prohibition of placing on the markets certain materials according to § 1 ChemVerbotsV*
14. *Prohibition of use for tar and other pyrolysis products based on organic material according to TRGS 551*
15. *Substitution of products based on aluminium driers wool according to TRGS 619*
16. *Use of substitutes and / or use restrictions for certain substances in various technical rules for hazardous substances (TRGS)*

7.4.2 Federal states

Measure for quantitative and qualitative prevention:

1. *Consulting programme for Ecodesign in Hamburg*, promotion of research and development projects of small and medium-sized enterprises and them being supported by experts, industrial designers and project engineers for the design and development of environmentally friendly products.

7.4.3 Municipalities

Measure for quantitative prevention:

1. *Award for recycling design.* Competition for young designers, organised by the working group recycling (Arbeitskreises Recycling e.V.) in Ostwestfalen Lippe.

7.5 Information about best available technology

The detailed description of this package of measures in Annex IV of the WFD is:

„5. The provision of information on waste prevention techniques with a view to facilitating the implementation of best available techniques by industry.“

For this set of measures one measure of the Federation and 14 of the federal states have been researched. Most of the measures are taken from programmes under § 5 par. 1 BImSchG or have been developed from mostly industry-specific consulting programmes for integrated pollution control, also in facilities not obliged to the BImSchG.

7.5.1 National level

Measure for quantitative and qualitative prevention:

1. *Obligation for a waste consultation according to § 38 Abs. 1 KrW-/AbfG*

7.5.2 Federal states

Measures for quantitative and qualitative prevention:

1. *Consulting Programme I to prevent, reduce and recover waste from industry and trade*, consultation for 150 firms in Baden-Württemberg, funded by the waste levy.
2. *Consulting Programme I to prevent, reduce and recover waste from industry and trade.* Development of checklists in addition to 1.
3. *Waste prevention programme according to § 5 par.. 1 No. 3 BImSchG for plants requiring an emission control permit.* These programmes have been conducted in many federal states, mostly with industry-specific projects.
4. *Industry concepts for plants not requiring an emission control permit*; concepts of the Senate of Berlin for the prevention and recycling of paint and paint sludge from electroplating waste.
5. *Hazardous waste management company SAM (Sonderabfall-Management-Gesellschaft Rheinland-Pfalz mbH SAM).* Established for consultation on ways to prevent, reduce and recycling of hazardous waste.
6. *Cleaner Production (PIUS)*, Internet portal of the federal states North Rhine-Westphalia, Hesse and Rhineland-Palatinate about experiences with projects on resource efficiency, PIUS and Sustainable Business.
7. *Information platform for environmental protection.* Information platform for environmental protection for several industries in Baden-Württemberg.
8. *Consultation programme ECO+.* Programme of the chamber of handicrafts in Baden-Württemberg with support of the Ministry of Environment. The participating companies receive an environmental check.
9. *Development of industry expertise in Baden-Württemberg and their deployment to http://www.gaa.baden-wuerttemberg.de.*
10. *Integrated Product Policy - integration of environmental aspects into product development.* In a study of the ABAG Baden-Württemberg companies in different industries and sizes were asked how they consider the IPP approach in product development, which expertise for methodological and technical solutions they use, and what lessons - opportunities and barriers - could be won.
11. *Prevention by the study of innovative technologies*. Scientific studies of the MUNLV in NRW with regard to potentials, scope and risks of innovative technological developments.
12. *Provision of guidelines for the implementation of § 5 (a) No 3 BImSchG.* For support and knowledge dissemination MUNLV and LANUV created guidelines for especially environmentally relevant production processes.
13. *Industry research and industry waste prevention programmes according to § 5 (a) No 3 BImSchG.* Industry programmes to establish the state of the art

for technologically possible and appropriate measures for the prevention and recycling in NRW.

14. *Prevention through the development of existing technologies in the area of forging in NRW.* Scientific studies by MUNLV and LANUV and to further development of existing technologies in order to raise further potential for waste prevention and resource conservation.

7.6 Training of the licensing authorities

The detailed description of this package of measures in Annex IV of the WFD is:

„6. Organise training of competent authorities as regards the insertion of waste prevention requirements in permits under this Directive and Directive 96/61/EC."

For this set of measures one measure of the federal states has been researched. An education and training - including waste prevention aspects – takes place probably in all federal states, without being published in this context.

7.6.1 Federal states

Measure for quantitative and qualitative prevention:

1. *Seminar for training of trade control officers in Lower Saxony*; implementation of the results of the project "Strategy development of a special waste avoidance and reduction plan" for Lower Saxony.

7.7 Measures in facilities not covered by the Directive 96/61/EC

The detailed description of this package of measures in Annex IV of the WFD is:

„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."

For this set of measures one measure of the federal states has been researched.

7.7.1 Federal states

Measure for quantitative and qualitative prevention:

1. *Implementation programme to WHG § 7 in Baden-Württemberg*, enforcement according to water management priorities is complemented by a control system for waste management priorities.

7.8 Sensitization - funding of specific measures - advice

The detailed description of this package of measures in Annex IV of the WFD is:

„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."

For this set one measure of the Federation, eleven of the federal states and two of the municipalities have been investigated.

7.8.1 National level

Measure for quantitative prevention:

1. *Establishment of the German material efficiency agency (Deutschen Materialeffizienzagentur, demea).* Individual counseling and support for networking companies, offering the material efficiency prize.

7.8.2 Federal states

Measures for quantitative and qualitative prevention:

1. *Cluster „Environmental technology".* Direct technology funding by the MUNLV NRW especially to promote integrated environmental protection as an alternative to end of pipe approaches
2. *EcoBest benchmarking Project*; Benchmarking programme of the environmental alliance of Hesse which measures branch specific standards of corporate environmental and resource protection in the participating companies.
3. *EcoBest benchmarking Project*; Benchmarking programme of the environmental alliance of Hesse which measures branch specific standards of corporate environmental and resource protection in the participating companies.
4. *Companies for resource protection.* The Ministry of Urban Development and Environment in Hamburg offers ons production and service companies financial support, consulting, also on-site, teaching specialists and the development of economic solutions resource protecting measures and techniques.
5. *Information and advice on prevention and recycling of waste requiring spezial monitoring (BIVA).* Programme to advise and to provide information for small and medium enterprises and cottage industries in Hessen funded by a levy on hazardous waste with a focus on free consultation (1050 initial consultations), implementation advice, the provision of information through seminars, workshops, guidance documents and leaflets
6. *Efficiency Agency in North Rhine-Westphalia*, promotion of production and product integrated environmental protection and of environmental

management systems by several specific guidance tools: PIUS-Check, Jump-tool product design, resource cost (RKR) and Eco efficiency Check.

7. *Optimization of material flows in small and medium companies.* Industry-specific model studies and pilot projects in Baden-Württemberg for minimizing resources in production processes
8. *Material flows management*: Information transfer and communication. Improving the information transfer and communication between actors in in Baden-Württemberg
9. *Support for low-waste technologies.* Financial support for investments and environment-technical expertise for SME in Berlin.
10. *Environmental allicance Saxony Environment and Economy*. The voluntary agreement between the State Government and the economy aims at optimal conditions for a sustainable economic development.
11. *Waste Prevention by the „Dialogue Business and Environment" (Dialog Wirtschaft und Umwelt).* A new communication and action platform for government and economy in NRW.

7.8.3 Municipalities

Measures for quantitative prevention:

1. *Waste prevention agency AVA (Abfallvermeidungsagentur GmbH), Unna. C*onsultation, qualification, information and other services for SME.
2. *Newsletter for operational environment protection by the AVA*

7.9 Voluntary agreements - actor cooperation

The detailed description of this package of measures in Annex IV of the WFD is:

„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. "

For this set, two measures of the federal states were researched.

7.9.1 Federal states

Measure for quantitative and qualitative prevention:

1. *Industrial waste coordination committee*; Environmental Alliance Saxony

Measure for quantitative prevention:

2. *Framework agreements between the government and the foundry industry in Saxony-Anhalt,* reduction of mineral wastes by appropriate internal and external measures.

7.10 Promotion of environmental management systems

The detailed description of this package of measures in Annex IV of the WFD is:

„10. The promotion of creditable environmental management systems, including EMAS and ISO 14001."

For this bundle, two federal measures, four measures of the federal states and one of the municipalities have been researched, aiming especially at the dissemination of environmental management systems EMAS and Ökoprofit.

7.10.1 Federal states

Measure for quantitative and qualitative prevention:

1. *Participation in the European eco-audit scheme EMAS*, the environmental agency Brandenburg is involved in the community scheme for the environment management system.
2. *Promotional programme environmental management in Saarland*
3. *Award "Ecocamping"*. The project „Ecocamping" sponsored by the Ministry of Environment in NRW awards a prize for camping sites with a special ecologic engagement.
4. *Waste prevention by supporting environmental management systems*. The federal state of NRW grants a 30% reduction on fees for approval procedures to companies certificated with EMAS or the like.

7.10.2 Municipalities

Measure for quantitative and qualitative prevention:

1. *Ökoprofit*, the environmental management system ÖKOPROFIT is a cooperation project between local authorities and the business community and has been implemented in many European communities.

7.11 Economic instruments e.g. for shopping

The detailed description of this package of measures in Annex IV of the WFD is:

„11. Economic instruments such as incentives for clean purchases or the institution of an obligatory payment by consumers for a given article or element of packaging that would otherwise be provided free of charge."

For this set, eight measures of the municipalities have been researched. Those relate to financial incentives for eco-friendly behaviour (e.g., promoting the participation in diaper services) and (indirectly) to the avoidance of waste with the help of waste charges based on weight and volume.

7.11.1 Municipalities

Measure for quantitative prevention:

1. *Subsidies for waste preventing behavior in Dreieich (Hessen).* Investments improving the environment, inter alia waste prevention, will be subsidized, mainly in private households.
2. *Promotion of business start-ups for private diaper services, and subsidies for the use of diaper services.*

Measures to increase separate collection of household waste primarily increase the proportion of waste recovery and recycling of residual waste, but indirectly also quantitative prevention:

3. *Waste fees based on weight with the help of ID Weighing Systems*
4. *Establishment of volume based waste fees*
5. *Introduction of variable litter bin sizes for residual waste*
6. *pro2010 – the new waste management concept of the district Kitzingen.* The focus is on an ident-system with transponder-technology for residual and bio waste
7. *Waste collection in large residential complexes.* Model for technical solutions of a collection of residual waste in urban areas with large residential complexes based on individual waste generation in Schwerin and Wismar.
8. *Identification system for litter bins in Mecklenburg-Vorpommern*

7.12 Awareness raising - Information

The detailed description of this package of measures in Annex IV of the WFD is:

"12. The use of awareness campaigns and information provision directed at the general public or a specific set of consumers.“

For this set of measures, three measures of the federal government, nine of the federal states, and eleven of the municipalities have been researched. These relate in particular to awareness campaigns aiming mostly at consumers and SMEs using Internet portals, partly supplemented by brochures and other waste related information.

7.12.1 National level

Measure for quantitative prevention:

1. *Publication of educational materials on waste prevention, waste management and recycling.* Teaching materials, published by the BMU, for teachers at primary schools.
2. *Overdose - An anti-returnable cans campaign*, "event"-like character, of the BMU, aiming at young people.
3. *EcoTopTen*. Project funded by the BMBF in order to alert and inform consumers about environmentally friendly (including durable) products, giving market surveys on the Internet and in guidebooks.

7.12.2 Federal states

Measure for quantitative and qualitative prevention:

1. *Consultation from the Consumer advice centre*. Advice on waste prevention e.g. low-waste shopping, durability of products.
2. *Waste prevention in the education and training of company waste officers in Saxony*
3. *Brainstorming for ideas on ways of prevention of domestic waste.* The Bavarian State Office for the Environment (LfU) has developed a collection of ideas on ways of prevention of domestic waste, as part of an online portal on waste prevention.
4. *Municipal waste management concepts in the own area*. The Bavarian State Office for the Environment obligates the districts to set an example for the industry (and ultimately the citizens) and to start an integrated waste prevention in their own administrative area.

Measure for quantitative prevention:

5. *Using instead of possessing*; investigation and campaign of the Ministry of Environment Baden-Württemberg with the Consumer Direct, concentrating on renting or borrowing instead of buying products.
6. *"The free of waste allotment - the free of waste gardening*." Brochure, guide and online database of the Ministry for Agriculture, Forestry, Environment and Conservation in Thüringen (TMLFUN).
7. *Brochure "Low-waste living and shopping".* Brochure of the Bavarian Environment Ministry to raise awareness of citizens on purchase.
8. *Registration and brokering of used furniture in Bavaria.* The Bavarian State Office for the Environment (LfU) published lists of 146 non-profit organizations in Bavaria on the Internet, which broker well-kept used furniture.

9. *Group discussions on low-waste consumption patterns.* In Hamburg, about 50 households with about 140 people have been consulted in group discussions on low-waste consumption patterns.

7.12.3 Municipalities

Measures for quantitative and qualitative prevention:

1. *Establishing municipal waste information centres.* The Conservation Advisory in Plön was developed and expanded into a decentralized Environmental Consulting (natur, environment and waste).
2. *Creation of additional positions for local environmental and waste consultants (including education and training)*
3. *Public relations by waste consultants.* In 92 Bavarian cities and counties over 190 full-time and 106 volunteer waste consultants are employed.
4. *Prevention concept of the City of Dresden.* Contains inter alia teaching materials for environmental education, waste management partnerships with schools and kindergartens, reuse of goods, repair guides, concept for low-waste events.
5. *Stage play on green behaviour.* Plays for children in preschool and primary schools.

Measures for quantitative prevention:

6. *Distribution of a brochure on waste prevention.* Ideas and positive examples of citizens in Bonn how to avoid waste and to relieve the environment are summarized in this booklet.
7. *Information portal of the municipal waste management company (Kommunalen Wirtschaftsunternehmen Entsorgung, KWU) of the District Oder-Spree.* Information inter alia on an online portal aiming among others on the change of consumption patterns. A reduction of the total amount of municipal waste by 2.7% is partly refered to waste prevention.
8. *Campaign „Low-waste christimas“*. Participatory action for gift packaging and decoration out of discarded materials. Advice on environmentally friendly and long-lasting Christmas presents.
9. *Publication of a purchasing guide for low-waste shopping*
10. *School children and adults should be given an understanding of recycling and the sustainable use of resources with the help of a multimedia approach.*
11. *Waste prevention concept Haßberge*. The district Haßberge shows his exemplary prevention measures on the Internet.

7.13 Eco labels

The detailed description of this package of measures in Annex IV of the WFD is:

„13. The promotion of creditable eco-labels."

For this set of measures one measure on the national level and one of the federal government have been researched.

7.13.1 National level

Measures for quantitative and qualitative prevention:

1. *Promotion of ecological product labels (Blauer Engel); Product label for easy and quick orientation during shopping according to environmental criteria established and checked by the Environmental Label Jury, the Federal Ministry of Environment, the Environmental Protection Agency, and RAL GmbH.*

7.13.2 Federal states

Measures for quantitative and qualitative prevention:

1. *MINI-MÜLL e.V., the prevention of packaging waste in the food sector.* The Environmental Association MINI-Müll in Hamburg awards retailers who have successfully implemented prevention measures developed by the association.

7.14 Agreements with industry and trade

The detailed description of this package of measures in Annex IV of the WFD is:

„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. "

For this set of measures two measures of the federal states has been researched. Interferences with the package of measures described in chapter 6.9 cannot be ruled out.

In addition programmes of cooperation with the economy in the form of voluntary agreements exist or existed in almost every federal state, such as "Environmental Dialogue Sustainable Baden-Württemberg", "Environmental Pact of Bavaria", "Environmental initiative of North Rhine-Westphalia", "Berlin agreements", "Environmental Agreement Thüringen", "Environmental Partnerships" in Brandenburg, Bremen and Hamburg as well as "environmental alliances"in Hessen, Mecklenburg-Vorpommern and Saxony (BDI 2004). The support for management systems for environmental protection and resource conservation measures is usually one part of these programmes. Concrete measures are described in section 17 with the other remaining prevention measures.

7.14.1 Federal states

Measures for quantitative and qualitative prevention:

1. *Voluntary agreement to avoid waste from foundries,* between the State of Baden-Württemberg and all foundries in the federal state. The agreement aims at reducing the land filling of foundry sand by 70% within four years, through the development of internal recycling measures and waste-avoiding technologies.

Measure with a questionable classification as prevention:

2. *Arrangements of the Ministry of Environment and Nature, Agriculture and Consumer Protection of NRW with the business community regarding the legal waste classification of residues such as slag, blast furnace slag, etc.*

7.15 Public Procurement - promoting private sector procurement

The detailed description of this package of measures in Annex IV of the WFD is:

„15. In the context of public and corporate procurement, the 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."

For this set of measures the following measures have been researched: two measures of the federal government, three of the federal states and two measures of the municipality, which only concern the public procurement.

7.15.1 National level

Measures for quantitative and qualitative prevention:

1. *Obligations for public authorities with regard to procurement according to § 37 par. 1 KrW-AbfG.* Federal authorities are obliged to contribute to the purposes of § 1 KrW-/AbfG.
2. *Training for an environmentally friendly public procurement.* Very specific on-site trainings for an environmentally friendly public procurement in the public administration funded by BMU and UBA.

7.15.2 Federal states

Measures for quantitative and qualitative prevention:

1. *Public Procurement,* according to § 3 (1) HmbAbfG in Hamburg have to favour environmentally friendly products in the procurement. According to a decree in North Rhine-Westphalia in the public procurement aspects of environmental protection and energy efficiency are to be taken into account.
2. *Environmental directive on public procurement*. According to article 2 par. 1 of the Bavarian waste law state, municipalities, counties, districts and other

legal persons of public law are obliged to exemplary ensure that the objectives of waste prevention, minimization of pollutants in the waste and recycling of unavoidable waste will be achieved.

Measure for quantitative prevention:

3. *DOMEA processing system. Implementation of a paperless administration in Mecklenburg-Vorpommern.*

7.15.3 Municipalities

Measures for quantitative and qualitative prevention:

1. *Low-waste management*, competition and programme of the city of Dresden which aims at preferring low-waste products with municipal contracts if they are more expensive.
2. *Conversion of public offices and facilities into a low-waste procurement.* Administrative instruction, Hanover.

7.16 Informal, economic, logistic and other ways of promoting concrete measures to reuse and repair - Networking

The detailed description of this package of measures in Annex IV of the WFD is:

„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."

For this set of measures, five measures of the federal government / on the national level, seven of the federal sates and 20 of the municipalities have been researched. Four of the measures of the municipalities lay in the grey area to recycling.

7.16.1 National level

Measures for quantitative prevention:

1. *Securing the share of reusable beverage in beverage packaging*, with the help of the guidelines/requirements of the packaging ordinance.
2. *Re-use of transportation packaging according § 4 VerpackV*
3. *Reduction of the amount of packaging according § 12 VerpackV*
4. *Ecomöbel - increasing the rate of recycling old furniture*; cooperation network and Internet platform of different providers for various high-quality and individually designed furniture that is tested on harmful substances, supported from the BMBF.
5. *Re-use of car parts according to § 5 par. 1 AltfahrzeugV*

7.16.2 Federal states

Measures for quantitative prevention:

1. *Refurbishing. Workshop series on "refurbishing" as part of the programme "Integrated Product Policy" of the Ministry of Urban Development and Environment in Hamburg.* Aims to establish new markets by the marketing of used equipment and vehicles with guaranteed quality of refurbishment.
2. *Transfer of movable property.* Guideline within the tax authorities in Hamburg that Goods no longer needed have to be sold or transferred to other departments, authorities or to third parties whenever possible.
3. *Selection and recovery of state-owned movable property - recovery-liability guidelines,* Hessian recovery policy that obilgates to check whether movable property no longer needed can be used within the authorities.
4. *Exchange for soils, components and building rubble (ALOIS).* Effective, cheap and interactive marketplace in the federal states NRW, Hessen and RLP aiming at the reuse or recycling of soil, construction debris, and other components
5. *Excavation exchanges*
6. *Pilot project for optimizing the collection of used furniture in Bavaria.* Presentation material for the final report "Optimizing the collection of used furniture in Bavaria in order to increase the reuse rate" by the University of Augsburg (2007), together with the Bavarian State Office for the Environment (LfU).
7. *Green Repair Guide.* About 1,000 repair crafts in Hamburg are marked with a green "R" in the phone book.

7.16.3 Municipalities

Measures for quantitative and qualitative prevention:

1. *Restaurant concessions with waste management requirements.* Regulations for the use of reusable dishes, etc.
2. *Use of reusable dishes and mobile automatic dishwashers.* Mandating the use of reusable dishes at events by regulatory law. Switching to reusable dishes has reduced the waste generation at the Munich Oktoberfest from 11,000 tonnes to 400 tonnes.
3. *Waste concept Hessentag 1997.* Comprehensive approach with a ban for non-reusable dishes supported by rigorous implementation and separate collection of waste reduced the waste generation by 60%.
4. *Establishment of exchange and gift markets,* Online Market Place to search for of offer furniture, appliances, etc. free of charge.

5. *Developing a concept for the collection of food for the needy in Karlsruhe.* In support of soup kitchens and the “Tafel”.
6. *Promotion of non-profit and commercial collection of old furniture, old appliances, etc.*
7. *Recycling Exchange East Westphalia-Lippe*, the working group Recycling eV (registered association) is a medium-sized business integration operating under the name "recycling market" is running second-hand stores in seven locations. It operates in cooperation and with the support of several municipalities.
8. *Workshop for bicycles "Make one out of three".* Recycling project of the “Recycling Exchange East Westphalia-Lippe”.
9. *Recycling of electronic devices.* Repair and reuse of electronic and electrical appliances. Individual project of the “Recycling Exchange East Westphalia-Lippe”
10. *Reuse of used books.* Internet shop of the “Recycling Exchange East Westphalia-Lippe”
11. *Use of reusable containers.* Regulation in Bids in the waste statutes of many Bavarian municipalities with an obligation for reusable containers in public places, in commercial buildings and public places
12. *Diaper Service.* Promotion and agency for diaper services in Bavarian communities
13. *Citizens Centre “Kempodium" and "BrauchBar".* The Kempodium provides with the "BrauchBar" the possibility to deliver used and old goods and for those interested not only to buy but also to test, repair or rebuild under the guidance of trained staff.
14. *Establishment of agencies and coordination for construction materials and building components (building material markets).* Ulm and Neu-Ulm also operate an exchange for historic building materials.

Measures for qualitative prevention:

15. *Adaptation of the cemetery statue.* Prohibition of the use of certain plastic products
16. *Exchange for chemicals at the University Hospital of Jena.*

Difficult distinction to recovery:

17. *Collection and reuse of used clothes "FairWertung”.* The RecyclingBörse collects used clothing, shoes, etc. in a special "blue bag".
18. *„ReDesign“ of furniture.* Refurbishment of used furniture Individual project of the RecyclingBörse.

19. *Promotion of home composting.* Financial support and advice for composting, free chaffing services.
20. *Exchange for bulky waste, etc. in cooperation with non-profit institutions.* Collection, refurbishment and marketing of old furniture, etc. in cooperation with local non profit institutions.

7.17 Other measures

In this category measures are listed that could not be clearly assigned to one of the 16 listed in Annex IV of the WFD.

For other measures six measures of the federal government / on the national level, and five of the municipalities have been researched.

7.17.1 National level

Measures for quantitative and qualitative prevention:

1. *Primacy of the quantitative prevention and reduction of harmfulness of waste according to § 4 par. 1 KrW-/AbfG*
2. *Obligation of the federal states to set up waste management plans in accordance with § 29 KrW-/AbfG*
3. *Criteria to determine the state of the art according to Annex III KrW-/AbfG*, including "Use of low-waste technologies" and "Use of less hazardous substances".
4. Operators duty to prior prevention of waste according to § 5 par. 1 No 3 BImSchG
5. *Standards and regulations for the quality of products.* Öko-Institut and Prognos proposed in a joint study in 1991 to develop and introduce norms and standards with specific guidelines for resource-protecting production practices and the durability of products.

Measures for quantitative prevention:

6. *Green Goal – waste prevention at the soccer world championship 2006*. A waste prevention concept funded by the BMU within „Green Goal“ including reusable cups for beverages, reusable transport packaging for food and regulations for low-waste packaging and merchandising.

7.17.2 Municipalities

Measures for quantitative and qualitative prevention:

1. *Incentives for waste prevention in weekly markets and fairs statues*, the city of Mainz records in the market statutes the waiving of packaging made of PVC, polystyrene foam and aluminium and also the use of returnable container / packaging including the taking back the empties.

2. *Carsharing. Organisations for the collective use auf vehicles.*
3. *Reduction of material consumption in the flue gas of a waste incineration plant (MVA).* By better use of lime in a MVA in Bremen the volume of consumption and thus the resulting flue gas cleaning residues have been reduced by around 7000-8000 t.

Difficult distinction to recovery:

4. *Use of mulching mowers in the care of local green and open spaces.*
5. *Grazing of green areas in Neuss. Avoidance of biowaste.*

8 Examples of waste prevention measures abroad

The measures researched implemented abroad have been differentiated into sets of measures initiated by actors on the following levels:

- EU
- National level
- Regional level
- Municipalities

8.1 Planning - economic instruments to promote resource efficiency

8.1.1 National level

Measures for quantitative and qualitative prevention:

1. *Japan's New Action Plan towards a Global Zero Waste Society; Japan.* Based on the 3R Initiative the plan aims at home and in cooperation with neighboring countries to create the conditions for waste prevention.
2. *Ressource Conservation Challenge (RCC); USA.* Participation of all relevant stakeholders (authorities, industry, citizens) to create an efficient material management.
3. *US Waste Prevention Strategy; USA (201).* Programme „Spotlight on Waste Prevention" by the US Environmental Protection Agency (EPA) aiming to induce changes for the design und production of products and their use.
4. *"National Waste Management Plan"; Sweden.* Plan of the Swedish Environmental Protection Agency to increase resource efficiency and to reduce environmental impacts from waste disposal.
5. *Municiple Waste Plans, Sweden.* Provision for municipal waste planning in the regulation NFS 2006:6 in order to strengthen the contribution of local waste prevention.

8.1.2 Regional level

Measures for quantitative and qualitative prevention:

1. *Waste Prevention Framework, UK*; establishment of an inter-sectoral forum on waste prevention, support of eco-design in the production sector in Northern Ireland.
2. *Development of regional waste plans; UK.* These plans, which the Welsh local authorities have to present since 2001 and have to extrapolate every three years, include in addition to data on waste management also general objectives such as prevention.

3. *Development of a municipal waste strategy; UK.* Based on No. 2 Welsh local authorities have to develop municipal waste strategies.

Measure for quantitative prevention:

4. *Creating a infrastructure for composting in the planning of new residential areas; UK.* For the planning of residential areas in Wales infrastructures for self-composting have to be taken into account according to the requirements of TAN 21.

8.2 Promotion of research and development - Information - Implementation programme

8.2.1 National level

Measures for quantitative and qualitative prevention:

1. *Zero Waste Strategy; USA.* The Zero Waste Alliance (ZWA), a network of companies, universities, governments and non-profit organisations aims to reduce the amount of waste and pollutants following the example of nature. It therefore offers advice, planning and concept development as services.
2. *Waste prevention in rural areas, Austria.* Consultation project with public funding for waste prevention in rural areas.
3. *Material building pass, Austria.* With a material building pass the use and location of the main building material groups (concrete, metals, brick, glass) are recorded during construction or major reconstruction activities and define a base for their later re-use.

Measure for quantitative prevention:

4. *Programme "Factory of the Future", Austria.* The aim of the research programme is the initiation and implementation of exemplary sustainable technology development in companies. One focus is the prevention of waste.

8.2.2 Region

Measures for quantitative and qualitative prevention:

1. *Bricolage Design Prize; Australien.* Offering an award for the design of sustainable products out of secondary raw materials.

Measures for quantitative prevention:

2. *Competition “Regional product of the year“, Switzerland.* Support for the marketing of resource protecting products and services, participation of the population of Basel as jury.
3. *Waste prevention in hospitals, Austria.* Low-waste management, trainings and green procurement in a hospital in Burgenland with public funding.

Measures for qualitative prevention:

4. *Use of the "Environmental Technology Best Practice Programme" as a support for municipal decisions, UK.* Programme for local licensing authorities when assessing whether proposed measures take into account the objective of (particularly qualitative) waste prevention.

8.3 Development of indicators for the environmental impact of waste generation

8.3.1 Municipalities

Measure for quantitative prevention:

1. *Campaign "100 kg less waste per capita"; Europe.* The campaign of the European Association ACR+ assumes that in Europe a reduction of 100 kg of waste per capita is enforceable by simple means of prevention.

8.4 Promotion of eco-design

8.4.1 EU

Measures for quantitative and qualitative prevention:

1. *Product design for electrical and electronic equipment according to article 4 WEEE Directive 2002/96/EG*

Measures for qualitative prevention:

2. *Reduction of pollutants in vehicles and vehicle parts according to article 4 par. 1 of the ELV Directive 2000/52/EG*
3. *Prohibition of substances for electrical and electronic equipment according to article 4 par. 1 WEEE Directive 2002/96/EG*
4. *Prohibition and restriction of the manufacture, marketing and use of persistent organic pollutants according to article 3 par. 1 of the Directive No. 850/2004/EG*
5. *Prevention of pollution of waste containing persistent organic pollutants according to article 7 par. 1 Directive (EC) No. 850/2004*

8.4.2 National level

Measures for quantitative prevention:

1. *Eco-Emballages Packing Advisory; France.* Interface between companies and other stakeholders to promote recyclable packaging and reducing packaging waste. Training and consulting services to engineers, developers and small businesses.

2. *Introduction of minimum standards for products; UK.* Objectives are mainly the reduction of product weights and volumes and the extended durability of the products.
3. *Extension of the warranty period, Austria.* An extension of the statutory warranty on products can make a significant contribution to waste prevention.

Measures for qualitative prevention:

4. *Electronic Product Environmental Assessment Tool – EPEAT; USA.* Internet portal as a shopping guide for electronic devices funded by EPA. Only devices meeting prescribed standards are listed.

8.4.3 Municipalities

Measures for quantitative and qualitative prevention:

1. *Cradle to Cradle, USA, Europe.* Approach to ecological product design, particularly the abandonment of harmful chemical substances allowing an unrestricted reuse. Involved companies will receive a label and cooperate with each other regarding take back systems. Support from some municipalities especially in the U.S. and in Europe.

8.5 Information about best available technology

8.5.1 National level

Measures for quantitative and qualitative prevention:

1. *National Industry Symbiosis Programme (NISP); UK.* The NISP was established in 2005 as an "independent agent" to bring together companies from different sectors and different sizes in order to reduce pollutions, which arise during the product life cycle (from mining of raw materials to waste management).
2. *Waste prevention at construction sites; Luxembourg.* Brochure entitled "Waste prevention in organization and execution of the building work."
3. *STIP - Support and Information Centre on the Prevention of Waste, Belgium.* STIP, a project initiated by the Belgian Ministry of Environment, is based on three pillars: 1. improved information flows for the target groups 2. improved networking within the target group 3. feedback to different measures to the political actors.

8.5.2 Federal states

Measures for quantitative and qualitative prevention:

1. L*ocal Authority Prevention Demonstration Programme; Ireland.* National waste prevention programme in Ireland.
2. *Waste to Wealth Programme; USA.* Programme for the consultation of municipalities and SME in California regarding environmental protection measures (e.g. waste prevention), technology assessment, conceptions, case studies etc.
3. *National Construction and Demolition Council; Ireland.* Committee to promote prevention measures during demolition.

Measures for qualitative prevention:

4. *Reduction of hazardous waste from companies in different industries, Austria.* In 11 companies in Styria 964 tons per year of hazardous waste could be avoided by the programme.

8.6 Training of the licensing authorities

For this set no measure has been researched abroad. The “Waste to Wealth“ programme in California in the last chapter also contains aspects of this bunch of measures.

8.7 Measures in facilities not covered by the Directive 96/61/EC

8.7.1 National level

Measures for quantitative and qualitative prevention:

1. *Ecological waste management in companies, Luxembourg (236)*. Provision of information materials and free advice for the development of waste management and prevention concepts.

8.7.2 Federal states

Measures for quantitative and qualitative prevention:

1. *Waste prevention in business parks; Switzerland.* Project to implement waste reduction measures in a business in the district of Basel. In the 10 participating companies the generation of waste to be disposed has been reduced by 10%. The influence of waste prevention is unknown.

8.8 Sensitization - funding of specific measures - advice

8.8.1 National level

Measure for quantitative and qualitative prevention:

1. *Design for Environment Support; Japan.* Information portal of the Japanese Ministry of Environment, which is designed to support especially small and

medium-sized enterprises to take into account prevention when designing products.

Measure for quantitative prevention:

2. *Waste prevention in hospitals, Austria.* Research project on the "Analysis of the possibilities of optimizing the consumption and collection of materials in order to reduce the amounts of waste" and initiating their implementation.

Measure for qualitative prevention:

3. *Unified Green Cleaning Alliance (UGCA); USA.* The UGCA aims to support the development and dissemination of sustainable cleaning products on the market, especially in the industrial sector.

8.8.2 Regional level

Measures for quantitative prevention:

1. *Waste Cap; USA.* Consulting, training and concepts for companies on waste prevention in the construction and demolition industry.
2. *Incentive programme waste prevention, Austria.* Incentive programme initiated by the ARA together with Vienna and Lower Austria on waste prevention measures in small and medium enterprises (SMEs), local departments and enterprises, associations, educational and health facilities etc. Since 2009 also large companies can participate.
3. *Flanders Waste Prevention Plan, Belgium*, concept for incentives for companies, recommendations for local authorities, arrangements with defined target groups, and legal obligations. Aiming at reducing the amount of residual waste per inhabitant to 150 kg per year.
4. *The Green Business Initiative; Ireland.* Provision of instruments and tools and advice on resource efficiency in the three thematic areas of waste, water and energy.

8.8.3 Municipalities

Measures for quantitative prevention:

1. I*t's Smart with Less Waste' Helsinki'; Finland.* Raising of public awareness on the need for prevention and information for companies on ways of better resource management.
2. *Reusable instead of disposable, Austria.* Initiative of municipal waste consultants to activate consumers' pursuit of reusable products in retail.

8.9 Voluntary agreements - actor cooperation

8.9.1 National level

Measures for quantitative prevention:

1. *Halving Waste to Landfill; UK.* Voluntary agreement of construction companies to implement good practices in waste reduction, recycling and the use of recycled and recovered materials.
2. *Reduction of direct mail advertising, France*, voluntary agreement under the threat of tax. Aiming at a significant contribution for the reduction of residual waste at 200 kg per inhabitant per year. The potential of unwanted advertising material is estimated at 40 kg per household per year.
3. *Courtauld Commitment - Voluntary agreement with leading retailers to reduce packaging waste; UK.* In July 2005, 13 leading retailers signed the 'Courtauld Commitment', a voluntary programme to promote innovations in order to minimize packaging waste in households.

8.10 Promotion of environmental management systems

8.10.1 National level

Measure for quantitative and qualitative prevention:

1. *EMAS Poland.* A national branch of EMAS was established in Poland to support and implement the EMAS system, EMAS auditors and company representatives have been trained.

Measure for quantitative prevention:

2. *Waste Wise; USA.* Environmental management system that obligates the participants to waste preventing measures and thoroughly informs about results and progress. According to data from “Waste Wise” 1,700 members have reduced waste by 120 million tonnes since 1994. The influence of waste prevention is unknown.

8.10.2 Municipalities

Measure for quantitative prevention:

1. *Sustainable Concordia' Campus Waste Prevention Strategy; Canada.* The R 4 programme ('Rethink, Reduce, Reuse, Recycle') has been developed in order to reduce the cost and environmental impact of waste on the campus of the University of Montreal and is used as an environmental management system at 10 other universities.

8.11 Economic instruments e.g. for shopping

8.11.1 National level

Measures for quantitative prevention:

1. *Carbon Tax on Packaging; Netherlands*; packaging tax based on the climate footprint of packaging materials.
2. *Tax on products and packaging, Denmark.* Since 1978, packaging and various small products are taxed based on life cycle analysis of the used materials.
3. *Tax on Packaging*, Finnland. Since 1976, one-way packaging for beverages is taxed. The tax is 17 cents for a disposable packaging with deposit, 70 cents for those without a deposit.
4. *Levy on plastic bags, Ireland.* 22 cents per non reusable bag.

More indirect prevention approaches:

5. *Landfill tax; Ireland.* Since 2008: 20 € / t. Prevention effects for demolition and industrial waste.
6. *Waste incineration tax; Sweden,* the amount of tax for the incineration of household waste depends on the proportion of fossil carbon in the waste and the energy extraction of waste incineration plants. The promotion of waste prevention is an explicit goal.

8.11.2 Regional level

Measures for quantitative prevention:

1. *Pay-By-Use Domestic Waste Charges in Ireland; Ireland.* Payroll system for waste fees based on individual waste generation. The residual waste was reduced by 45%. The influence of waste prevention is unknown.
2. *Waste Tax Project; Italy.* Reduction of waste taxes by 5% for local authorities who committed themselves to the reduction of waste. Statistical collection and analysis of the current data on waste volumes to demonstrate the impact of waste prevention.

8.11.3 Municipalities

Measures for quantitative prevention:

1. *Individual differentiation of waste charges according to the rhythm of the discharge (DifTar), Netherlands.*
2. *Individual differentiation of waste charges according to the amount of waste generation (DifTar), Netherlands.*
3. *Payment via "expensive bag" (DifTar); Netherlands.* Garbage collection in garbage bags for 1 €.

8.12 Awareness raising - Information

8.12.1 EU

Measure for quantitative prevention:

1. *European Week for Waste Reduction.* Funded by the EU LIFE Programme. First execution in 2009, with more than 2,600 actions.

8.12.2 National level

Measures for quantitative and qualitative prevention:

1. *Zero Waste Manual "Nula Otpada"; Croatia.* Guideline published in December 2007 to waste relevant measures including prevention is aimed mainly at municipal authorities and stresses the need for joint action by all stakeholders (including NGOs and the public).
2. *A Guide to Environmental Community Service; USA.* Guide for examples of volunteer projects for the reduction of municipal waste, inspiring and motivating the citizens for active participation in waste projects.
3. B*rochure "Waste Prevention, Recycling, and Composting Options: Lessons from 30 US Communities"; USA.* Guide, which describes case studies for waste prevention in the participating municipalities.

Measures for quantitative prevention:

4. "*Love Food Hate Waste"- Campaign; UK.* Waste prevention campaign that offers practical advice such as meals planner, a calculator for the size of dishes, tips on proper storage of foods and recipes for the use of older food. Since the start, 1.8 million households have been involved and have prevented 137 000 tonnes of food waste.
5. *Menu Dose Certa; Portugal.* Consumer campaign with "green" procurement advisers. One focus is the reduction of organic waste from restaurants. Goal is to reduce the amount of food waste in restaurants per year and visitors by 48.5 kg.
6. *“Stop Pub”- letterbox stickers, France.* Campaign of the Ministry of Environment and Sustainable Development to reduce the flood of unaddressed mail using mailbox stickers.
7. *Influencing the consumer market by stimulation and suppression, UK*
8. *Waste Management Award "Phoenix - idea instead of waste", Austria.* Countrywide annual waste management price awarding creative, practical and / or innovative solutions and approaches that contribute to a sustainable development of waste management.

9. *Waste management concepts in schools, Austria.* Assistance for schools by the funding pool of the ARA for preparation of a waste management concept as by waste consultants. Co-financing the development of an e-learning tool.
10. *Waste prevention at major events, Austria.* Information to the organizers on specific prevention measures, including support by information material for visitors on waste prevention.
11. *K-12 Sustainable Schools programme; USA.* Initiative to teach schoolchildren about the important values of waste prevention by classroom instruction and other interaction opportunities.
12. *Service-Learning Education beyond the classroom; USA.* Collection of ideas for waste prevention projects in schools and neighbourhoods.
13. *Zero Waste Planning, United States*; programme to assist municipalities and other constitution to reduce the disposal of waste amongst others by means of waste prevention. The aim was a reduction of 60% by 2008.
14. *Waste prevention in the retail industry; Luxembourg.* Pilot project to promote low-waste and environmentally friendly products, such as reusable or returnable packaging (eg beverages), products in refill packaging (eg detergents) or from recycled materials.

8.12.3 Regional level

Measures for quantitative and qualitative prevention:

1. *California Waste Prevention Programme; USA.* Programme with a website on waste prevention, including second-hand market for consumers, communities and schools etc.
2. *Internet Portal "Eu Nao Faco Lixo"; Portugal.* Programme in eight communities with the support of actor collaborations. The Internet Portal encourages participating.
3. *Piedmont Home Composting Campaign; Italy.* Public awareness campaign on waste prevention with a focus on promoting home composting and reducing packaging waste.
4. *Waste prevention as a topic in vocational schools; Switzerland.* Development of principles for the teaching and mediation of prevention in various forms (teaching modules, teacher training, projects).
5. *Eden Project; UK.* Demonstration project to promote the public understanding of the responsible management of natural resources based on practical demonstration projects with suggestions for the everyday life of the visitors.

8.12.4 Municipalities

Measures for quantitative and qualitative prevention:

1. *Swap-O-rama-rama; USA.* Extensive awareness-raising and hands-on programme with the aim of extending the life cycle of clothing and reduce the associated environmental impacts.
2. *Increasing the environmental awareness of the population by actions on the municipal level; UK.* Using local media (radio, TV, press), working with schools, consulting for industry, commerce and industry with local associations, the measure aims at raising awareness among the population to increase the effectiveness of prevention measures by private households.
3. *Development and implementation of waste prevention concept in cooperation with the citizens, UK.* Involving the public in the aims of the strategy.
4. *Training of vocational teachers, Austria;* trainers and teachers from different areas were taught in the subject of waste for their different vocational contexts.
5. *Information on waste prevention in the local newspaper, Luxembourg.*

Measures for quantitative prevention:

6. *Waste prevention and recycling with the participation of citizens, Austria.* Project to achieve participation with the involvement of local people in working groups on waste prevention for a stronger identification with the topic.
7. *Waste awareness at school, Austria.* Waste prevention projects in schools, for example installation of a drinking water well to avoid aluminum cans (400 kg / a) and PET bottles (300 kg / a).
8. *Living and Breathing Recycling at ASU; USA.* Waste management concept at the University of Arizona with students as "recycling ambassadors". Focuses inter alia on reuse and recycling.
9. *Solid Waste Authority volunteer programme, USA*, programme for volunteer citizens to provide information on prevention, reuse and recycling ("Neighbor-to-Neighbor" and sponsorships for certain regions).
10. *Municipal management plan for schools and universities, Seattle.* Plan to promote the reuse and recycling of different materials.

8.13 Eco labels

8.13.1 Staat

Measures for quantitative and qualitative prevention:

1. *Incentive programme "Factory of the Future", for example: establishment of a Sustainability Label for electrical (electronic) devices (white and brown goods) with a design for recycling, Austria.* Development of the criteria for a Sustainability Label for equipment with a design for recycling, targeted marketing and public relations to manufacturers and consumers, training of examiners and awarding of the label.
2. *Clever Akfafen Ecolabel; Luxembourg. "Product labeling" initiative by the Environment Ministry and the SuperDrecksKëscht together with the Chamber of Commerce and the Consumers Union in Luxembourg with the aim of increasing the external perception and public awareness of organic products.*

8.14 Agreements with industry and trade

For this set no measure has been researched abroad.

8.15 Public Procurement - promoting private sector procurement

8.15.1 National level

Measures for quantitative and qualitative prevention:

1. *Green Purchasing Law; Japan.* Obligates all public bodies to promote a low-waste procurement and to report annually to the Ministry of Environment. For a better orientation a "green" standard is defined and updated annually for about 200 products.

8.15.2 Regional level

Measure for quantitative and qualitative prevention:

1. *Municipal procurement, Austria.* Municipal support for joint procurement with the integration of environmental criteria, such as eco guidelines or bonus points for local procurement.

8.15.3 Municipalities

Measure for quantitative and qualitative prevention:

1. *Local and green procurement (“Ökokauf”), Austria.* List of banned, tolerated and recommended cleaning agents for hospitals in Vienna, information programme for the economical use of cleaning agents, etc. This has saved

about 23% of cleaners and 10% of the cost. Extended to other categories of services.

8.16 Informal, economic, logistic and other ways of promoting concrete measures to reuse and repair - Networking

8.16.1 EU

Measure for quantitative prevention:

1. *Reuse of vehicle parts according to article 4 and article 7 Directive 2000/53/EC*

8.16.2 National level

Measures for quantitative and qualitative prevention:

1. *Nemsitt.hu Construction Material Exchange; Hungary*. Internet Portal for the trade of used construction materials
2. *No Disposables Campaign; Corea.* Campaign to reduce disposable materials and food waste mainly in (fast food) restaurants and retail.
3. *Development/Promotion programme "Factory of the Future", example: treatment and reuse of single-use medical devices under sustainability aspects, Austria. Average* waste reduction 80%.
4. *Development/Promotion programme "Factory of the Future", example: "Repa & Service Mobil"; Austria.* Development and pilot implementation of a mobile repair and service facilitiy.
5. *Increase in the proportion of reusable packaging, Austria.* Development of concepts for reusable packaging, including the design of the packaging.

8.16.3 Regional level

Measures for quantitative and qualitative prevention:

1. *Kringloop Reuse Centres; Belgium.* The reuse centers sort, collect, repair and sell used products. The long term goal is inter alia the reduction of the annual waste volume by 5 kg per capita.
2. *Promotion of washable diapers; Austria.* Financial Support (40 €) for the purchase of washable diaper packages.
3. *Reusable dishes / mobile dishwashing machine; Austria.* 1700 festivals, 1.9 million visitors, 1.3 million kg avoided waste or 0.7 kg per visitor.
4. *Fresh school milk from the farm, Austria.* Financial support for fresh school milk.

5. *Reuse-A-Shoe programme; USA.* Cooperation between the regional waste management company, the sports brand Nike and local secondary schools to promote the reuse of footwear.

8.16.4 Municipalities

Measures for quantitative and qualitative prevention:

1. *Vienna Waste Prevention Programme; Austria.* Many prevention initiatives in Vienna: Web Flea Market, Repair and Service Centre (23 local small repair shops for electrical devices), financial support for services and culture, instead of material goods, etc.
2. *Waste prevention in the health industry; Austria.* Use of digital x-ray equipment. Savings of disposable packaging.
3. *Mobile phones - waste prevention by collection and re-use; Austria.* Establishment of a reverse logistics system as a prerequisite for the subsequent re-use of complete appliances or components. The percentage for reuse is 66%.
4. *Quality standards in repair networks, Austria.* Following the development of regional repair networks, uniform quality standards for repair have been developed.

Measures for quantitative prevention:

5. *The Real Nappy Campaign, UK*, Manual for switching to reusable nappies and financial support.
6. *Repair, rental and second-hand guide; Austria*
7. *Flea market on the Internet, Austria*
8. *Food for the needy instead of mountains of rubbish; Austria.* Collection of expired food and hygiene products and distribution to the needy
9. *Purchase and use of reusable cups, Austria.* Event organizers in Vienna use reusable cups at various festivals.

8.17 Other measures

8.17.1 National level

Measures for quantitative and qualitative prevention:

1. *Register for electrical goods, Sweden.* The SFS law from 2005 as implementation of the WEEE directive established a mandatory register for electrical and electronic equipments as a condition for the implementation of the financial producer responsibility in the end of life phase.

2. *Landfill ban on certain fractions of waste, Netherlands.* The target is inter alia prevention and reuse of waste fractions, such as car batteries, oil filters, office waste, liquid waste etc.
3. *The Waste Council - A forum for actors in the waste field; Sweden.* Promoting the exchange of information between manufacturers, private recycling companies and local authorities to support sustainable resource management and to put together the necessary knowledge for innovative approaches.

Measures for quantitative prevention:

4. *Eco-Point Initiative, Italy, Switzerland.* Sales of everyday foods (such as rice, pasta, nuts, spices, coffee, etc.) without packaging or in appropriate dispensers.
5. *Planning Environmentally Aware Events; USA.* Exemplary event for waste professionals from 50 states and guide.
6. *Packaging ordinance; Sweden.*
7. *Building Material Control (UK aggregates tax),* Britain, tax for operators of mining plants (eg quarries) and other organizations commercially mining for building material.

8.17.2 Federal states

Measure for quantitative and qualitative prevention:

1. *Waste prevention in nursing homes; Switzerland.* Project with nursing homes. Reduction of waste by 36%.
2. *Strategy Group Waste Prevention / mass flow management*; Austria; group of all stakeholders involved evaluating waste prevention projects and developing focal themes for the following years.

8.17.3 Municipalities

Measure for quantitative prevention:

1. *Reduced paper use by switching to electronic corresponcence, Austria.* Project at a company for automatic data capture, supported inter alia by the City of Vienna, savings approximately 2850 kg / a of paper and paperboard.
2. *Eco-Business-Plan Vienna, Austria.* Programme of counseling services for different company sizes and industries regarding waste prevention, waste management, energy saving and climate protection.

9 Conclusions

The project aimed at providing a compilation of German and international waste prevention measures as a basis of the German waste programme. We can draw some preliminary conclusions from the German measures and policies in combination with a comparison of approaches in other countries.

The multiplicity of actions carried out in Germany shows a very broad range of measures and covers almost completely the list of examples in Annex IV of the WFD. The collected measures provide a good basis for a nationwide prevention programme. Therefore, from the point of view of the authors, the focus should be in particular on good coordination and networking of these individual projects less than on the development of new instruments and measures.

A starting point should be an optimized adaptation of the offer of information to the needs of specific target groups. Information on waste prevention activities can be found in a variety of different places. Partly, actors have started to gather this knowledge. Often there is a lack of opportunities to exchange experiences between stakeholders (producers, retailers, consumers, government, etc.) in order to realize possible learning effects. For the policy makers structures such as the Swedish Waste Council, enabling its participants to exchange experiences in the areas of waste prevention and resource management would also be desirable.

Therefore, one of the important objectives of a national waste prevention programme should be to represent a strategic reference framework for the coordination of actions at the federal, state and municipal level.

A common approach - each within its own specific jurisdictions - could certainly generate significant synergies between the different individual projects. In terms of a transition management (Geels 2004), this interaction between the different levels is of crucial importance if substantial changes are to be achieved beyond incremental innovations.

In view of established structures in waste management as well as consumption and production patterns, combined with many years of optimized behaviour and enormous investment in existing infrastructures it is clear that a prevention-oriented policy can not be successful without the involvement of various stakeholder groups: this includes both, the producers, who could substantially contribute to waste prevention by their decisions on product design as well as consumers, who need to be aware of a low-waste consumption pattern and have to be sensitized for waste prevention and resource conservation.

Waste reduction cannot be solved as an isolated problem. In many areas, it requires a change of framework conditions in order to set the necessary incentives for waste prevention. This includes, in particular in the field of qualitative prevention, the prohibitions of further substances, such as successfully implemented in the RoHS directive. But also for quantitative waste prevention deeper interventions are necessary if basic problems, such as cheap raw materials due to the externalization of environmental costs or the still too cheap disposal of waste should be faced. The chance to revive the issue of waste prevention with a specific programme

allows to intensify the necessary interaction between different measures and instruments. The success of concrete measures, such as:

- reduction of material consumption in production,
- durable design of products,
- use of low-waste products, with a variety of new approaches to benefit from any product without owning it,
- green procurement,
- extending the product life time by promoting repair and reuse, etc.

depends crucially on the creation of appropriate conditions by the use of legal tools and creating economic incentives, e.g. weight based waste fees in large residential complexes. Equally important is the support through intensive information and motivational programmes that usually have to be accompanied even after the introduction of the measures.

Since the success of waste prevention activities can be difficult to measure, the reports rarely contain information on the expected success of quantitative measures. Specific details of the avoided waste are usually found only on concrete activities in specific companies. Therefore a special focus should be on the development of appropriate, meaningful benchmarks, which could also reflect a shift in waste generation into other regions by the import of semi-finished and finished goods/products.

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