TEXTE
204/2020

Updating the Waste Prevention Programme: Preparing the foundations for updating the Waste Prevention Programme based on an analysis and evaluation of the implementation status

Final report

German Environment Agency

Umwelt Bundesamt

TEXTE 204/2020

Ressortforschungsplan of the Federal Ministry for the Enviroment, Nature Conservation and Nuclear Safety

Project No. (FKZ) 3716 34 328 0

Report No. FB000218/ENG

Updating the Waste Prevention Programme: Preparing the foundations for updating the Waste Prevention Programme based on an analysis and evaluation of the implementation status

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by

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Imprint

Publisher
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Report completed in:
April 2019

Edited by:
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Publication as pdf:
http://www.umweltbundesamt.de/publikationen

ISSN 1862-4804

Dessau-Roßlau, November 2020

Abstract: Updating the Waste Prevention Programme: Preparing the foundations for updating the Waste Prevention Programme based on an analysis and evaluation of the implementation status

Article 29 of Directive 2008/98/EC requires that Member States adopt waste prevention programmes (WPP). The German Federal Government first adopted the programme in July 2013 under the title "Abfallvermeidungsprogramm des Bundes unter Beteiligung der Länder" ("Waste Prevention Programme of the German Government with the Involvement of the Federal States"). The German WPP is to be evaluated every 6 years and updated as required in Section 33 of the German Circular Economy Act.

Under the circumstances of the upcoming review of the WPP due by 2019, the current status of the implementation of the WPP was to be determined and evaluated during this project. Other aspects not previously addressed in the WPP were also to be examined to see whether they contribute to waste prevention. Specific proposals to possibly develop and update the programme were elaborated based on the results of the analysis of the current status of the implementation of the WPP at the federal, state and municipal levels and an evaluation of existing prevention potentials. Specific proposals for measures concerning previously prioritised waste streams and relevant priority prevention approaches were developed to facilitate this.

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List of abbreviations

BAT	Best available techniques
BImSchG	Federal Emission Control Act (Bundes-Immissionsschutzgesetz)
BMBF	Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung)
BMEL	Federal Ministry of Food and Agriculture (Bundesministerium für Ernährung und Landwirtschaft)
BMJV	Federal Ministry of Justice and Consumer Protection (Bundesministerium der Justiz und für Verbraucherschutz)
BMI	Federal Ministry of the Interior (Bundesministerium des Innern)
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit)
BMUB	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit)
BMVI	Federal Ministry of Transport and Digital Infrastructure (Bundesministerium für Verkehr und digitale Infrastruktur)
BMWi	Federal Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie)
CAD	Computer-Aided Design
CHAFEA	Consumers, Health, Agriculture and Food Executive Agency
CONAI	Consorzio Nazionale Imballaggi (National Packaging Consortium)
CRD	Cumulative Raw Material Demand
EEA	European Environment Agency
EMAS	Eco Management and Audit Scheme
EMS	Environmental management system
EPR	Extended Producer Responsibility
EU	European Union
EWWR	European Week for Waste Reduction
FKZ	Research project no.
GDP	Gross Domestic Product
GHG	Greenhouse gas
HDPE	High-density polyethylene
KNB	Competence center for sustainable procurement (Kompetenzstelle nachhaltige Beschaffung)
KMU	Small and medium-sized enterprises (Kleine und mittlere Unternehmen)
KrWG	Circular Economy Act (Kreislaufwirtschaftsgesetz)
LCA	Life Cycle Assessment
OECD	Organisation for Economic Co-operation and Development
örE	Public waste management authorities (Öffentlich-rechtliche Entsorgungsträger)

PSS	Product service systems
PET	Polyethylene terephthalate
PP	Polypropylene
PRTR	Pollutant Release and Transfer Register
PSS	Product service systems
RC	Recycling
ReFED	Rethink Food Waste
RFID	Radio-Frequency Identification
SDG	Sustainable Development Goals
SME	Small and medium-sized enterprises
UBA	German Environment Agency (Umweltbundesamt)
VDI	Association of German Engineers (Verein Deutscher Ingenieure e.V.)
VerpackG	Packaging Act (Verpackungsgesetz)
WEEE	Waste of Electrical and Electronic Equipment
WFD	Waste Framework Directive
WPM	Waste Prevention Measures
WPP	Waste Prevention Programme
WRAP	Waste and Resources Action Programme
WWF	World Wide Fund For Nature

Summary

Article 29 of Directive 2008/98/EC requires that Member States adopt waste prevention programmes (WPP). The German Federal Government first adopted the programme in July 2013 under the title "Abfallvermeidungsprogramm des Bundes unter Beteiligung der Länder" ("Waste Prevention Programme of the German Government with the Involvement of the Federal States"). The German WPP is to be evaluated every 6 years and updated as required in Section 33 of the German Circular Economy Act. Under the circumstances of the review of the WPP due by 2019, the current status of the implementation of the WPP was to be determined and evaluated during the planned project. In light of previously unused waste prevention potential, the inspection orders specified in the WPP also had to be included. Other aspects not previously addressed in the WPP were also to be examined to see whether they contribute to waste prevention. Specific proposals to possibly develop and update the programme were elaborated based on the results of the analysis of the current status of the implementation of the WPP at the federal, state and municipal levels and an evaluation of existing prevention potentials. Concrete proposals for measures concerning previously prioritised waste streams and relevant priority prevention approaches were developed to facilitate this.

Current status of the implementation of the Waste Prevention Programme measures

The aim of Work Package 1 was to determine the current status of implementation of the WPP at the federal, state and municipal levels. To achieve this, the evaluators developed a fundamental structure for the analysis to be carried out, performed literature and source research on the status of the implementation of the various WPP measure areas and supplemented this with in-depth surveys of relevant stakeholders at the federal, state and municipal levels.

Based on the fundamental structure described in Chapter 2.1 the evaluators performed desk research of documented implementation activities in the federal, state and municipal governments. For this purpose, the evaluators conducted an examination as to which available publications contained summarising information on the current status of the implementation of waste prevention measures at the federal, state and municipal levels. Open-ended questions for the in-depth assessments were identified based on the research results. Subsequently, an individual survey concept was developed for each stakeholder level, which was specifically designed and substantiated with regard to both the content of the questions and the stakeholders to be interviewed.

Status of the implementation of the WPP at the federal level

In order to gather more detailed information on the implementation status of the WPP at the federal level, a survey was conducted on measures and activities regarding waste prevention among selected responsibilities at the level of federal ministries. This survey was conducted through telephone interviews with selected individuals from various ministries and higher federal authorities between October and December 2017. In each case, the questions were related to implementation activities in the WPP's main action areas and were supplemented by questions on how well known the WPP is and its significance for the respective departmental activities.
A summary of the results of the survey on the individual action areas is presented below.

Waste prevention in companies (industrial plants): The contact person from the Federal Ministry for the Environment (BMU), subdivision IG I 2 "Air pollution control for industrial installations", is familiar with the WPP from "word of mouth", but not with the concrete subject matter or the cross-references with the field of emission control for industrial installations. Within the Federal Ministry for the Environment, the contact person believed Division WR II 1

(Circular Economy) to be responsible for the implementation of these measures. The situation analysis of the WPP regarding the lack of current reference standards to make the operator obligations operational under Article 5 para. 3 of the Federal Emission Control Act[1] (BMU 2013, pg. 28) is considered still valid. The contact person does not currently identify any political drivers that would suggest strengthened waste prevention in the coming years in connection with further development of the BAT reference documents at the European level or in connection with the emission control efforts in Germany.

Waste preventing product design: The contact person from the Federal Environment Agency (UBA), Department III.1.3"Ecodesign, ecolabelling, eco-friendly procurement", is aware of the WPP and of the role of implementing the Ecodesign Directive 2009/125/EC and the implementation measures. She indicated that until now, implementing measures of the Ecodesign Directive have formulated waste prevention requirements for products only in exceptional cases, for example: durability of lighting products, durability of vacuum cleaner components. As part of the process of implementing the Ecodesign Directive, intensive standardisation work is currently taking place based on the standardisation mandate M/543, which aim to make it possible to test products with regard to their reparability, durability, upgradeability, etc. This work is intended to enable better product evaluation with a view to include consideration for waste prevention and to define waste preventing product requirements as necessary in the future. The extent to which Germany actively supports ecodesign requirements that have a waste preventing effect in the consultations and in the regulatory committee will only become clear in the coming months. Consultations are currently pending, as the EU Commission is calling for requirements to be formulated even now, insofar as these are possible without standardization. In a few months, votes on requirements will also probably be pending (e.g. on the repairability of "white goods"). The EU Commission is clearly the driving force behind this issue. Germany generally supports the EC in this process, while there are certainly other Member States which tend to slow things down and make demands to wait for the end of the standardisation process.

Waste preventing public procurement: The contact person from the Federal Ministry of the Interior (BMI), Competence Centre for Sustainable Procurement (KNB) is aware of the WPP and of the reference to the Competence Centre for Sustainable Procurement[2] in the programme. According to the contact person, the focus of the activities at KNB is to train procurement office employees. KNB also collects guidelines written by other entities and additional tools on sustainable procurement and uploads these on its website. KNB only creates its own work aids in few exceptional cases. Thus far, it has developed two guidelines (on electromobility and on resource efficient procurement of building materials). Waste prevention aspects are an important topic for training in resource efficiency, albeit not directly under the name "waste prevention". Examples of training content within the context of waste prevention include among others:

- Product tenders for electrical equipment (e.g. computers without packaging and manuals)
- Formulation of packaging requirements in the specification of services (e.g. for textiles delivered in bulk as opposed to individually packaged)
- Prevention of food waste

[1] Act on the prevention of harmful effects on the environment caused by air pollution, noise, vibration and similar phenomena (Federal Emission Control Act - BImSchG), as amended from 17 May 2013 (BGBl. I pg. 1274), last amended by Article 3 of the Law of 18 July 2017 (BGBl. I pg. 2771)

[2] KNB is responsible for advising all procurement entities that must procure according to public procurement law. However, it deals exclusively with the procurement of products and services, not with construction projects.

- Avoidance of plastic dishes in catering services.

Food waste prevention: The WPP is well known to the contact person at the Federal Ministry of Food and Agriculture (BMEL), Division 216 "Sustainable Nutrition, Reduction of Food Waste", also thanks to active participation in various workshops and expert discussions on the implementation of the WPP. According to the contact person, the head of the newly formed Division 216 "Sustainable Nutrition, Reduction of Food Waste" is also fundamentally aware of the existence of the WPP and their partial overlap of objectives and activities.
Notably, the "national strategy" on the prevention of food waste currently being developed by the BMEL will continue to show relevant overlaps with waste prevention efforts in the context of the WPP. They could give rise to a corresponding need for consultation and coordination between the two. Regarding the work on updating the WPP, the contact person suggested that the necessary need for coordination between the WPP and a future "national strategy" be discussed in a coordination meeting at the technical working level based on the work progress achieved.

Product use intensification (car sharing example): Implementation activities in the area of use intensification were assessed using the example of car sharing. Relevant entities in the transport and environment ministries were interviewed for this purpose. These were the Federal Ministry of Transport and Digital Infrastructure (BMVI), Division G 23 "Passenger Transport, Public Transport Systems", and the BMU, Division IG I 5 "Environment and Transport, Electric Mobility". The contact persons were unaware of the WPP. According to them, programmes such as the "Climate Protection Plan 2050" (BMUB 2016b) are more relevant, especially the chapter on "Climate Protection and Transport", and the Federal Government's "Sustainability Action Programme" (State Secretary Committee for Sustainable Development 30 March 2015). They do not believe that there is a need for support from other federal programmes. The Federal Government promotes car sharing through the Car Sharing Act, which entitles municipalities to grant certain privileges to users of car sharing systems in public spaces through the provision of parking spaces. The purpose of this measure is to reduce individual car ownership. However, the object of this measure is not waste prevention but rather air pollution control, economical inner-city land use and climate protection.

Research funding: The WPP was not previously known to the contact at the Federal Ministry of Education and Research (BMBF), Div. 724 "Resources and Sustainability". However, the contact noted the existence of the WPP with great interest, as it could prove helpful in justifying the formation of current research priorities. They expressed various overlaps between the action areas in the WPP and existing research funding priorities: With regard to waste-preventing plant technology, there are also regular activities in Division 5 "Key Technologies – Research for Innovations". From the area of Division 7, the "KMU innovative" programme was deemed relevant, as it also allows new resource-efficient technologies to be funded. The often necessary expansion of available waste-prevention technologies and the promotion of non-investment measures (such as in the area of waste-prevention handling practices, training etc.) are still not a focus of the BMBF's responsibilities. In this respect, reference was made to the funding activities of BMU and BMWi.

Status of the implementation of the WPP at the state level

The reporting from the federal states on their waste prevention activities (and on the activities of the municipalities/public waste management authorities (örE)) is conducted in different ways and, most notably, with significantly varying degrees of detail. The description of waste prevention activities in the waste management plans and waste balances of the federal states does not refer to the measures indicated in the annex to the WPP. In individual cases, however,

they are assigned to the measures in Annex 4 of the waste framework directive (UM 2015; MKULNV 2015). In light of the knowledge gaps regarding the implementation status of the WPP, the evaluators worked together with UBA/BMU to design and conduct an online survey of the competent federal state authorities in order to systematically collect further information.

All 16 federal states participated in the survey. [3] The evaluators received a response from all federal states to the core questionnaire. Seven federal states have also answered all the in-depth questionnaires. Eight federal states have answered at least one in-depth questionnaire.

Eight federal states have established a central responsibility for the implementation of the WPP. Conversely, funds for state-run activities or third-party activities were only provided in four and three federal states respectively. A formal decision was made to adopt the WPP in two federal states. Additional human resources were made available in only one state. [4] Ten states reported events held on the topic of waste prevention. Nine states indicated that analyses of waste prevention potential were produced/commissioned. In eight states, expert opinions have been prepared/commissioned to review the current condition of waste prevention activities and/or public campaigns have been initiated. Five states indicated that working groups related to waste prevention have been established with external stakeholders from business and civil society. Four states indicated that interdepartmental working groups have been established. Two states indicated that the topic of "waste prevention" has been included in the curriculum.

Departments in the environment ministries of the federal states were asked to assess familiarity with the WPP in their own department, as well as in other areas, such as general environmental administration, the public waste management authorities and businesses. The degree of familiarity with the programme was assessed very differently by the departments in relation to the surveyed areas. In the field of "waste management", awareness was rated comparatively high in most federal states. The level of awareness was rated significantly lower in all other areas. In the "general environmental administration" and in the "environmental administration of municipalities" the WPP seems to be much less well known. With regard to "civil society" and "business", awareness of the programme was mostly deemed low.

In some instances, the respondents evaluated the significance of possible obstacles to implement the WPP very differently. The following aspects were determined to be major obstacles of particularly high relevance:

- a low legally binding nature,
- lack of human resources and
- lack of subsidies.

Status of the implementation of the WPP at the municipal level

At the municipal level, the performed implementation efforts consisted almost exclusively of waste management plans and waste balances sheets of the federal states as well as the assessments of some states on the current status of selected action areas. Systematic assessments on the current status of such municipal activities were conducted in four of the federal states. [5] In each case only the public waste management authorities were asked about selected action areas. [6]

[3] Survey period: 04 April 2017 to 19 July 2017

[4] The human resource is a project office for public relations work in waste prevention limited to one and a half years.

[5] The federal states were Schleswig-Holstein, Lower Saxony, Saxony and Baden-Württemberg.

[6] The action areas were waste prevention consulting measures and activities to promote reuse.

The waste prevention activities of the public waste management authorities mainly include general information and consulting services, either online or during general waste consulting. Such general information on waste prevention can be observed in a majority of the public waste management authorities, although other activities are less common. This primarily includes activities initiated and/or supported by the public waste management authorities, such as used-goods market places on the Internet, flea markets, mobile dishwashing station rentals and references to used goods department stores or repair initiatives in the region.

By contrast, other municipal waste prevention activities (e.g. repair activities carried out by the public waste management authority, etc.) or established collaborations for instance with reuse facilities from the social economy sector are the exception. This also includes temporary actions (e.g. during the European Week for Waste Reduction (EWWR)), such as school projects, activities to switch out disposable bags for reusable bags or communication projects with local media.

The outlined results of the literature evaluation coincide with the direct experiences of the evaluators from the discussion processes accompanying the nationwide surveys in three federal states.

A supplementary evaluation of all German activities, which can be found in the EWWR database, also showed that the public waste management authorities were almost consistently active as initiators at the municipal level and that these were almost exclusively measures concerning extended waste consulting to citizens mentioned above (Verband kommunaler Unternehmen e.V. o.J.a – German Association of Local Utilities o.J.a).[7]

The contractors first designed and prepared an online questionnaire in order to gather additional and more detailed information on the implementation activities at the municipal level and to determine which of the WPP action areas they correspond to and what obstacles stand in their way.

Four of the five interviewed waste collection centres are aware of the existence of the WPP. One centre was unaware of the WPP. None of the respondents could answer who is responsible or accountable for implementing the WPP in the municipality. Two of the centres stated that they had read the programme. Only one of these two centres could specifically remember having officially received the WPP. None of the interviewees were able to recall during the course of their respective conversations that the WPP or the measures mentioned therein had been the subject of discussion or debate by other municipal government authorities or institutions since it was adopted in 2013. It became equally clear that the respondents are under the impression that no consistent, effective measures to reduce the amount of waste are being implemented either at state or federal level, and that there is also a lack of serious municipal and federal political willingness to implement waste prevention.

Acceptance of the term “waste prevention” and identification with the topic vary greatly among stakeholders from “non-waste sectors” that intersect with waste prevention, such as sustainability, resource efficiency or climate protection. Upon hearing the term “waste prevention”, something immediately came to mind for the majority of the interviewees from the “non-waste sector” and they have indeed worked on waste prevention in the past (although mostly not with this label, but rather through events on topics such as resource efficiency, sufficiency etc.). However, the other interviewees clearly rejected the topic and pointed out that other waste authorities were responsible. Almost all of the respondents were able to report on

[7] A broad range of highly creative and high-profile activities will undoubtedly be performed. However, a systematic involvement of other “areas” of local government seems to be limited.

measures and activities which (also) pertained to waste prevention or which are mentioned in the WPP. In many cases however, the interviewees were only able to cite these activities, which were often under different headings, after the evaluators had given them specific references to the activities.

Assessment of ten selected waste prevention measures

The aim of Work Package 2 was to scientifically analyse the implementation status of the WPP and to evaluate corresponding progress towards improved waste prevention on a scientific basis in order to then develop complementary measures with respect to prevention potentials that had not been identified and/or addressed yet. As a first step, the implementation status was evaluated based on the survey of the current situation at the federal, state and municipal levels. As a second step, the environmental effects of implementing individual waste prevention measures were assessed.

To this end, the following eight measures were selected, as sufficient specifications could be identified for the measures and information on the savings potential of waste could be derived from them.

- Measure 2: Stakeholder cooperation. One example chosen for this measure was the reduction of food waste for out-of-home consumption through the *Restlos Genießen* campaign. Concrete data were available on the amount of food waste that could be saved and converted into specific food categories (wheat, beef, etc.) based on UBA-Texte 85/2016.
- Measure 7: Identifying product-specific requirements for waste-preventing product design within the scope of implementation measures for the EU Ecodesign Directive. The example selected for the identification of product-specific requirements for waste-preventing product design was the initiative for standardised smartphone chargers. It was possible to estimate the amount of waste prevented using assumptions (proportion of smartphones sold without a charger in Germany) and life cycle inventory data.
- Measure 18: Agreements between industry/trade and government agencies on waste prevention. Due to the current relevance of the topic, the "Agreement to reduce the consumption of plastic bags" was chosen as an example.
- Measure 21: Promoting waste-preventing product service systems. Stationary rental services were selected as an example for this measure. These services are increasingly offered in practice and also portray a clear potential for supportive measures by the public sector.
- Measure 22: Promoting waste management structures and systems that promote waste prevention. The example selected for this measure was a fee structure based on the polluter-pays principle, for example through waste fees based on weight or volume with accompanying waste prevention consultation, in which support for waste prevention is also repeatedly mentioned as an argument, in addition to incentives for optimised separation.
- Measure 30: Promoting the reuse or multiple use of products. The second-hand department store *Stilbruch* in Hamburg was chosen as an example for this measure. The store is one of the best practical examples in the reuse sector on a national scale and provides a transparent data base for its activities.

- Measure 31: Supporting repair networks. Repair cafés have been selected as an example for this measure. These have made decisive contributions to raising public awareness in recent years and in getting the public involved in the possibilities of extending the service life of products.
- Measure 33: Designing events in public facilities to prevent waste, reusable instead of disposable: In this field, there are always opportunities to contribute to waste prevention in public spaces, especially for local authorities.

Updating the WPP

Based on the evaluations of the current status of the implementation of the WPP at the federal, state and municipal levels, as well as the feedback from the stakeholders involved in the expert discussions of the research project, it is clear that the large number of starting points mentioned in the existing WPP have by no means lost any relevance. However, due to the wide range of topics, it is still up to debate as to where the various stakeholders should or can set priorities. At the same time it was pointed out during the surveys that the previous structure of the WPP has also caused confusion as to what the stakeholders should use as guidance during their efforts to prevent waste due to rather broadly described action areas in Chapter 4 and comparatively small-scale case studies in Chapter 6 of the WPP.

In light of this, proposals should be developed to update the WPP, which may aim to achieve

- both better prioritising of waste streams (see Chapter 3.1) and specifications of prevention concepts (see Chapter 3.2),
- as well as a stronger institutional foundation and a more action-oriented structure in the WPP (see Chapter 3.3).

For both aspects, importance was attached to ensuring that the content and structure of the WPP is as compatible as possible with existing structures and initiatives. In view of the cross-sectorial character of waste prevention, the WPP is not intended to develop parallel structures, but to link ongoing projects and processes with the greatest possible synergy effects for waste prevention.

Very different criteria can be used to prioritise waste streams in the WPP. In principle, the main focus should be on the specific environmental and human health impacts caused by waste generation, which should be reduced in accordance with the objectives of the WPP. However, such impact-related data are virtually unavailable. Thus further aspects can be used, such as the actual prevention potential, the development of the waste volume and also the real recycling paths (waste prevention should therefore be given priority for example in those areas where it has not yet been possible to recycle the recyclable materials contained in the waste to a high quality).

During the project, a three-step procedure was chosen to underpin the prioritisation:

- Systematic analysis based on German waste statistics,
- Analysis of the development of aggregated waste streams compared to other EU Member States and
- Analysis of priority waste streams in existing WPPs from other EU Member States or regions responsible for the WPPs.

The analysis of the relative and absolute growth of waste streams entering as input into different waste treatment facilities has produced two sets of rankings each for the period of 2006-2015 and 2006-2014. The results of the rankings for percentage growth compared to absolute growth show little overlap. Only 4 or 5 waste code numbers[8] are in the top 30 in both absolute and percentage increase. It is also striking that high percentage growth does not necessarily mean a high absolute waste volume. For several waste codes, the absolute increases are workable considering the overall very small quantities used, even if the percentage increases are in excess of 1,000 %. With very low initial values in 2006, even comparatively low growth rates can result in very high percentage increases. Therefore, the absolute growth rates are better suited to identify priority waste streams that should be studied for their prevention potential. Starting points for more in-depth investigations based on these evaluations could include:

- waste in the construction & demolition sector,
- industrial waste,
- secondary waste from waste treatment,
- food waste and
- packaging waste.

A further limitation is that no growth can be shown for 84 (between 2006-2015) or 86 (between 2006-2014) waste codes, as no data are available or have not been recorded for either the start or end year. However, a review of these waste codes shows that – apart from a few exceptions – the waste categories that are primarily affected are those where only small quantities have been documented overall.

The following possible priority starting points were identified based on the analytical steps described and also given the experience of the evaluators at the state level and in the assessment of the European programmes. Analytically (and thus also following the logic of action of many stakeholders) a distinction is made between priority waste streams and priority waste prevention concepts. While the waste streams can certainly be addressed by different instruments, the prevention concepts also refer to different waste streams.

Priority product groups / waste streams

- Plastic packaging waste
- Food waste
- Waste electrical and electronic equipment
- Construction and demolition waste

Priority prevention approaches

- Public procurement
- Repair/reuse
- Promoting product service systems.

[8] Waste code 010408, 010411, 100117, 100115 during 2006–2015 or 010411, 100117, 190307, 100115, 191202 during 2006–2014.

Specific suggested measures for priority waste streams

Concrete proposals for measures were outlined that could be taken up in a WPP based the analyses of waste streams to be addressed as a matter of priority from a waste prevention perspective.

Plastic packaging waste

In 2016, a total of 18.16 million tonnes of packaging was consumed and thus accrued as waste. 17.65 million tonnes of this waste were recycled (12.84 million tonnes materially, 4.77 million tonnes energetically). Compared to 2015, packaging consumption has risen by 0.05% or 8,700 tonnes to the highest level ever recorded. In 2016, the consumption of packaging that was generated as waste by private end consumers increased by 0.7% or 62,200 tonnes compared to the previous year. The consumption of plastic packaging in particular has even doubled compared to 1995 levels (Schüler 2018).

The following concrete approaches for action were identified:

- Supporting voluntary agreements to avoid plastic products with an extremely short life span such as plastic straws
- Implementing financial incentives to reduce packaging via the German Packaging Act
- Supporting pooling systems in transport packaging
- Supporting reuse and reusable systems.

Food waste

In Germany, approximately 11 million tonnes of food are discarded each year (Kranert et al. 2012). This does not factor in losses from the agricultural sector. Households generate approximately 6.7 million tonnes or 82 kg of food waste per person per year, 4.35 million tonnes or 53 kg of which are considered preventable (47%) or partially preventable (18%). Out-of-home consumption generates approximately 1.9 million tonnes of food waste per year. According to the calculations, approximately 550,000 tonnes are generated in trade and approximately 1.85 million tonnes in industry.

The following concrete approaches for action were identified:

- Collecting data on food waste and losses according to EU methodology
- Establishing a coordination unit and sectoral working groups for monitoring
- Imparting the economic added value of reducing food waste to stakeholders
- Strengthening consumer education and implementing it in existing structures, integrating psychological research into research on food waste prevention
- Legal requirements and voluntary agreements for food trade and industry
- Digitalization (e.g. “dynamic shelf life”) and improved transparency in the value chain by optimising data acquisition, exchange and processing

Waste electrical and electronic equipment

In Germany, the collected quantity of waste electrical and electronic equipment (WEEE) in 2016 totalled 782,214 tonnes, 711,005 tonnes of which were collected from private households (UBA 2018a). WEEE represents a challenge, especially regarding qualitative waste prevention and in light of the resources required to produce this equipment.

The following concrete approaches for action were identified:

- Proof of technical service life and availability of spare parts by manufacturers (see also Schlacke et al. 2015 and UBA 2017d), open source solutions such as 3D printing of spare parts
- Supporting free software and hardware solutions
- Obligation for public waste management authorities to provide evidence of cooperation with internal or external reuse facilities

Construction and demolition waste

Reducing construction and demolition waste is an important factor in reducing resource consumption and achieving European and national waste reduction targets merely by virtue of the quantities involved. For example, the amended European Waste Framework Directive and the German Circular Economy Act stipulate that the preparation for reuse, recycling and other material recovery of non-hazardous construction and demolition waste must be increased to a minimum of 70 per cent by weight by 2020. The ordinance known as "Mantelverordnung", which is currently being prepared, is intended to regulate the handling of mineral substitute building materials uniformly throughout Germany.

The following concrete approaches for action were identified:

- Establishing raw material passes for buildings
- Promoting construction item exchanges
- Recognition for exemplary preservation of old structures

Priority concepts for waste prevention

Public procurement as a driving force for waste prevention

Public procurement is a market-based approach to support waste prevention, which has been repeatedly mentioned both nationally and internationally. The aim is to integrate waste prevention criteria into public procurement requirements, thereby supporting existing low-waste alternatives on the market, such as more durable products, and creating dynamic incentives for the development of such products given the financial dimensions of public procurement.

With this in mind, the following four measures could provide additional momentum in the WPP to integrate waste prevention more closely into public procurement practice.

The following concrete approaches for action were identified:

- Developing binding procurement requirements in the form of regulations or other legal acts for the procurement of goods and services that prevents waste
- Developing concrete guidance on waste prevention for public procurement
- Supporting or educating public procurement employees in the field of waste prevention
- Implementing consumer conferences on environmentally friendly procurement.

Repair/reuse

The extension of product life cycles through repair and remanufacturing is mentioned in both the German WPP and the Waste Framework Directive as a key approach to waste prevention.

> "Member States shall take measures, as appropriate, to promote the re-use of products and preparing for re-use activities, notably by encouraging the establishment and support of re-use and repair networks, the use of economic instruments, procurement criteria, quantitative objectives or other measures." (Article 11(1) of the Waste Framework Directive).

With this in mind, the WPP could adopt the following five measures. This will provide some overlap in content with the topic of WEEE as a priority waste stream, where the topic of repair should naturally also play an important role.

The following concrete approaches for action were identified:

- Supporting circulation of an umbrella brand and quality standards for reuse and repair facilities (second-hand products); including support for the development of insurance packages for repair shops
- Introducing a reduced VAT rate for repair services by SMEs
- Supporting standardisation of repair-friendly products

Supporting product service systems

One of the key challenges of waste prevention is the fact that industry and trade are clearly interested in selling as many products as possible, thus stimulating economic growth and generally increasing waste volumes. The mass and complexity of the products purchased annually and the associated material consumption and waste volume are constantly increasing in industrialised countries. However, in most cases it is not at all about the possession of products, but rather about the benefits derived from them (Environment Agency Austria 2008, pg. 7). With this in mind, product service systems (PSS) are a central approach of waste prevention as they follow the basic idea of "using products instead of buying them".

It is thus recommended that the new WPP sharpen the thematic focus of this approach and take greater consideration for the limits of the concept (keyword "rebound effects").

The following concrete approaches for action were identified:

- Identifying the scope of application with i) high waste prevention potential and ii) real need for public support
- Supporting the demand for product service systems

Examining the structure of the existing WPP and proposals for updating the WPP

In addition to the content, the structure of the existing WPP was also to be examined during this research project to determine possible adaptation and modification requirements.

The following steps were taken chapter by chapter in order to identify the areas of the current WPP where there may be a need for structural adjustments and changes and how this need could be implemented:

1. An examination of the weaknesses, deficits or change requirements identified in the analyses of the current status and cited by various stakeholders involved in the corresponding surveys and in technical discussions.
2. Compiling conceptual ideas and proposals for further structural development resulting from the work and discussions on surveying (work package 1) and potential analysis (work package 2)

3. Identifying the activities that would be a necessary requirement if the desired or proposed changes and additions were to be implemented.

Results regarding the existing Chapters 1 & 2 of the WPP

With regard to the previous Chapter 2, representatives from all governmental levels (from the federal ministries, the federal states and local authorities) used the surveys to describe the lack of clarity on basic concepts as unsatisfactory and in some cases irritating.

Ideas and suggestions for possible solutions:

In order to overcome this ambiguity, the following proposals have been identified or developed during the course of the work:

- Explicit designation of governmental and non-governmental authorities responsible for the WPP.
- Emphasis on the cross-sectorial nature of waste prevention and the relevance of non-waste and non-environmental political and administrative aspects to successfully address this societal challenge.
- Clear designation of commitment on behalf of the state bodies responsible for the WPP.
- Inclusion of wording that will make clear how other non-state stakeholders are invited/prompted/encouraged to participate in the waste prevention effort.
- Support for the stakeholders in the discussion and implementation of chemicals legislation in their efforts to implement the central objectives of waste prevention.

Results regarding the existing Chapter 3 of the WPP (waste prevention targets)

The lack of (quantified) objectives or defined milestones is considered problematic by some municipalities and particularly by committed supporters of waste prevention at the state level. From the point of view of these stakeholders, this lack of specification makes it difficult to focus implementation efforts and tap the necessary resources at the respective levels of action.

Ideas and suggestions for possible solutions:

- Examine whether the indicators developed during a currently completed departmental research project[9] (Wilts et al. 2019) should be included in the WPP, such as overall economic waste intensity. Formulate quantified targets for indicators that are suitable for measuring the success in certain areas of activity and on which the updated WPP focused such as implementing the proposals from the authors of this report. These can be corresponding objectives at appropriately defined milestones during the implementation of measures (see the proposals for Chapter 4), which can be differentiated over time (short, medium and long-term).
- In light of the existing uncertainties, these objectives can certainly be formulated as "orienting" target margins with a corresponding tolerance range.

Results regarding the existing Chapter 4 of the WPP **(**specific waste prevention measures**)**

This revealed existing uncertainties regarding the level of detail of the "Recommended Measures" described in Chapter 4 of the WPP.

[9] FKZ 3715343020

Ideas and suggestions for possible solutions:

- It will be useful to make a clearer distinction to avoid the uncertainties regarding the degree of specification or detail mentioned by some stakeholders in Chapter 4 and in the Annex of the WPP. We suggest that we deliberately only speak of approaches for action and action areas in Chapter 4, and describe them in such broad terms that all relevant descriptions of measures in the Annex fit. The measures in the Annex should again be very clearly identified as "exemplary" examples of measures in order to leave room for the development and implementation of other measures that fit into the recommended action field in Chapter 4.

Results regarding the existing Chapter 6 of the WPP (annex measures and their evaluation)

Representatives from all target groups of the WPP repeatedly questioned the character of the list of measures in the Annex of the WPP. The Annex has repeatedly been used as a sort of "complete list of proposals" in previous implementation practice, particularly in the political debate on whether waste prevention measures can and should be implemented. (Even here), it is often stated that the descriptions are clearly not specific enough for direct implementation. In connection with the overall character of the WPP, the fact that in some cases "non-state stakeholders" are mentioned as initiators or co-initiators of measures gives rise to questions both on the part of the mentioned non-governmental organisations which often "reflexively" question the legal basis for the alleged obligation, and on the part of representatives of the state authorities who argue that much more could be done for waste prevention on the part of private sector and civil society stakeholders and that the contribution of the state authorities should therefore be put into perspective more explicitly.

Suggestions and ideas for possible solutions:

- As already explained in the context of Chapter 4 of the WPP, we consider it useful to introduce a much stronger differentiation in terms of content and language between waste prevention approaches and action areas, waste prevention instruments and waste prevention measures, annulment or more specific description as explicitly stated "possible example measures".
- On that clearly structured basis, we can then decide whether recommendations on "instrumentation" should also be made in addition to the recommended focal points on waste prevention approaches and action areas in Chapter 4 of the WPP, or whether the presentation of possible instruments in the implementation of activities in the prioritised action areas should be shifted to the Annex.
- As for the truly illustrative, exemplary "implementation measures", reference should perhaps be made to descriptions outside the WPP itself, for instance regarding municipal implementation measures to the list of measures for the "European Week for Waste Reduction (EWWR)".
- In the interest of clarity on the nature of the WPP as a guiding framework for the self-regulation of government agencies, descriptions of action areas, instruments and measures should be consistently formulated in such a way that the initiative lies with the government agencies.

Further research needs

The analyses performed during this project have generated extensive information on the current situation of the WPP implementation, on obstacles, on the environmental effects of individual measures and on the possible key topics derived from these measures for the continuation of the programme. Nevertheless, considerable research is still needed in the field of waste prevention if waste volumes and the associated environmental burdens are not only to be separated from economic development, but also significantly reduced, as required by the Sustainable Development Goals for example.

With this in mind, below are identified individual aspects with a special need for research. The structure is based on the chronological approach in the project and does not depict priority of individual issues.

- Further research need 1: Involving local stakeholders in the WPP
- Further research need 2: Horizontal crossover of waste prevention
- Further research need 3: Environmental impacts of individual waste streams
- Further research need 4: Efficiency and comparability of individual waste prevention measures.

1 Objectives and procedures[10]

Article 29 of Directive 2008/98/EC requires that Member States adopt waste prevention programmes (WPP). The German Federal Government first adopted the programme in July 2013 under the title "Abfallvermeidungsprogramm des Bundes unter Beteiligung der Länder" ("Waste Prevention Programme of the German Government with the Involvement of the Federal States"). The German WPP is to be evaluated every 6 years and updated as required in the German Circular EconomyAct. Under the circumstances of the upcoming review of the WPP due by 2019, the current status of the implementation of the WPP was to be determined and evaluated during this project. Other aspects not previously addressed in the WPP were also to be examined to see whether they contribute to waste prevention.

The aim of the first Work Package (Chapter 2) was to determine the status quo of the implementation of the WPP at the municipal, state and federal levels. An analytical framework was developed for this purpose, covering the status of implementation, obstacles to implementation and further planning. The implementation activities for the subsequent evaluation were determined based on literature and source research. Following this general survey, open-ended questions were identified and addressed in in-depth surveys. Separate methods were selected for these depending on the respective stakeholder level. The survey methods included telephone interviews, technical workshops, online surveys and bilateral discussions.

In the second work package (Chapter 3, the waste prevention measures were assessed to identify untapped and/or unaddressed waste prevention potentials in order to further develop and update the WPP. Ten representative waste prevention measures which may provide concrete results in waste prevention were selected from Chapters 4 of the WPP ("Specific waste prevention measures") and 6 ("Appendix: Measures and their assessment"). These measures were further substantiated in order to permit an assessment. After a discussion of the assumptions, an environmental assessment of the individual waste and material flows was performed. Recommendations for updating the WPP shall also be made based on the evaluations.

The third work package (Chapter 4) includes an elaboration of the foundations to further develop and update the WPP. In this section, points were identified at which the various stakeholders should and can take priority action to contribute to achieving the objectives of the WPP. To this end, waste streams were first prioritised using three analytical steps: a systematic analysis was performed based on German waste statistics, a comparison of volume trends in other EU Member States was made and the prioritisation of waste streams in other EU Member States' Waste Prevention Programmes was examined. Various criteria were used to substantiate prioritisation. First the environmental and human health impacts associated with waste generation – however since data on this are scarce, other factors such as actual prevention potential, waste generation trends and real recycling routes have been included. Priority waste streams and prevention approaches were determined based on this analysis, for which concrete initiatives shall be subsequently identified and successful examples shall be presented.
In addition to the analysis of the content, the structure of the existing WPP was examined to assess the need for structural adjustments and changes to the programme and to identify the necessary conditions to implement it. The analysis was carried out in a three-stage procedure for each chapter of the WPP, beginning by examining which weaknesses, deficits or necessary changes were mentioned by the various stakeholders in the surveys and expert discussions on

[10] Detailed descriptions of the procedures and methodology can be found in the respective chapters.

the status quo of the WPP. This was followed by a compilation of the conceptual ideas and proposals for further structural development resulting from the work and discussions on the status quo and potential of the WPP in Work Package 1 and Work Package 2. Subsequently, activities were identified that could be deemed necessary for an amendment or addition in the WPP.

Finally (Chapter 5) need for further research was identified based on the analyses carried out during the project in order to decouple waste generation and the associated impacts on human health and the environment from economic growth – as envisaged in the WPP –as well as to achieve a significant reduction in waste generation.

2 Status of the implementation of the Waste Prevention Programme

The aim of Work Package 1 was to determine the current status of implementation of the "Waste Prevention Programme of the German Federal Government with the Involvement of the Federal States" at the municipal, state and federal levels. To achieve this, the evaluators developed a fundamental structure for the analysis to be carried out, performed literature and source research on the status of the implementation of the various WPP measure areas and supplemented this with in-depth surveys of relevant stakeholders at the federal, state and municipal levels.

The fundamental structure of the analysis and the methodological procedure are first described below. This is followed by a presentation of the results at the current state.

2.1 Fundamental structure of the analysis

At the beginning of the project, a fundamental structure for examining the current status was defined in order to enable a targeted and focused analysis of the implementation status of the WPP achieved thus far. This structuring concerns both the stakeholders as well as the content of the assessment.

Various waste prevention measures are described in the WPP. While the "addressees" of these measures are predominantly non-state stakeholders (e.g. enterprises, trade, consumers), governmental bodies at the federal, state and municipal levels are cited as key initiators of these measures. Therefore these federal, state and municipal government agencies were defined as starting points for the assessment of possible implementation activities for the situation analysis with regard to the stakeholders to be examined.

The second structuring level concerned the question of how to group possible implementation activities by content for the purpose of analysis. The evaluators proposed that the structure be based on the recommended measure areas in Chapter 4 of the WPP "Specific waste prevention measures" (BMU 2013, pg. 26 et seqq.) and to extend this framework specifically to include questions concerning

- the structural (i.e. informal and organisational) nature of the implementation of the programme
- and possible obstacles to implementation.

Based on these considerations, the following content structure was developed to perform the analysis:

1. Status of the (primary) structural implementation of the WPP
2. Status of implementation of the horizontal measures "research and development" and "information and raising awareness"
3. Status of implementation of activities in the principal areas of action
    a. Waste prevention in companies (relating to the implementation of mandatory requirements and to support for voluntary activities)
    b. Extending the product use phase by supporting reuse and repair
    c. Waste preventing product design (implementation of mandatory requirements and support of voluntary activities)
    d. Product use intensification

e. Food waste prevention
f. Waste preventing public procurement

Obstacles to implementation

a. For the primary structural implementation
b. For the implementation of activities and specific waste prevention measures in the principal areas of action

Additional planning

a. For the primary structural implementation
b. For the implementation of activities and specific waste prevention measures in the principal areas of action

Given the fact that activities in the areas of "research and development" and "information and raising awareness" are also often closely linked to the subject matters of the principal areas of action[11], these measures as well as obstacles and planning were each assessed in direct context with activities in the principal areas of action.

The structure of the situation analysis outlined above was discussed both with the clients and with various representatives from the federal states.

2.2 Methodology

Based on the fundamental structure described above, the evaluators carried out desk research of documented implementation activities of federal, state and municipal governments. For this purpose, it was examined which available publications contained summarising information on the current status of the implementation of waste prevention measures at the federal, state and municipal levels. Open-ended questions for the in-depth assessments were identified based on the research results. Subsequently, individual survey methodologies were developed for each stakeholder level, which was specifically designed and substantiated with regard to both the content of the questions and the stakeholders to be interviewed. The respective survey methods are described below in the section "In-depth assessment: concept, content and time period of the survey". In the process, it becomes clear that the basic structure developed to assess the state of implementation at both the state and federal levels has been largely retained. At the municipal level, however, this had to be changed and adapted accordingly (see Chapter 2.5).

2.3 Status of the implementation of the Waste Prevention Programme at the federal level

The results of the desk research on implementation activities at the federal level and the results and methodological approach of the in-depth assessment are presented below.

2.3.1 Results from the evaluation of available information

At the time of the research, there were no publications in which the activities of the federal government (or the higher federal authorities) were presented in a consolidated manner.[12] However, a number of relevant activities in the field of research and sponsorship of organisations could be identified for the scope of responsibility pertaining the environmental

[11] In practice, it is in fact rather rare to communicate in general terms on the subject of "waste prevention". This is instead accomplished via more concrete terms such as "waste prevention in product use" or "food waste prevention" or similar subjects.

[12] Research period: June to September 2017

department (Federal Environment Agency (UBA) and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)) and collected through specific individual searches in UBA's[13] online databases based on additional research projects performed by the evaluators. These activities can be assigned to the WPP's areas of activity as follows:

Action area "Information and raising awareness"

- Support of the "European Week for Waste Reduction" (EWWR) (German Association of Local Utilities (Verband Kommunaler Unternehmen e. V. (VKU)) 2018) [14]
- Environmental Research Plan (UFOPLAN) Project: "Bestimmung der soziologischen Faktoren der AV und Konzipierung einer zielgruppenspezifischen Kommunikation" (Determining the sociological factors of waste prevention and crafting communication specific to a target group), short title: "Soziologische Bestimmungsfaktoren der Abfallvermeidung" (Sociological determinants of waste prevention) (FKZ 3717 34 333 0) (Duration: 20 October 2017 to 29 February 2020)
- Brochure "Ratgeber: Abfälle im Haushalt – Vermeiden, Trennen, Verwerten" (Guide: household waste – prevent, separate, recycle (UBA 2014a)
- Funding of associations "Abfallvermeidung ist Ressourcenschonung" (Waste prevention is resource conservation) [15] (Grant recipient: NABU-Landesverband Berlin; Funding period: 01/01/2013 to 31/12/2013)
- Funding of associations "Dreck-weg-Wochen: Bundesweite Jugend-Aktionswochen zur Abfallvermeidung" (Rubbish be gone weeks: nationwide youth action weeks for waste prevention) [16] (Grant recipient: Nature conservation youth at NABU e.V.; Funding period: 01 May 2013 to 31 December 2014)

Action area "Waste prevention in companies"

- Waste Prevention Dialogue 10 on "Waste prevention in industrial companies – status of implementation of operator obligations and possibilities for further strengthening" (21 February 2017) and Waste Prevention Dialogues 11/12 on "Abfallvermeidung in Unternehmen – Stärkung systematischer Management- und Unterstützungsstrukturen für KMU" ("Waste prevention in companies – strengthening systematic management and support structures for SMEs") (20/21 March 2017)[17] as part of the UFOPLAN Project "Bewertung und Umsetzung des AVP und Entwicklung geeigneter Kommunikationsstrategien" ("Evaluation and implementation of the Waste Prevention

[13] This comprised the database on project funding within the framework of sponsorship of organisations (UBA 2017b) and the environmental research database (UFORDAT) (UBA 2017e), which lists the current and completed research projects of the Federal Environment Ministry.

[14] For further information see online https://www.wochederabfallvermeidung.de/ueber-uns/, last accessed on 9 July 2018 (VKU o.J.a)

[15] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/abfallvermeidung-ist-ressourcenschonung, last accessed on 9 July 2018 (UBA 2013a)

[16] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/dreck-weg-wochen-bundesweite-jugend-aktionswochen, last accessed on 9 July 2018 (UBA 2013-2014)

[17] For further information see online https://www.umweltbundesamt.de/abfallvermeidung-produzierendes-unternehmen/, last accessed on 9 July 2018. (UBA o.J.a)

Programme and development of suitable communication strategies") (project code number (FKZ) 3714 32 324)

Action area "Product lifetime extension"

- Funding of associations "Kultur der Reparatur stärken" (Strengthening repair culture)[18] (Grant recipient: ReUse e.V.; Funding period: 01 April 2017 to 31 March 2019)
- Funding of associations "Wiederverwendung durch Reparatur stärken – Potenziale des 3D-Druck zur Ersatzteilbeschaffung nutzen" (Strengthen reuse through repair – using the potential of 3D printing to procure spare parts)[19] (Grant recipient: Sustainable Design Center e.V.; Funding period: 01 April 2017 to 30 September 2018)
- Funding of associations "WiRD – Wiederverwendungs- und Reparaturzentren in Deutschland" (WiRD – reuse and repair centres in Germany)[20] (Grant recipient: Arbeitskreis Recycling e.V.; Funding period: 01 April 2015 to 31 March 2017)
- Funding of associations "hikk offensiv – Abfallvermeidung durch Wiederverwendung von Restholz" (hikk offensive – waste prevention through reuse of residual wood)[21] Grant recipient: BAUFACHFRAU Berlin e.V.; Funding period: 01 April 2015 to 31 March 2017)
- Waste prevention dialogues 1–2 on "Förderung der Wiederverwendung wirksam umsetzen" ("Effectively implementing promotion of reuse") (13-14 April 2015)[22] and waste prevention dialogue 3 on "Wirksame Unterstützung von Reparaturnetzwerken" ("Effective support of repair networks") (2 June 2015)[23] during the UFOPLAN Project "Bewertung und Umsetzung des AVP und Entwicklung geeigneter Kommunikationsstrategien" ("Evaluation and implementation of the Waste Prevention Programme and development of appropriate communication strategies") (FKZ 3714 32 324)
- Symposium "Wider die Verschwendung I – Konkrete Schritte zur Abfallvermeidung" ("Combating waste I – concrete steps to prevent waste") (22 May 2014)[24]

[18] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/kultur-der-reparatur-staerken, last accessed on 9 July 2018. (UBA 2017-2019a)

[19] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/wiederverwendung-durch-reparatur-staerken, last accessed on 9 July 2018. (UBA 2017-2018)

[20] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/wird-wiederverwendungs-reparaturzentren-in, last accessed on 9 July 2018. (UBA 2015-2017b)

[21] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/hikk-offensiv-abfallvermeidung-durch, last accessed on 9 July 2018. (UBA 2015-2017a)

[22] Documentation of the event is available online at: https://www.umweltbundesamt.de/abfallvermeidung-reparatur, last accessed on 9 July 2018. (UBA o.J.c)

[23] Documentation of the event is available online at: https://www.umweltbundesamt.de/abfallvermeidung-reparatur, last accessed on 9 July 2018. (UBA o.J.c)

[24] The range of topics discussed at the symposium also addressed aspects from the action area "Waste preventing product design". Documentation of the conference is available online at: https://www.umweltbundesamt.de/service/termine/wider-die-verschwendung-konkrete-schritte-zur, last accessed on 9 July 2018. (UBA 2014b)

Action area "Waste preventing product design"

- Participation in standardisation activities to promote waste prevention in product design
- Symposium "Wider die Verschwendung II: Strategien gegen Obsoleszenz" ("Combating waste II: strategies against becoming obsolete") (25 June 2015)[25]
- Symposium "Wider die Verschwendung III: Ecodesign - Nachhaltige Lebensstile und Chancen für Geschäftsmodelle" ("Combating waste III:_Ecodesign – Sustainable lifestyles and opportunities for business models") (11 May 2017)[26]

Action area "Product use intensification"

- Funding of associations "Umsetzung Carsharinggesetz" (Implementation of the Car Sharing Act)[27] (Grant recipient: Bundesverband CarSharing e.V.; Funding period: 01 May 2017 to 28 February 2019)
- Waste prevention dialogues 7–9 on "Abfallvermeidung durch neue Nutzungsformen – Identifikation, Ausgestaltung und Unterstützung abfallvermeidender Produktdienstleistungssysteme" ("Waste prevention through new forms of use – identification, design and support of waste preventing product service systems") (June/July 2016)[28] as part of the UFOPLAN project "Bewertung und Umsetzung des AVP und Entwicklung geeigneter Kommunikationsstrategien" ("Evaluation and implementation of the Waste Prevention Programme and development of suitable communication strategies") (FKZ 3714 32 324)

Action area "Food waste prevention"

- Funding of associations "Qualifizierung von Ehrenamtlichen, Tafel-Kundinnen und Tafel-Kunden im nachhaltigen Umgang mit Lebensmitteln" (Qualifying volunteers and Tafel customers in the sustainable handling of food products)[29] (Grant recipient: Bundesverband Deutsche Tafel e.V.; Funding period: 01 June 2017 to 31 May 2019)
- Expert forum "Lebensmittelverschwendung wirksam reduzieren – gemeinsam mehr erreichen" (Effectively reducing food waste – achieving more together) (5 September 2017)[30]

[25] Documentation of the event is available online at: https://www.umweltbundesamt.de/wider-die-verschwendung-ii-programm, last accessed on 9 July 2018. (UBA 2015a)

[26] Documentation of the event is available online at: https://www.umweltbundesamt.de/wider-die-verschwendung-iii-vortraege-download, last accessed on 9 July 2018. (UBA o.J.d)

[27] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/umsetzung-carsharinggesetz, last accessed on 9 July 2018. (UBA 2017-2019c)

[28] Documentation of the event is available online at: https://www.umweltbundesamt.de/abfallvermeidung-neue-nutzungsformen, last accessed on 9 July 2018. (UBA 2016b)

[29] A short description of the funded project is available online at: https://www.umweltbundesamt.de/das-uba/was-wir-tun/foerdern-beraten/verbaendefoerderung/projektfoerderungen-projekttraeger/qualifizierung-von-ehrenamtlichen-tafel-kundinnen, last accessed on 9 July 2018 (UBA 2017- 2019b)

[30] Documentation of the event is available online at https://www.umweltbundesamt.de/themen/abfall-ressourcen/abfallwirtschaft/abfallvermeidung/forum-lebensmittelverschwendung-reduktion-gelingt, last accessed on 9 July 2018 (UBA 2018b)

- Publication of the brochure "Leitfaden: Vermeidung von Lebensmittelabfällen beim Catering" (Guideline: preventing food waste in catering) (UBA 2016a)
- UFOPLAN project "Entwicklung von Instrumenten zur Vermeidung von Lebensmittelabfällen" ("Developing instruments to prevent food waste) (FKZ 3712 32 311) (Jepsen et al. 2016)
- Waste prevention dialogue 4 on "Gezielte Maßnahmen zur Vermeidung von Lebensmittelabfällen in der Außer-Haus-Verpflegung" ("Targeted measures to prevent food waste in the restaurant and catering sector") (10 November 2015), waste prevention dialogue 5 on "Konzertierte Umsetzung von Vermeidungsmaßnahmen" ("Concerted implementation of prevention measures") (11 November 2015) and waste prevention dialogue 6 on "Integration der Abfallvermeidung als Abwägungsaspekt in Ermessensentscheidungen der lebensmittelhygienischen Vollzugspraxis" ("Integration of waste prevention as an aspect of consideration in discretionary decisions of food hygiene enforcement practice") (14 January 2016)[31] from the UFOPLAN project "Bewertung und Umsetzung des AVP und Entwicklung geeigneter Kommunikationsstrategien" ("Evaluation and implementation of the Waste Prevention Programme and development of suitable communication strategies") (FKZ 3714 32 324)

Additionally, the Federal Ministry of Food and Agriculture (BMEL) has been conducting an information campaign called "Zu gut für die Tonne!" (too good for the bin) on the prevention of food waste since 2012.[32]

Action area "Waste preventing public procurement"

- UFOPLAN project "Erarbeitung wissenschaftlicher Grundlagen zur Forcierung der Berücksichtigung von Umweltkriterien bei der Vergabe von Aufträgen durch die öffentliche Hand" ("Development of scientific principles to promote consideration for environmental criteria when awarding public contracts") (FKZ 3715373260)[33] (project period 1 September 2015 – 30 November 2018)

In addition, indicators to monitor and evaluate waste prevention measures were developed in the UFOPLAN project "Ermittlung geeigneter Maßstäbe und Indikatoren zur Bewertung und Überwachung erzielter Fortschritte bei den Maßnahmen des Abfallvermeidungsprogramms" ("Identification of suitable benchmarks and indicators to assess and monitor progress achieved in the measures of the Waste Prevention Programme") (FKZ 3715 34 3020) (Wilts et al. 2019).

2.3.2 In-depth survey at the federal level: concept, subject matter and time period of the survey

In order to gather further information on the implementation status of the WPP at the federal level, an in-depth survey was conducted on measures and activities regarding waste prevention among selected responsibilities at the level of federal ministries. This survey was conducted through telephone interviews with selected individuals from various ministries and higher

[31] Documentation of the event is available online at https://www.umweltbundesamt.de/abfallvermeidung-lebensmittel, last accessed on 9 July 2018 (UBA 2015c)

[32] For more information on the campaign objectives and measures, see online at: https://www.zugutfuerdietonne.de/, last accessed on 9 July 2018 (BMEL 2018)

[33] However, it is not known to what extent waste prevention aspects are specifically addressed and taken into account in the project.

federal authorities between October and December 2017. In each case, the questions were related to implementation activities in the WPP's main action areas (see Table 1) and supplemented by questions on how well known the WPP is as such and on its significance for the respective departmental activities.

Table 1: Federal-level interviewees and thematic reference to the WPP

Agency, interviewed entity	Topic relating to the WPP
BMU, IG I 2 "Air pollution control related to industrial installations"	**Waste prevention in companies (industrial plants)** "The practice of waste prevention during the operation of industrial plants can be improved in many cases, although many successful efforts have already been made in this area. For this purpose, it is necessary to identify the state-of-the-art possibilities and potential for waste prevention for the various types of plants and to point out this potential to both the plant operators and the approving authorities." (BMU 2013, pg. 28)
UBA, Section III.1.3 "Ecodesign, Ecolabelling, Green Procurement"	**Waste preventing product design** "The Federal Government is participating at European level in scientific work that aims to develop measurable criteria for the use of resources in product design (ecodesign). "Based on the research results, it is to be examined in the following for which products waste prevention criteria can be provided in the implementing regulations of the EU Ecodesign Directive (2009/125/EC), if applicable." (BMU 2013, pg. 27)
Federal Ministry of Transport and Digital Infrastructure (BMVI), Division G 23 "Passenger Transport, Public Transport Systems" BMU, Division IG I 5 "Environment and Transport, Electric Mobility"	**Product use intensification (using the example of car sharing)** "Wider distribution and intensive use of product service systems is encouraged to prevent consumer waste. These systems are used to share certain consumer goods with other people or temporarily rent these (e.g. car sharing, using lawnmowers, sweepers etc. amongst several people)." (BMU 2013, pg. 30)
Federal Ministry of Food and Agriculture (BMEL), Division 216 "Sustainable Food, Reduction of Food Losses"	**Food waste prevention** "With regard to preventing food waste, concerted actions and agreements between public institutions and industry/trade should be encouraged to reduce food waste generated along the production and supply chain. The aim is to reduce food waste by looking at the entire value chain – not just consumer behaviour – in order to reduce waste." (BMU 2013, pg. 29)
Federal Ministry of the Interior (BMI), Competence Centre for Sustainable Procurement (KNB)	**Waste preventing public procurement** "The Competence Centre for Sustainable Procurement at the procurement office of the Federal Ministry of the Interior will, within the

Agency, interviewed entity	Topic relating to the WPP
	scope of its resources and including the technical competence of the federal ministries, take up the development of practical working aids for the awarding bodies of the public sector to ensure increased consideration of resource efficiency aspects. In the process, waste prevention should also be taken into account." (BMU 2013, pg. 30)
Federal Ministry of Education and Research (BMBF), Div. 724 "Resources and Sustainability"	**Research funding** "Projects focused on waste prevention are to receive further funding within the framework of existing support programmes and measures." (BMU 2013, pg. 27)

Source: Own compilation.

2.3.3 Results of the assessment on the current implementation status of the Waste Prevention Programme

The key findings of the survey are presented below.

2.3.3.1 Structural implementation of the Waste Prevention Programme

A key finding of the survey is that the WPP and its subject matter are only known to individual entities at the federal level. Measures (also) including waste prevention effects are partly implemented. However, this is not carried out directly in reference to the WPP. However, some interviewees see the WPP as an interesting (supplemental) assistance for existing activities. The interviewees have not observed any independent responsibility for implementing the WPP thus far.

2.3.3.2 Status of implementation in individual action areas

The results of the survey in the individual action areas are presented below.

2.3.3.2.1 Waste prevention in companies

Industrial plants: Fundamental aspects of the Waste Prevention Programme

The contact person from the BMU, subdivision IG I 2 "Air pollution control for industrial installations" is familiar with the WPP from "word of mouth", but not with the concrete subject matter or the cross-references with the field of emission control for industrial installations. The contact considers the BMU (Division WR II 1) to be responsible for the implementation of the WPP.

Implementation of the operator obligation to prevent waste according to the Emission Control Act (BImSchG)

The situation analysis of the existing WPP regarding the lack of current reference standards to make the operator obligations operational under Article 5 para. 3 of the Federal Emission Control Act[34] (BMU 2013, pg. 28) is considered still valid. This is also considered to be true regarding the exchange of information in the Seville process, where aspects of waste prevention hardly play any role. At the time of the interview, the contact person was also not aware of any

[34] Act on the prevention of harmful effects on the environment caused by air pollution, noise, vibration and similar phenomena (Federal Emission Control Act – BImSchG), as amended on 17 May 2013 (BGBl. I pg. 1274), last amended by Article 3 of the Law of 18 July 2017 (BGBl. I pg. 2771) (BMU 2017)

efforts and/or activities in Germany involving work being carried out to ascertain specific operator obligations or where these are the focus of enforcement and monitoring. As justification for this "flaw" in the implementation of Article 5 para. 3 of the Federal Emission Control Act (BImSchG), reference was made to the lack of resources at all levels of enforcement and monitoring, while simultaneously setting different priorities. The contact person does not currently identify any political drivers that would suggest strengthened waste prevention in the coming years in connection with further development of the BAT reference documents at the European level or in connection with the emission control efforts in Germany.

2.3.3.2.2 Waste preventing product design

Fundamental aspects of the Waste Prevention Programme

The contact person from UBA, Section III.1.3 "Ecodesign, Ecolabelling, Green Procurement" is aware of the WPP, the role of the implementation of the Ecodesign Directive 2009/125/EC[35] and the implementing measures.

Waste prevention requirements for product design

Until now, implementing measures of the Ecodesign Directive have formulated waste prevention requirements for products only in exceptional cases, for example: durability of lighting products, durability of vacuum cleaner components. As part of the process of implementing the Ecodesign Directive, intensive standardisation work is currently taking place based on the standardisation mandate M/543[36], which aims to make it possible to test products with regard to their reparability, durability, upgradeability, etc. According to the contact person, this work is intended to enable better product evaluation, to include consideration for waste prevention and to define waste preventing product requirements as necessary in the future.

German federal authorities (especially UBA and the Federal Institute for Materials Research and Testing (BAM)) are intensively involved in this work, the contact person stated. For each working group involved in this standardisation process one representative of the authorities is responsible for German participation; the working group on durability was even headed by UBA until 2018. Additionally, German company representatives are active in the standardization process. Germany can thus be regarded as one of the active and supportive countries on this issue, but was not necessarily the most "driving" Member State. The German side (in particular the lead ministry) calls for a realistic assessment of the regulatory possibilities here and only to agree to requirements whose advantages and verifiability were given.

The extent to which Germany actively supports ecodesign requirements that have a waste preventing effect in the consultations and in the regulatory committee will only become clear in the coming months. Consultations are currently pending, as the EU Commission is calling for requirements to be formulated even now, insofar as these are possible without standardization. In a few months, votes on requirements will also probably be pending (e.g. on the repairability of "white goods"). The EU Commission is clearly the driving force behind this issue.

[35] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework to set ecodesign requirements for energy-related products, OJ L 285, 31.10.2009, pg. 10-35 (European Parliament & Council of the European Union 2009)

[36] C(2015) 9096 final Commission Implementing Decision of 17.12.2015 establishing a mandate for the European standardisation organisations in the field of ecodesign with regard to material efficiency aspects of energy-related products in support of the implementation of Directive 2009/125/EC of the European Parliament and of the Council (see also Mager & Oehme 2017)

2.3.3.2.3 Waste preventing public procurement

Fundamental aspects of the Waste Prevention Programme

The consulted entities (Federal Ministry of the Interior (BMI), Competence Centre for Sustainable Procurement (KNB)) are aware of the WPP and of the reference to the Competence Centre for Sustainable Procurement (KNB)[37] in the programme. According to the contact person, the focus of the activities at KNB is to train procurement office employees. KNB also collects guidelines written by other entities and additional tools on sustainable procurement and uploads these on its website. KNB only creates its own work aids in few exceptional cases. Thus far, it has developed two guidelines (on electromobility and on resource efficient procurement of building materials).

Waste preventing public procurement

Waste prevention aspects are an important topic for training in resource efficiency, albeit not directly under the name "waste prevention". Examples of training content within the context of waste prevention include among others:

- Product tenders for electrical equipment (e.g. computers without packaging and manuals)
- Formulation of packaging requirements in the specification of services (e.g. for textiles delivered in bulk as opposed to individually packaged)
- Prevention of food waste
- Avoidance of plastic dishes in catering services

Avoiding new purchases was also a topic in the training module "climate-friendly procurement", for example by performing repairs and by acquiring used equipment. The latter, however, is more likely to be met with resistance by those involved, due to various difficulties.

Some of the guides provided would also contain information on waste preventing or resource efficient procurement. To this effect, feedback is regularly requested from the trained entities after one year. KNB thus remains partially informed regarding the implemented topics. However, a comprehensive evaluation cannot be carried out. A major difficulty in formulating sustainable invitations to tender is that several parties in the procurement agencies must support corresponding aspects. Often there is at least one person in a relevant position who rejects a change to the conventional procedure ("This is how we've always done it").

2.3.3.2.4 Food waste prevention

Fundamental aspects of the Waste Prevention Programme

The WPP is well known to the contact person at the Federal Ministry of Food and Agriculture (BMEL), Division 216 "Sustainable Nutrition, Reduction of Food Waste", also thanks to active participation in various workshops and expert discussions on the implementation of the WPP. According to the interviewee, the head of the newly formed Division 216 "Sustainable Nutrition, Reduction of Food Waste" is also fundamentally aware of the existence of the WPP and their partial overlap of objectives and activities.

Activities to prevent food waste

Notably, the "national strategy" on the prevention of food waste currently being developed by the Federal Ministry of Food and Agriculture (BMEL) will continue to show relevant overlaps

[37] KNB is responsible for advising all procurement entities that must procure according to public procurement law. However, it deals exclusively with the procurement of products and services, not with construction projects.

with waste prevention efforts in the context of the WPP. This could give rise to a corresponding need for consultation and coordination between the two. Regarding the work on updating the WPP, the contact person suggested that the necessary need for coordination between the WPP and a future "national strategy" be discussed in a coordination meeting at the technical working level based on the work progress achieved.

2.3.3.2.5 Product use intensification

Fundamental aspects of the Waste Prevention Programme

Implementation activities in the area of use intensification were assessed using the example of car sharing. Relevant entities in the transport and environment ministries were interviewed for this purpose. These were the Federal Ministry of Transport and Digital Infrastructure (BMVI), Division G 23 "Passenger Transport, Public Transport Systems", and the BMU, Division IG I 5 "Environment and Transport, Electric Mobility". The contact persons were unaware of the WPP. According to them, programmes such as the "Climate Protection Plan 2050" (BMUB 2016b) are more relevant, especially the chapter within this programme on "Climate Protection and Transport", and the Federal Government's "Sustainability Action Programme" (State Secretary Committee for Sustainable Development 30 March 2015). They do not believe that there is a need for support from other federal programmes.

Funding car sharing as a waste prevention measure

The Federal Government promotes car sharing through the Car Sharing Act[38], which entitles municipalities to grant certain privileges to users of car sharing systems in public spaces through the provision of parking spaces. The purpose of this measure is to reduce individual car ownership. However, the object of this measure is not waste prevention but rather air pollution control, economical inner-city land use and climate protection.

2.3.3.2.6 Research funding

Fundamental aspects of the Waste Prevention Programme

The WPP was not previously known to the contact at the the Federal Ministry of Education and Research (BMBF), Div. 724 "Resources and Sustainability". However, the contact noted the existence of the WPP with great interest, as it could prove helpful in justifying the formation of current research priorities. The National Programme for Sustainable Consumption (Die Bundesregierung 2017) was also unknown, unlike the German Resource Efficiency Programme (ProgRess) (BMUB 2012; BMUB 2016a), in whose development and design Division 724 has long been involved. A research and innovation strategy is currently being developed herein in liaison with BMU.

Research funding in the field of waste prevention

There are various overlaps between the action areas in the WPP and existing research funding priorities: With regard to waste-preventing plant technology, BMBF regularly has activities also in Division 5 "Key Technologies – Research for Innovations". From the area of Division 7, the "KMU innovative" programme was mentioned to be relevant, as it also allows new resource-efficient technologies to be funded.

Furthermore, a new research concept, "Resource-efficient circular economy", was recently adopted. Within the framework of this research concept, a first funding guideline for collaborative research projects with the focus on corresponding "new business models" of the environmental service branch will be issued in December 2017. The funding guideline explicitly

[38] Car Sharing Preference Act (Car Sharing Act – CsgG) of 5 July 2017 (BGBI. I pg. 2230) (BMJV 2017)

covers typical waste prevention approaches such as "new forms of use" or "measures to extend service life". UBA/BMU had been specifically involved in the preliminary coordination of the new research concept "resource-efficient circular economy". The environment department will also be involved in further implementing the research concept.

An additional future funding guideline will cover the field of building material recycling and will also address aspects of the accumulation and reduction of pollutants and similar issues.

The often necessary expansion of available waste-prevention technologies and the promotion of non-investment measures (such as in the area of waste-prevention handling practices, training etc.) are still not a focus of the BMBF's responsibilities. In this respect, reference was made to the funding activities of BMU and BMWi. However, the BMBF points to the increasingly relevant "expansion gap", especially in the area of non-investment measures. For this reason, the educational aspect is emphasised, especially in the area of horizontal cross-sectional research, the contact person stated.

2.3.3.3 Obstacles to implementing the Waste Prevention Programme

One of the main obstacles to the implementation of the WPP at the level of the federal ministries is that only a few authorities know of the programme. As for the entities that are aware of the existence of the WPP, the lack of legal binding force and/or lack of human resources and, in particular, the lack of clear responsibilities inhibits comprehensive implementation.

2.4 Status of the implementation of the Waste Prevention Programme at the state level

The results of the desk research on implementation activities and supplementary enquiries to those responsible for the WPP at the state level, as well as the results and conceptual approach of the in-depth survey are presented below.

2.4.1 Results from the evaluation of available information

Table 2 shows an overview of the sources that contain summary information on waste prevention activities and which have been identified by the evaluators. These documents are waste management plans and waste balances of the federal states as well as surveys and studies of individual federal states on selected waste prevention topics.

Table 2: Overview of the sources identified to determine the implementation status at state level

Federal state	Publisher (year)	Title	Document type
Baden-Württemberg	UM (2015)	Waste management plan – municipal waste subplan	Waste management plan
Baden-Württemberg	UM 2017 *(unpublished)*	Query at 44 public waste management authorities in Baden-Württemberg *(Note: The evaluators are unaware of an official title of the query)*	Query
Bavaria	LfU 2016	Household waste in Bavaria – balance 2015	Waste balance
Lower Saxony	Lower Saxony Ministry for	Final report of working group	Report and study

Federal state	Publisher (year)	Title	Document type
	the Environment and Climate Protection (2016)	Circular economy	
North Rhine-Westphalia	MKULNV (2015)	Waste management plan North Rhine-Westphalia – municipal waste subplan	Waste management plan
Saxony	LfULG (2015)	Further development of the waste prevention contribution	Study
Saxony	LfULG (2016a)	Presentation and evaluation of food waste prevention measures for the Free State of Saxony	Study
Saxony	LfULG (2016b)	Inventory and evaluation of measures to promote reuse and preparation for reuse in Saxony	Study
Saxony	LfULG Saxony (2017a)	Reuse study I – municipal tasks and refinancing	Study
Saxony	LfULG Saxony (2017b)	Municipal waste balance 2016	Waste balance
Saxony-Anhalt	Saxony-Anhalt State Office of Administration (2017)	Waste management plan for the State of Saxony-Anhalt, updated 2017 – municipal waste and non-hazardous waste subplan Halle (Saale)	
Saxony-Anhalt	MULE (2016)	Waste balance 2015 for the State of Saxony-Anhalt – part I municipal waste balance part II balance of waste subject to verification	Waste balance
Schleswig-Holstein	MELUR (2013)	Promotion of reuse – experience from Schleswig-Holstein	Study
City of Hamburg	City of Hamburg	Hamburg waste management plan for municipal waste 2016	Waste management plan

Source: Own compilation.

2.4.1.1 General observations

The federal states report on their waste prevention activities (and on the activities of the municipalities/public waste management authorities (örE)) in different ways and, most notably, with significantly varying degrees of detail. The description of waste prevention activities in the state waste management plans and waste balances does not refer to the measures indicated in the annex to the WPP. In individual cases, however, they are assigned to the measures in Annex 4 Waste Framework Directive (see UM 2015 and MKULNV 2015). The start date of an activity is rarely reported. It is unclear whether there is a link between the initiation of measures and the WPP with respect to most of the state waste prevention activities.

2.4.1.2 Status of the structural implementation of the Waste Prevention Programme

It was not possible to discern from the identified publications,

- whether central responsibilities to implement the WPP have been established at the state level,
- whether (binding) implementation strategies exist for the WPP at the state level or if they are currently being planned,
- whether internal or interministerial working groups have been set up to implement the WPP, and
- the quantity of human and/or financial resources available for the corresponding activities.

Accordingly, no information was found on how the WPP was implemented structurally (i.e. formally and organisationally) at the state level.

2.4.1.3 Status of implementation of activities in the six principal action areas

At the state level, little documented information was available on which implementation activities had been initiated by the federal states themselves. In the available documentation, the states predominantly presented activities at the municipal level.

Several of the activities reported, which were initiated at the state level, can be assigned to the action area “Waste prevention in companies”. Some federal states have relevant consulting and funding programmes for the field of operational environmental protection (e.g. the funding programme “Unternehmen für Ressourcenschutz" in Hamburg (see BUE 2017, pg. 10) or the consulting programmes for the prevention, reduction and recycling of waste in industrial and commercial enterprises in Baden-Württemberg (UM 2015, pg. 29); there are collaborations in individual states with regional economic stakeholders (e.g. “Umweltallianz Sachsen” (SMUL 2016, p. 19) or “Umweltallianz Sachsen-Anhalt” (State Office of Administration of Saxony-Anhalt 2017, pg. 14). The extent to which waste prevention aspects are addressed is largely indiscernible. According to the current information available to the evaluators, the state of Saxony-Anhalt is the only federal state that explicitly addresses waste prevention with the funding priority “Innovative measures for waste prevention” (State Office of Administration of Saxony-Anhalt 2017, pg. 14).

Furthermore, publications from some states contain references to corresponding activities in the field of waste preventive procurement, including corresponding legal acts and secondary regulations and guidelines (e.g. the publication of the brochure “Umweltfreundliche Beschaffung – Kurz und knapp die wichtigsten Schritte” (Green procurement – the essential steps) (SMUL 2011) or the publication of the “Leitfaden Umweltverträgliche Beschaffung” (Green procurement guide) (BUE 2016). However, the references to these activities do not acknowledge if and to what extent waste prevention aspects were addressed.

Additionally, other activities were reported where the initiator was not clearly identified and which cannot be assigned to the municipal or state level (such as, for example with regard to the reported “reuse requirement” for food and beverages in public Bavarian institutions (see LfU 2016, pg. 15) or the “networking of local food producers with the retail trade for direct marketing to prevent waste” (UM 2015, pg. 29) in Baden-Württemberg).

2.4.2 In-depth survey at the state level: concept, subject matter and period of the survey

The evaluators' observations regarding the reported activities based on the examined reports and studies (see Chapter 2.4.1.3) were confirmed by the participating state representatives at a specialist workshop in Berlin on 24 January 2017. The participants did not mention further available sources or publications on the implementation status. However, it became clear that, in addition to the reported waste prevention activities, other waste prevention activities are being implemented at the state level that are not yet subject to systematic reporting.

In light of the gaps in knowledge outlined above regarding the implementation status of the WPP, the evaluators worked together with UBA/BMU to design and conduct an online-based survey of the competent state authorities in order to systematically collect further information.

While developing the concept for this online survey, the following requests were expressed both at the specialist workshop and in bilateral talks with individual WPP officers from the federal states:

- The query regarding the current situation should be carried out at a higher level of aggregation than at the level of the sample measures from Annex 6 of the WPP.
- If possible, preformulated answer options should be used to speed up the answering process.
- Responding entities should have the opportunity to add their own implementation activities.
- Responding entities should have the opportunity to direct questions on individual action areas to other competences/departments.
- The survey should also include a review of existing obstacles and restrictions.

The draft of the online survey was prepared based on this feedback. In March 2017, the draft was sent to UBA and BMU for final review and to two state WPP officers as a trial. Based on the feedback from this "field test" at the state level, the evaluators implemented final (minor) changes to the draft and issued the final version.

The survey was divided into seven separately fillable questionnaires in PDF format (i.e. one core questionnaire and six in-depth questionnaires) in order to facilitate management of the responses. This made it possible for the departments responsible for the WPP to deliberately involve other entities in answering questions on specific action areas. The survey focused on fundamental questions regarding the organisational and content-related implementation of the WPP as well as any obstacles associated with it. Six in-depth questionnaires on

a) "Waste prevention measures in companies"

b) "Extending the product use phase"

c) "Waste preventing product design"

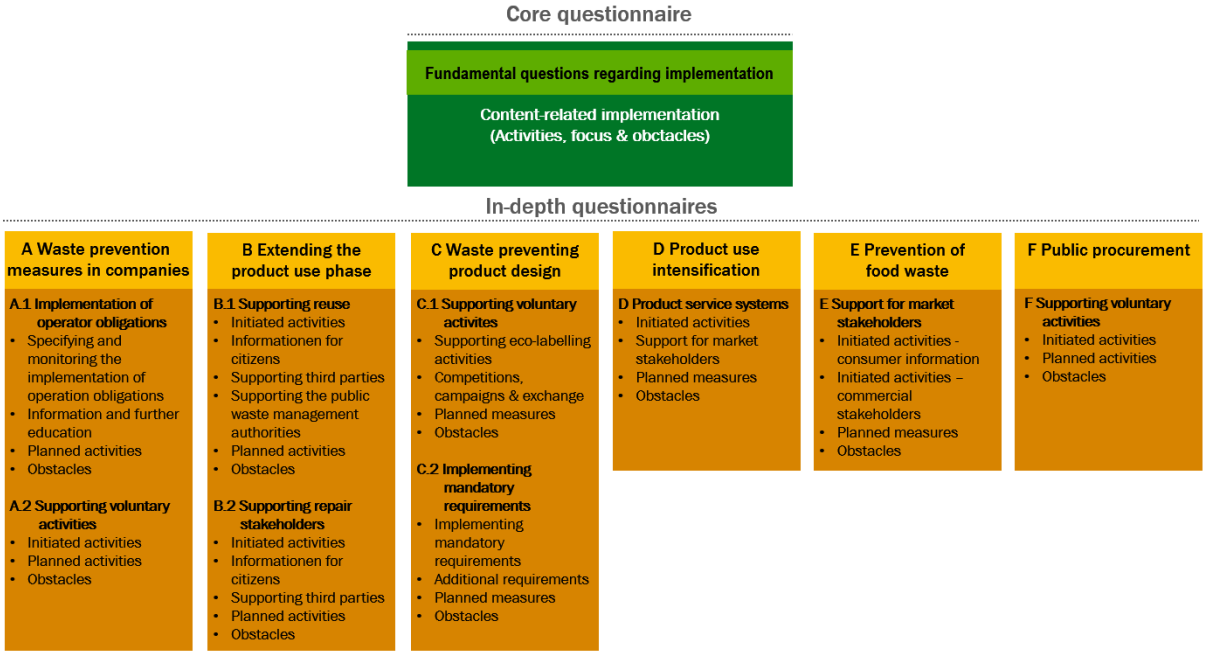
d) "Product use intensification"

e) "Prevention of food waste"

f) "Waste preventing public procurement"

were used to determine the implementation status of the WPP in relation to the respective action areas, as well as possible obstacles and planned activities. A detailed overview of the main focus of the in-depth questionnaires can be found in Figure 1.

Figure 1: Organisation and structure of the online survey



Source: Own compilation by Ökopol.

The survey was mainly based on questions with predetermined answer options and additional text fields for supplementary explanations.[39]

2.4.3 Results of the assessment on the current implementation status of the Waste Prevention Programme

The results of the survey are presented in the following chapters. The results are reported anonymously.

Response

All 16 federal states (n[40]=16) participated in the survey. [41] The evaluators received a response from all federal states to the core questionnaire. Seven federal states have also answered all the in-depth questionnaires. Eight federal states have answered at least one in-depth questionnaire.

Table 3: In-depth questionnaires: Response from the individual federal states

Waste prevention in companies	Extending the product use phase	Product design	Use intensification	Food waste	Public procurement
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X

[39] The original survey can be viewed online at: https://www.oekopol.de/umsetzung-des-deutschen-abfallvermeidungsprogramms-fragen-an-die-laender/.

[40] n: Number of federal states
[41] Survey period: 04 April 2017 to 19 July 2017

Waste prevention in companies	Extending the product use phase	Product design	Use intensification	Food waste	Public procurement
X	X	X	X	X	X
X	X	X	X	X	X
-	-	X	-	X	X
X	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
X	-	-	-	X	X
-	-	-	-	-	X
X	X	-	-	X	X
X	-	-	-	X	-
-	-	-	-	X	-
11	8	8	7	12	11

Legend: X: A reply to the questionnaire was received. Each line represents a state. They are listed at random.
Source: Own compilation.

The online survey involved 33 entities from 22 state authorities. Most of the entities involved belong to the environmental departments.

2.4.3.1 Status of the structural implementation of the Waste Prevention Programme

A central responsibility to implement the WPP has been assigned in half of all states. Eight federal states have established a central responsibility for the implementation of the WPP. Financial resources for corresponding individual state-run activities were provided in only 4 states and for third-party activities in only 3 states. A formal decision was made to adopt the WPP in two states. Additional human resources were made available in only one state. [42] The activities regarding organisational implementation are shown in Table 4.

[42] Human resource refers to a project office for public relations work in waste prevention limited to one and a half years.

Table 4: Organisational implementation of the Waste Prevention Programme by the federal states

WPP – central responsibility	WPP – formal decision	Additional human resources	Financial resources for individual state-run activities	Financial resources for third-party activities	Task distribution plan
X	X	-	-	X	-
X	X	-	-	-	-
X	-	-	-	-	-
X	-	-	-	-	-
X	-	-	-	-	-
X	-	-	-	-	-
X	-	-	X	-	-
X	-	-	X	X	-
-	-	X	X	-	-
-	-	-	X	X	X
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
8	2	1	4	3	1

Legend: X: The activity was implemented. Each line represents a state. They are listed at random.
Source: Own compilation.

Overarching activities for the implementation of the Waste Prevention Programme

Ten states reported events held on the topic of waste prevention. The following events were specifically mentioned:

- Meeting with the state consumer advice centre and the Association of Municipal Enterprises (VKU) during the "European Week for Waste Reduction"
- Dialogue process in collaboration with the state consumer advice centre with the stakeholders in the food value chain (producers, trade, consumers, gastronomy/large consumers) about possibilities to reduce food losses
- Event regarding the presentation of the study on food waste prevention
- "Waste prevention in municipalities" event
- Seminars for public waste management authorities

- Events on reuse with public waste management authorities, social enterprises and associations
- Regular discussions regarding Article 5 para. 1 No. 3 BImSchG with the subordinate authorities to determine the implementation status (including orders pursuant to Article 17 BImSchG) and to clarify doubts
- Annual event at a training centre

Nine states indicated that analyses of waste prevention potential were produced/commissioned.

In eight states, expert opinions have been prepared/commissioned to review the current condition of waste prevention activities and/or public campaigns have been initiated. With regard to activities to survey existing approaches, the following activities were identified:

- Survey of the state public waste management authorities
- Investigation of potential for prevention and reuse in various sectors and preparation of operator guidelines with regard to Article 5 para. 1 No. 3 BImSchG
- Identification of priority material flows and sectors
- Survey of the public waste management authorities and the Chamber of Industry and Commerce
- Expert opinions on reuse (in planning)

The following was mentioned regarding initiated public relations campaigns:

- Campaign on coffee to go and marine debris (marine litter)
- Forum on waste prevention, brochures for commercial waste producers
- Flyer on dealing with waste/waste prevention for refugees
- Kochbus project at markets, schools, daycare centres, community centres and farms
- Exhibition on waste prevention, press releases, activities for EWWR
- Broadcasted themed week on waste prevention
- Event on food waste prevention at the state parliament
- Six states reported that waste prevention policies have been developed.
- A detailed presentation of the state activities is shown in Table 5.

Table 5: Overarching activities for the implementation of the Waste Prevention Programme by the states (1/2)

Event(s) on waste prevention	Expert opinions on potential analysis	Expert opinions on current situation	Public relations campaigns	Waste prevention concept/ plan
X	X	X	-	X
X	X	X	X	X
X	X	X	-	X

Event(s) on waste prevention	Expert opinions on potential analysis	Expert opinions on current situation	Public relations campaigns	Waste prevention concept/ plan
X	X	X	X	X
X	X	X	-	X
X	X	X	-	X
X	X	X	-	-
-	-	X	X	-
X	-	-	X	-
X	-	-	X	-
X	-	-	X	-
-	-	-	X	-
-	X	-	-	-
-	X	-	-	-
-	-	-	X	-
X	-	-	-	-
11	**9**	**8**	**8**	**6**

Legend: X: The activity was implemented. Each line represents a state. They are listed at random.
Source: Own compilation.

Five states indicated that working groups related to waste prevention have been established with external stakeholders from business and civil society. Four states indicated that interdepartmental working groups have been established. Two federal states indicated that the topic of "waste prevention" has been included in the curriculum. A detailed presentation of the results in relation to these activities is depicted in Table 6.

Table 6: Overarching activities for the implementation of the Waste Prevention Programme by the states (2/2)

Working group with additional stakeholders	Interdepartmental Working group	Inclusion of waste prevention in the curriculum
X	X	X
X	X	-
X	X	-
-	-	-
-	-	-
-	-	-
X	-	-
X	X	-

Working group with additional stakeholders	Interdepartmental Working group	Inclusion of waste prevention in the curriculum
-	-	-
-	-	-
-	-	X
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
5	**4**	**2**

Source: Own compilation.

Furthermore, state representatives mentioned the following activities in the field of waste prevention:

- Obligation of public institutions to waste prevention pursuant to the State Waste Act
- Obligation of the municipalities to consult waste producers on waste prevention in local law
- Action to reduce the number of one-way plastic bags
- Promotion of the use of reusable cups
- Website on "sustainable consumption"
- School project on "sustainable nutrition"
- Funding for public waste management authorities to set up extracurricular learning places for waste and recycling management
- Projects to incorporate the unemployed
- Fee systems based on volume in the waste management sector
- Support of an event at schools by establishing contact with the Ministry of Education and application

Awareness of the Waste Prevention Programme

The entities were asked to assess familiarity with the WPP in their own department, as well as in other areas, such as general environmental administration, the public waste management authorities and businesses. The results are illustrated in Table 7. The degree of familiarity with the programme was assessed very differently by the entities in relation to the surveyed areas. Three entities have not provided any information on the issue of awareness. In the field of "waste management", awareness was rated comparatively high in most states. However, there were also two entities that rated the level of awareness as "very low" or "low". A similar situation was observed in the assessment of awareness in the "public waste management authorities" – although four entities have already assessed familiarity with the WPP among the public waste management authorities in the respective federal states as "low" or "very low".

The level of awareness was rated significantly lower in all other areas. In the "general environmental administration" and in the "environmental administration of municipalities" the WPP seems to be much less well known. With regard to "civil society" and "business", awareness of the programme was mostly deemed low. There was an exception to this in one federal state, where the respondent indicated that awareness was "high" in other areas outside the "waste management sector" – i.e. in "general environmental administration", in "environmental administration in municipalities" and in "business organisations".

Table 7: Assessments on the awareness of the Waste Prevention Programme among various stakeholders

Area of waste management	General environmental administration	Public waste management authorities	Environmental administration of municipalities	Business organisations	Enterprises	Civil society
very high	high	high	high	high	medium	medium
high	medium	medium	medium	medium	medium	medium
high	medium	high	medium	low	low	medium
medium	medium	medium	no reply	medium	low	low
high	medium	medium	medium	low	low	low
very high	medium	high	low	medium	low	very low
high	low	high	low	medium	medium	medium
very high	low	very high	low	high	low	medium
medium	low	medium	medium	low	low	very low
medium	very low	low	no reply	low	low	low
medium	low	low	low	low	low	low
very low	very low	very low	very low	very low	very low	very low
low	low	low	low	low	low	low
no reply	no reply	no reply	no reply	no reply	no reply	no reply
no reply	no reply	no reply	no reply	no reply	no reply	no reply
no reply	no reply	no reply	no reply	no reply	no reply	no reply

Source: Own compilation.

2.4.3.2 Status of implementation in individual action areas

The results of the survey in the individual action areas are presented below.

2.4.3.2.1 Waste prevention measures in companies

The specification of the operator obligations pursuant to Article 5 para. 1 No. 3 BImSchG is based on various standards, especially following the national translations of the relevant BAT reference documents. The operator obligations are predominately monitored after examination of any existing requirements from the respective plant permit, but also based on other requirements. There are mostly no further plans for activities to strengthen operator obligations. Both the lack of specification of the operator obligations for the different types of installations and the limited resources of the monitoring authorities were assessed as significant obstacles.

Measures to strengthen voluntary waste prevention activities are being implemented in seven states, such as information campaigns, handouts/guidelines and consulting services. Approximately three quarters of these activities were already conducted before 2013. Further plans for activities exist in four federal states. The lack of market incentives and the lack of

knowledge about practical waste prevention possibilities were identified as the main obstacle to the implementation of voluntary waste prevention efforts in companies.

Waste prevention measures in industrial plants

Specification of the operator obligations to ensure waste prevention during plant approval procedures[43]

Of the entities that responded, two are directly responsible for the approval of industrial installations and nine are not responsible. The specification of the operator obligations pursuant to Article 5 para. 1 No. 3 BImSchG occurs

- in eight federal states after examining the national translations of the relevant BAT reference documents
- in seven federal states after examining further regulations and guidelines (VDI[44] guidelines, ATV[45] leaflets or similar items)
- in six federal states based on specific key questions/checklists from the state
- in six federal states after examining reasonable options according to the general standards

Additional references used to specify operator obligations:

- Example Administrative Regulations of the Federal/State Working Group on Immission Control (LAI): General administrative regulation on the prevention, recycling and disposal of waste pursuant to Article 5 para. 1 No. 3 of the Federal Emission Control Act
- The example administrative regulations on waste prevention and use from LAI; many of the references mentioned there (change of legal basis) are no longer relevant and must be critically reviewed and taken into account where necessary.
- use of previous plant-related example administrative regulations on utilisation
- state-specific requirements for approving and monitoring installations
- state reports on the investigation of many different types of installations for the implementation of the residual waste prevention and utilisation requirement pursuant to Article 5 para. 1 No. 3 BImSchG
- Operator guidelines in different sectors
- Sector-specific leaflets from the Federal/State Working Group on Waste (LAGA)
- Working aids from the state's AG Verwertung
- Case-by-case assessment as part of the approval procedures
- State decree with a set of forms for approval procedures under the Federal Emissions Control Act (BImSchG); several forms relate to waste generation and the planned measures for substance management

[43] multiple responses possible

[44] Association of German Engineers (Verein Deutscher Ingenieure e. V.)

[45] German Wastewater Association (Abwassertechnische Vereinigung e.V.)

Monitoring the implementation of the operator obligations to ensure waste prevention

Of the entities that responded, one is directly responsible for monitoring the operator obligations of industrial installations, 10 are not responsible. Monitoring of operator obligations occurs[46]

- in ten federal states by examining any existing requirements from the respective plant approvals
- in eight federal states by checking against relevant current regulations and guidelines (BVT leaflets, VDI guidelines, ATV leaflets or similar items)
- in six federal states by checking against specific key questions/checklists from the state
- in five federal states by checking against reasonable options according to the general standards

Information and professional development of the employees of the approval and monitoring authorities with regard to measures for the implementation of the operator obligations for waste prevention[47]

In seven federal states, the information and professional development of the employees of the approval and monitoring authorities with regard to measures for the implementation of the operator obligations on waste prevention is ensured through a regular exchange of information, e.g:

- quality circles, service meetings
- regular staff meetings with subordinate authorities
- working groups for the creation of manuals

In two federal states this is ensured through training courses based on specific measure catalogues, e.g:

- procedure manual for the enforcement of waste legislation
- training using various manuals
- when new guidelines/example administrative regulations are adopted

The following steps and mechanisms have been identified as further measures:

- a central support office as contact point for the state factory inspectorates
- regularly exchanging experience on environmental inspections and monitoring, which can also address waste prevention issues

Planning of activities to strengthen the operator obligations

Currently there are additional specific plans for activities to strengthen operator obligations in one of the responding entities. It includes a discussion with selected monitoring authorities.

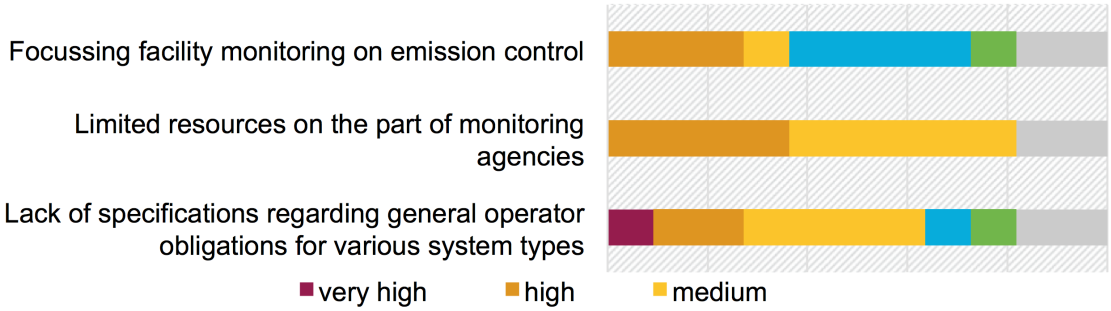
[46] Multiple responses possible

[47] Multiple responses possible

Obstacles to implementing the operator obligations on waste prevention

Nine of the eleven respondents assessed the queried obstacles. The major obstacles cited for the implementation of operator obligations were "limited resources of the monitoring authorities" and the "lack of specification of the operator obligations for the various types of installations" (see Figure 2).

Figure 2: Outcome of the assessments of obstacles to the implementation of operator obligations on waste prevention (N=11)



Source: Own compilation by Ökopol.

Measures initiated to support voluntary waste prevention efforts in facilities, businesses and administrative institutions

In seven of the eleven federal states that answered this partial questionnaire, activities are being conducted to support voluntary waste prevention efforts in facilities, businesses and/or administrative institutions. In two federal states

- an information campaign was conducted to raise awareness of waste prevention aspects in businesses
- handbooks/guidelines were created with information on low-waste management
- there are consulting services to introduce waste-preventing business management
- support is provided for the introduction of (environmental) management structures explicitly dealing with waste prevention, mostly by generally promoting environmental management systems such as EMAS
- suitable management systems/concrete waste prevention measures were established as examples in the responding entity

In one federal state, there is a direct exchange of experience on waste prevention between companies. Information on low-waste management is not offered in any federal state.

The following activities were mentioned as additional measures by individual states:

- Support of companies in operational material flow management and material flow cost accounting
- State agency for supporting companies in the field of operational resource efficiency with funding programmes
- Resource efficiency checks for companies in order to identify and support the implementation of specific measures to prevent or recycle waste in companies

Approximately three quarters of all measures undertaken were implemented before 2013.

Further concrete planning or basic considerations for activities to support voluntary waste prevention efforts

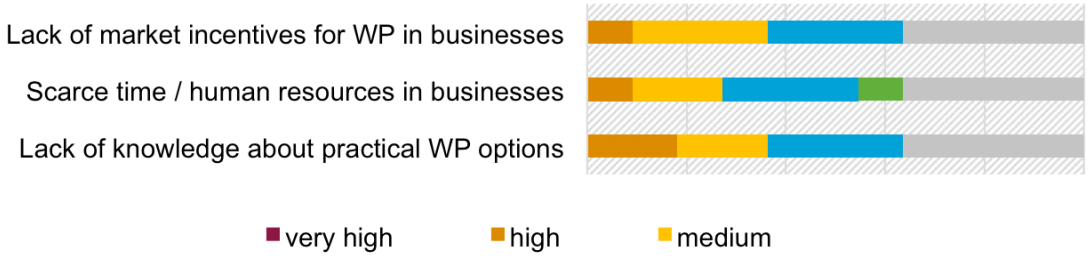
Four of the respondents have further concrete planning or basic considerations for activities to support voluntary waste prevention efforts in facilities, businesses and administrative bodies. There are plans/considerations in the following areas:

- Construction waste
- Food waste
- Qualitätsverbund umweltbewusster Betriebe (Quality network of environmentally conscious companies, QuB) and Ökoprofit

Assessment of obstacles to the implementation of voluntary waste prevention efforts

Seven of the eleven respondents assessed the queried obstacles. The "lack of market incentives" and the "lack of knowledge about practical waste prevention possibilities" were cited as the main obstacles to the implementation of voluntary waste prevention efforts in businesses.

Figure 3: Outcome of the obstacle assessment for the implementation of voluntary waste prevention efforts (n=11)



Source: Own compilation by Ökopol.

One of the respondents also believed that an additional major obstacle is to have already exhausted waste saving potentials through favourable disposal costs and also failing to realise that prevented waste also saves production costs.

2.4.3.2.2 Extending the product use phase

In seven states, one or more activities to promote reuse are being performed, for example via information campaigns, review of current situation and/or legal expert opinions. Citizens in six federal states are informed about possibilities of preparing for/executing the reuse of used products. Organisations executing reuse measures rarely receive specific support. Half of the respondents have further concrete plans or basic considerations for activities to support measures for reuse. The following aspects were identified as major obstacles to the implementation of reuse measures / measures to support reuse:

- Not professional enough (especially in marketing)
- Uncertainty regarding product law issues (e.g. compliance with new legal standards on pollution control, energy efficiency, product safety)
- Uncertainty regarding product liability in the case of damage and
- Lack of a means to recognise suppliers of quality-assured used goods

Information campaigns were initiated by some of the federal states to support repair work. Apart from that, there are hardly any relevant activities. The most relevant obstacle, according

to the respondents, is the lack of economic competitiveness compared to mass production of new goods.

Promoting product reuse activities to review status quo and further promote reuse[48]

Of eight federal states that answered the partial questionnaire, seven states have performed one or more activities in this area. In three federal states, an information campaign was conducted.

In two federal states, a regular exchange of information was initiated, e.g. in the form of an annual information event on municipal material flow management or communication on reuse during the annual exchange of experience between public waste management authorities and their waste consultants.

In four federal states, a survey of the status of reuse offers and how they were used was carried out. In one federal state, a legal opinion was commissioned to analyse grey areas and suggest improvements in the legal framework for reuse measures. Other activities mentioned are

- regular queries to the public waste management authorities to prepare the annual waste balance
- tender guidelines for opted waste electrical and electronic equipment (WEEE)
- completion of an expert report for the topic of reuse
- annual workshops on the implementation of the WPP (since 2014)
- development of the website on waste prevention[49]
- Flyer and exhibition on reuse and longevity

About one third of the activities took place before 2013.

However, the following possible activities were not performed in any federal state:

- Development projects to improve identification of reusable products
- Pilot projects to test practical cooperation models and contract forms to strengthen the targeted cooperation between different reuse providers
- Decree on the regular examination of the suitability for reuse of old products in all measures for product replacement by government agencies.

Information made available to citizens on preparing for/executing product reuse

The following information was provided by the federal states:

- In six federal states: General information on the environmental and social significance of reuse
- In two federal states: A list of (all) delivery points in the federal state for potentially reusable products
- In one federal state: A list of locations where refurbished used devices can be purchased

The information is always available on the Internet and in one case also in printed form. Several federal states indicate that this information is best circulated by the public waste management

[48] Multiple responses possible

[49] See online: http://www.umwelt.sachsen.de/umwelt/wertstoffe/index.html

authorities. However, further information (such as the assessment of the suitability of reuse of products, instructions or information on what consumers should pay attention to when buying used equipment) is not offered at the state level in any federal state.

Support possibilities for executing organisations for adherence to reuse measures

According to state provided information, financial support is granted for pilot projects or forms of cooperation, as well as additional measures for product reuse in two federal states. However, the two states refer to general support measures for waste management or the municipal sector as opposed to specific measures for reuse. In one federal state, consulting on waste and product law is given on the establishment of new reuse offers, if there are corresponding requests. In another federal state, efforts are currently being made to dismantle obstacles to the procurement of second-hand goods in public procurement.

No efforts are made in any federal state to stabilise or consolidate the sociopolitical and labour market support framework for stakeholders who implement measures for reuse.

About two thirds of the activities took place before 2013.

Initiated or implemented activities to strengthen individual activities or activities to support third parties in the field of reuse by municipalities/public waste management authorities

In two federal states, the promotion of reuse was specified in more detail as a regular task in the respective State Waste Act or in subordinate regulations. In two other federal states, the legal questions concerning the (waste) fee eligibility of activities to implement/promote reuse were clarified. In one federal state, guidelines/best practice examples were developed to provide a form of support for third parties in reuse activities that is permissible under public procurement law. Four federal states initiated an exchange of experience amongst the public waste management authorities on aspects of strengthening reuse, but mostly referred to general exchange possibilities already mentioned elsewhere.

In one federal state financial support is provided to pilot activities that aim to strengthen reuse, according to the state. About one third of the activities took place before 2013.

Additional concrete plans or basic considerations to support/promote measures for reuse

In three states, there are additional concrete plans for activities to support or promote measures for reuse and include the following aspects:

- strengthening waste prevention in the municipal sector,
- establishing a used goods department store and
- introducing a reusable coffee cup system.

In one federal state, there are considerations to collaborate with the state consumer advice centre to promote measures for reuse.

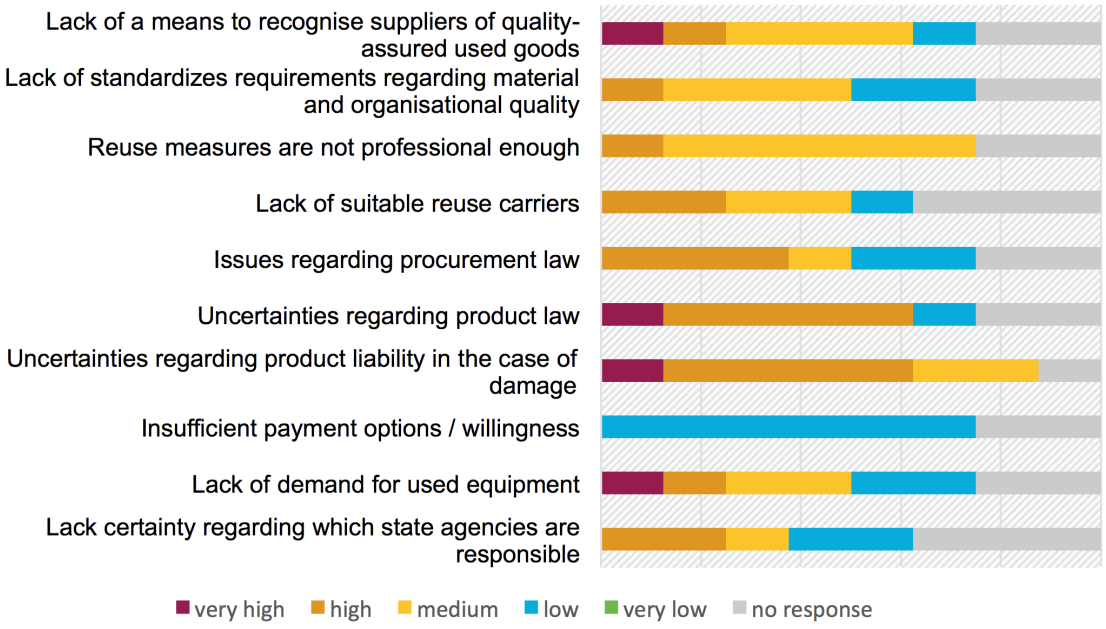
Obstacles to the implementation of measures supporting reuse

From the point of view of the entities surveyed, a large number of aspects inhibit the implementation of possible measures to support reuse. The following aspects were cited as major obstacles:

- Not professional enough (especially in marketing)
- Uncertainty regarding product law issues (e.g. compliance with new legal standards on pollution control, energy efficiency, product safety)

- Uncertainty regarding product liability in the case of damage and
- Lack of a means to recognise suppliers of quality-assured used goods

Figure 4: Results of the obstacle assessment for the implementation of reuse measures/measures to support reuse (n=8)



Source: Own compilation by Ökopol.

Additionally, the following obstacles have been identified by individual states:

- Lack of transparency with a concurrent variety of providers
- Lack of competence of public waste management authorities
- Competition between social enterprises and second-hand shops
- Inconsistent municipal implementation of equipment according to the social security statute for people in need

Support for repair networks

Activities performed or initiated to review and further strengthen repair services and initiatives

So far activities to strengthen repairs have only been implemented sporadically. Three federal states indicated that they inform citizens about the ecological and social advantages of repairs. The information formats discussed vary and include “Information on electrical appliances and textiles”, an “Action day for the public waste management authorities in cooperation with regional television” and an “Exhibition and flyer”. However, no federal state has provided practical or application-oriented information so far (such as lists of repair services or tips on what consumers should pay attention to when ordering repairs).

According to state provided information, financial support is granted for pilot projects or forms of cooperation in product repair measures and support for new product repair initiatives in two federal states. This support has existed since before 2013.

One federal state performed a legal opinion on the analysis of grey areas and suggestions for improvement. Another federal state implemented the possibility of considering repair-friendly procurement by means of a corresponding administrative regulation for public procurement and also referred to the tender guidelines for state opted WEEE.

No other activities surveyed (consulting on liability issues, consolidation of the labour market policy support framework for repair stakeholders) or additional activities have been performed in any of the federal states so far.

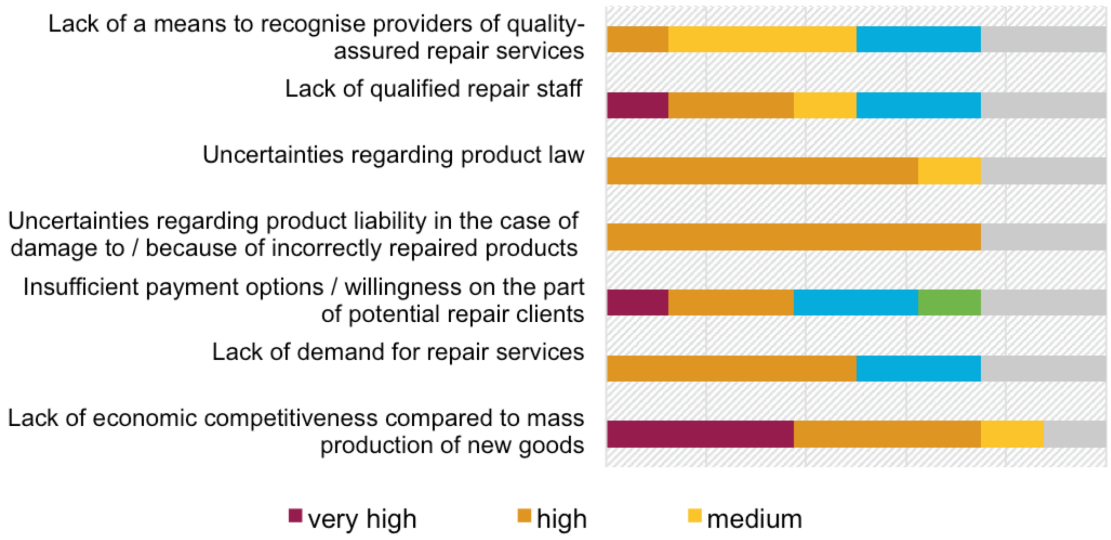
Additional planning or basic considerations for activities to support/promote repair services

In two federal states, there are concrete plans to support/promote repair work[50], in one state there are plans to cooperate with the state consumer advice centre.

Obstacles to the implementation of repair services

Six of the eight respondents assessed the obstacles that had been identified. No other obstacles were mentioned. The most relevant obstacle, according to the respondents, is the lack of economic competitiveness compared to mass production of new goods.

Figure 5: Results of the obstacle assessment for the performance of repair services (n=8)



Source: Own compilation by Ökopol.

2.4.3.2.3 Waste preventing product design

No federal state actively supports authorities or economic stakeholders in the development of waste prevention requirements for ecolabels. Individual states are active in competitions, information campaigns and exchange of experience, especially on waste preventing product design. There are no plans/considerations for additional activities in this area. In particular, the opportunities for government agencies to influence the situation and the interest shown by manufacturers were assessed as too low and consumers are considered not sufficiently sensitised.

Some respondents are not aware of waste preventing ecodesign requirements, while others state that they should be considered on an equal footing with energy efficiency requirements, where applicable. Three of the respondents have activities on mandatory waste prevention

[50] The respective activities were not explained in detail.

product requirements through opinions, participation in advisory group meetings and interaction with business stakeholders. There are no plans/considerations for additional activities in this area.

In particular, the lack of measurement standards, difficulties in verification and the lack of legal instruments were identified as significant obstacles.

Voluntary activities

Support for the inclusion of waste prevention aspects in environmental product labelling

No federal state actively supports authorities (BMU/UBA, EU Commission) in the development of waste prevention requirements in the award criteria for state (Type I) ecolabels (Blue Angel or EU ecolabels) or business stakeholders in the development of waste prevention requirements in the award criteria for voluntary (Type II) ecolabels.

Activities in competitions, information campaigns and exchange of experience on waste preventing product design

A few federal states indicated that they were conducting information campaigns and/or research projects. However, the additional explanations suggest that these are predominantly not activities specifically aimed at waste preventing product design. Exception: one federal state indicated that it had implemented all of the activities inquired, these primarily took place before 2013.

In detail these are:

- Information events on product preparation and environmentally friendly product development across all sectors using examples of best practices
- Announcement of a cross-sector competition for environmentally friendly product development for the categories of project idea and project implementation (2007 and 2013)
- Development of a template for the estimation of ecological follow-up costs associated with the acquisition of diagnostic imaging equipment
- Training on environmentally friendly product development for stakeholders in companies and industrial designers
- Working group on environmentally friendly product development with a focus on industrial designers as stakeholders (2011-2013)
- General support programme for innovations for climate protection, emission prevention and material efficiency (since 2009)

It should be noted that the last point is not specifically related to product design.

Further concrete planning or basic considerations for activities to support voluntary measures for waste preventing product design

Two federal states indicate that they have concrete plans or basic considerations for further activities. However, the explanations provided suggest that these are not (strictly) product design activities:

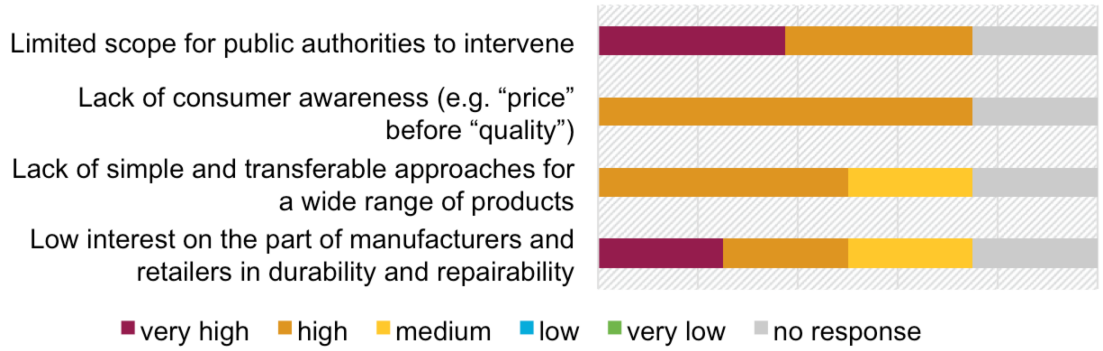
- Development of a waste prevention strategy in collaboration with the consumer advice centre
- Collaboration with companies for the purpose of introducing material flow cost accounting

Obstacles to the use of voluntary possibilities to support waste-preventive product design

Six out of eight respondents assessed the obstacles that had been queried. Key obstacles to the use of voluntary possibilities to support waste-preventing product design are:

- Low interest from manufacturers and retailers in durability and reparability
- Lack of simple and transferable approaches for a wide range of products
- Lack of consumer awareness (e.g. “price before quality”)
- Limited scope for public authorities to intervene

Figure 6: Results of the obstacle assessment for the use of voluntary possibilities to support waste-preventing product design (n=8)



Source: Own compilation by Ökopol.

Implementation of mandatory requirements

Implementation of existing mandatory product requirements to ensure a waste preventing design

Four of the responding entities are responsible for reviewing the execution of the implementation regulations under the European Ecodesign Directive ("market surveillance"). Regarding experience with requirements for waste prevention aspects, two responses indicated that such requirements are (as yet) unknown or not subject to review; two responses indicated that existing requirements are regularly reviewed on an equal footing with energy efficiency requirements and one response indicated that a review of these requirements is only carried out in exceptional cases (test campaign).

Activities related to the development and further development of mandatory product requirements for waste prevention

Three of the responding entities indicate that they are pursuing concrete activities to develop and further develop mandatory waste prevention product requirements. The following activities have been organised:

- in two cases, specialist statements on preliminary studies/regulatory proposals at the EU level
- in three cases, participation in BAM advisory board meetings as well as consultation forums and regulatory committees at the EU level and participation in the preparation of German statements on ecodesign in one of the cases
- in two cases, a discussion of regulatory proposals with concerned business stakeholders, with a working group in one of the cases and no further specifications in the other

- in one case, support for and participation in relevant standardisation processes

None of the responding entities have developed their own proposals for mandatory waste prevention product requirements (e.g. through research projects).

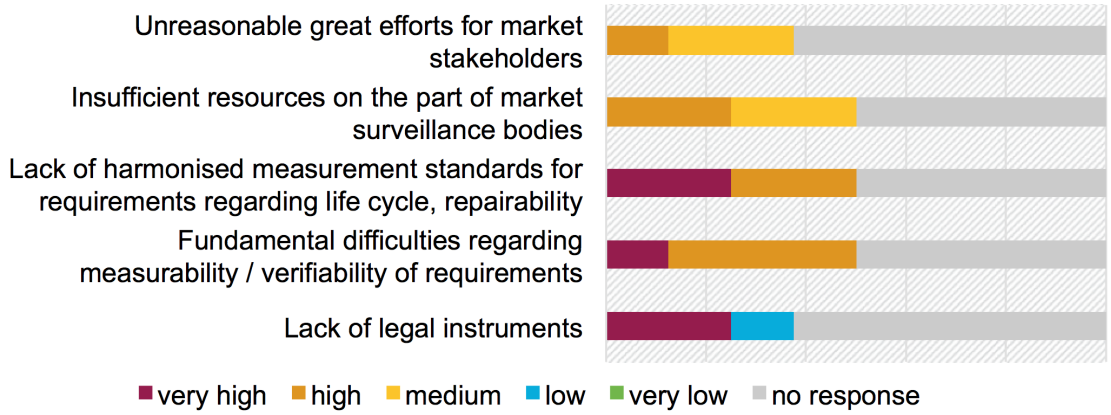
Further concrete planning or basic considerations for activities to support mandatory measures for waste preventing product design

There are currently no further considerations in any federal state.

Obstacles regarding further implementation of mandatory requirements for waste preventing product design

Half of the respondents assessed the obstacles that had been queried (see Figure 7).

Figure 7: Results of the obstacle assessment for the further implementation of mandatory requirements on waste prevention product design (n=8)



Source: Own compilation by Ökopol.

2.4.3.2.4 Product use intensification

Initiated activities for the distribution and use of waste prevention service systems

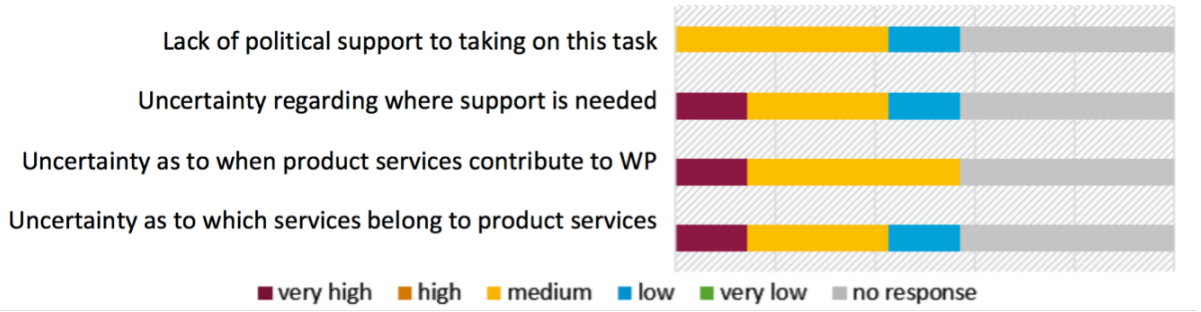
Two federal states have initiated information campaigns promoting shared product use. Apart from this, no further activities to support corresponding systems or system providers have been initiated nor have any such activities been planned thus far.

Obstacles to supporting product service systems

Four out of seven respondents assessed the significance of possible obstacles. The responses suggest that there is a great deal of ambiguity regarding support for waste prevention product service systems. The most relevant obstacle cited by the entities is the fact that it is usually difficult to clearly identify waste preventing product service systems.

One entity cited the lack of a “central contact person” as an additional obstacle.

Figure 8: Results of the obstacle assessment for the support of product service systems (n=7)



Source: Own compilation by Ökopol.

2.4.3.2.5 Prevention of food waste

Several states have initiated or implemented various measures to strengthen activities to prevent food waste among end consumers. The most frequent topic-related events were those for end consumers. Most notably, working groups of various formats have been established to strengthen food waste prevention in cooperation with other business stakeholders. Six of the 12 respondents have additional activities planned. A large number of obstacles have been identified by the responding entities. It became clear that,

- the strong need for coordination due to interdepartmental and interministerial responsibilities,
- the lack of financial and/or human resources regarding food waste and
- the lack of standardised definitions and a quantified target for reduction at the federal or EU levels

are the most significant obstacles.

Initiated or implemented measures aimed at end consumers

Six states have organised or initiated events to raise consumers awareness on food waste (including cooking events, "Lange Tafel", action days, film screenings and panel discussions).

In four states, there have been initiatives to include the subject in school curricula (e.g. promoting implementation of a "nutrition driving licence" in primary schools, a modular concept on the subject of "nutrition" for schools or the development of a teaching unit for on how to implement a project on food waste prevention)

Three states have initiated the development of recommendations or checklists intended to help consumers to produce as little food waste as possible and have initiated or supported various information formats that address food waste prevention:

- Article on the consumer protection calendar and on the Internet with in-depth information on food waste reduction
- Promotion of the consumer advice centre's "food saver"
- "Bewusst einkaufen kann jeder.de" campaign with farmers, the consumer advice centre, a church and a university

Other measures initiated by seven states include:

- educational offers for consumers at the district offices for the recycling of food residuals

- guidance for public waste management authorities as the point of contact for end consumers
- a student competition
- a round table with manufacturers, associations, market operators, consumer initiatives
- establishing food value estimation and food waste as a priority topic in all institutions funded by the Ministry in 2016
- research projects
- information campaigns for Tafel customers
- information material for schools
- as well as various activities related to waste prevention for school lunches:
  - a networking unit for school lunches
  - development and testing of a coaching module for school lunches
  - a symposium on school lunches

Two states indicated that they have incorporated the initiated and/or implemented measures in the elaboration of the "National Strategy for Food Waste Reduction".

Strengthening food waste prevention in cooperation with other business stakeholders

Seven states have established relevant working groups, such as

- a round table on food loss prevention in the food trade
- an interministerial working group to develop measures.

One federal state organised an event of the coalition factions with business stakeholders in the state parliament. Six federal states support regional direct marketing – either financially, professionally or by providing appropriate information.

Several federal states have performed or will perform research projects, for example

- on collecting data on food waste from the food industry
- on the topic "reducing bakers' food waste"
- on the topic "fruit and vegetable food loss in agriculture and trade".

One federal state supports the professional development of skilled workers in the catering sector through coaching measures on commercial kitchens; another federal state supports the implementation of a "more sustainable food supply while minimising food waste" in model enterprises.

So far, no state has set up a central competence centre for information and activities regarding food waste prevention.

Support for Tafel concepts (e.g. by clarifying legal issues) is not yet available at the state level.

Further concrete planning or basic considerations for activities to prevent food waste

Six of the responding entities have additional plans in this area, including:

- development of concepts, materials and activities for consumer education

- collaboration with the consumer advice centre
- collaboration with superordinate partners in the large-scale consumer sector (e.g. with the German Hotel and Restaurant Association)
- continuation of round tables
- continuation of a website on food waste prevention
- integration of the topic into teacher trainings
- inclusion of the issue in the current coalition agreement

Obstacles to initiating or implementing measures to prevent food waste

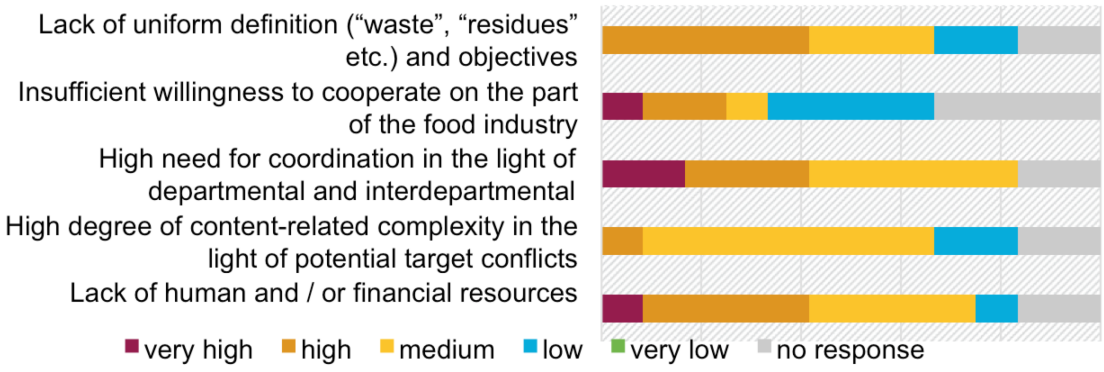
Obstacles to initiating or implementing measures to prevent food waste are, from the point of view of the queried entities, mainly due to

- cross-departmental and interdepartmental responsibilities,
- the lack of uniform definitions of terms and
- the lack of human and/or financial resources.

Additional obstacles cited by the respondents were:

- limited economic incentives
- a lack of awareness of the environmental impact of food throughout its life cycle
- deficient communication "between business and agriculture"
- difficulty of including the topic in teacher training

Figure 9: Results of the obstacle assessment to initiate or implement food waste prevention measures (n=12)



Source: Own compilation by Ökopol.

2.4.3.2.6 Waste preventing public procurement

According to the respondents, some states enforce mandatory requirements for waste preventing public procurement. Some states have a single point of contact for green public procurement (GPP) and provide training in green procurement. Additional measures are being implemented in individual cases.

Activities to implement waste preventing public procurement

Six of the respondents stated that there are mandatory contract awarding requirements in their federal state via regulations or other legal acts for the waste preventing procurement of goods. A central point of contact or competence centre for enquiries regarding GPP has been established in five states and training or continued education for public procurement employees has been implemented in another five states. Three states have public procurement guidelines containing requirements/criteria for different procurement areas. In two states, studies were carried out on the current status and/or on the potential of public procurement with increased waste prevention. The following activities were also specified by individual states:

- Holding conferences on GPP
- Building an alliance with municipal umbrella organisations and with associations and institutions from the construction industry
- Allocating a work aid in the field of construction
- Preparing a measure programme on sustainability in administrative action
- Developing a concept on the subject of "climate-neutral state administration", which also addresses procurement and waste volume

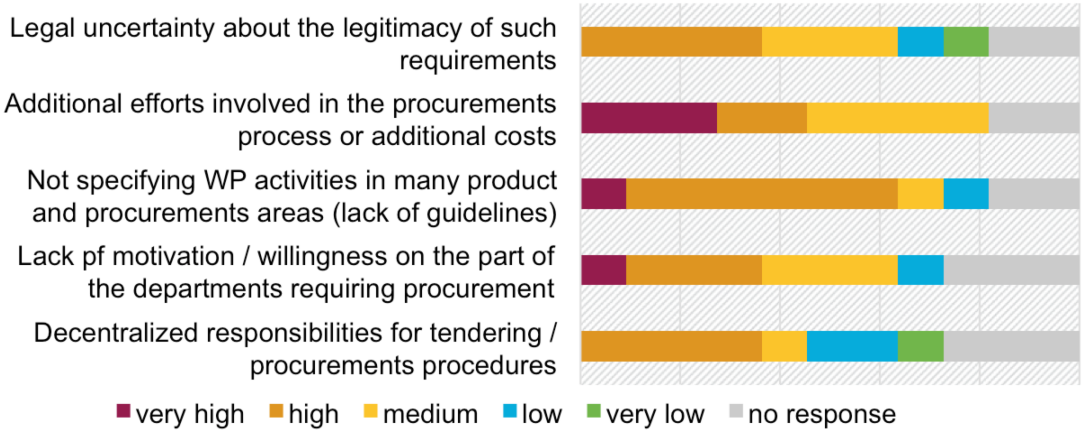
So far, no federal state has initiated an information and motivation campaign to implement an environmentally oriented and, above all, waste-prevention approach to procurement processes.

Obstacles to the systematic consideration of waste prevention aspects in procurement

The respondents cited the following essential aspects as obstacles to impede systematic consideration of waste prevention aspects in procurement processes:

- Additional procurement expenses
- Not specifying waste prevention activities in many procurement and product areas
- A legal uncertainty about the legitimacy of such requirements, and also
- Lack of effort on the part of the procuring agencies.

Figure 10: Results of the obstacle assessment to the systematic consideration of waste prevention aspects in procurement processes (n=11)



Source: Own compilation by Ökopol.

2.4.3.2.7 Obstacles to implementing the Waste Prevention Programme

In some instances, the respondents evaluated the significance of possible obstacles to implementing the WPP very differently. The following aspects were determined to be major obstacles of particularly high relevance:

- a low legally binding nature
- lack of human resources and
- lack of subsidies

However, several states also cited a lack of awareness of the programme and a lack of networking between the relevant departments as obstacles to implementation.

The following aspects were also explicitly cited by individual states as an obstacle:

- a lack of indicators to measure progress
- a lack of practical operationalisation
- legal uncertainties regarding the distinction between waste/product and possible consequences including legal ones
- competition with other environmental, political topics and questioning of the existing economic system in the case of thorough implementation

2.5 Status of the implementation at the municipal level

2.5.1 Results from the evaluation of available information

At the municipal level, the performed implementation efforts consisted almost exclusively of waste management plans, waste balances of the federal states and the surveys of some states on the current status of selected action areas (see Chapter 2.4.1). Systematic surveys on the current status of such municipal activities were conducted in four of the federal states.[51] In each case,

[51] The federal states were Schleswig-Holstein, Lower Saxony, Saxony and Baden-Württemberg.

(only) the public waste management authorities were asked about selected action areas.[52] The key observations and findings are presented below.

The activities of the public waste management authorities regarding waste prevention are mainly general information and consulting services, either online or during general waste consulting. Such general information on waste prevention can be found in a majority of the public waste management authorities, although in some cases it is not very prominent. Other activities are, however, quite rare. This primarily includes activities initiated and/or supported by the public waste management authorities, such as used goods market places on the Internet, flea markets, mobile dishwashing station rentals and references to used goods department stores or repair initiatives in the region.

By contrast, other municipal waste prevention activities (e.g. repair activities run by the public waste management authority, etc.) or established collaborations for instance with reuse facilities from the social economy sector are the exception. This also includes temporary actions (e.g. during the European Week for Waste Reduction), such as school projects, activities to switch disposable bags for reusable bags or communication projects with local media.

The outlined results of the literature evaluation coincide with the direct experiences of the evaluators from the discussion processes accompanying the nationwide surveys in three states.

A supplementary evaluation of all German activities, which can be found in the EWWR database (see VKU o.J.a), also showed that the public waste management authorities were almost consistently active as initiators at the municipal level and that these were almost exclusively measures from the spectrum of (extended waste) consulting to citizens mentioned above.[53]

2.5.2 In-depth assessment at the municipal level: concept, subject matter and period of the survey

The contractors first designed and prepared an online questionnaire in order to gather additional and more detailed information on the implementation activities at the municipal level and to determine which of the WPP action areas they correspond to and what obstacles stand in their way. During the project workshop on 24 January 2017 at the BMU in Berlin, the participants discussed which multipliers could and should be used to distribute this questionnaire to the respective addressees. The municipal umbrella organisations rejected both the survey method (online survey) and the support activities regarding distribution of the invitation to suitable municipal addressees for various reasons. It was found that

- many participants stressed the importance of including other local authorities outside of the waste management authorities/local waste authorities;
- a “broad” distribution of the questionnaires to the public waste management authorities is not considered to be effective, since they are already addressed via the state waste management authorities in many states (e.g. during queries on the municipal waste balance sheet, on waste management plans or concepts);
- it is not possible to distribute the survey via the state officers for the WPP to other municipal officers (other than the waste management authorities/local waste authorities), as there are no working relationships (or even opportunities to issue instructions);

[52] The action areas were waste prevention consulting measures and activities to promote reuse.

[53] A broad range of very creative and high-profile activities will undoubtedly be performed. However, a systematic involvement of other “areas” of local government seems to be limited.

- the municipal umbrella organisations (Association of German Cities and German County Association) do not support "broad" distribution to the heads of municipalities/districts, as this would be too unspecific and they are not considered to be in charge of the WPP.

As an alternative to the online survey, the municipal umbrella organisations offered to organise a workshop with representatives from selected municipalities in order to record and discuss the experience gleaned so far in implementing the WPP. UBA/BMU accepted this as a constructive offer. A corresponding meeting was to be conducted in autumn 2017. At the request of the client, the evaluators prepared a draft invitation and sent it to the client for approval on 10 June, which specified both the objectives and the subject of the planned specialist workshop were specified. The planned subject for the technical workshop was to hold a discussion on the following aspects:

- the formal and practical significance of the WPP in municipal administration,
- previous activities and experience in the field of waste prevention,
- limits and obstacles from a municipal perspective and
- opportunities to further support and strengthen municipal waste prevention efforts.

Due to the low number of registered participants, BMU and UBA decided not to go through with the technical workshop.

At the same time, the original tasks in Work Package 1 were specified in such a way that additional information from stakeholders at the municipal level should to be researched and evaluated through targeted bilateral discussions with municipalities in agreement between UBA/BMU and the evaluators. In this context, a survey concept was designed by the evaluators in spring 2017 and coordinated with the client, taking into account the various municipal responsibilities and the associated different approaches to the topic of waste prevention and the WPP. Two types of municipal bodies were chosen as possible access points to assess the municipal perspective on waste prevention:

- Access point 1: Municipal "waste" centres
- Access point 2: Municipal "non-waste" centres

2.5.2.1 Assessment of awareness and status of the Waste Prevention Programme among municipal "waste" centres

With regard to the type of waste prevention activities performed by the public waste management authorities, there is already a comparatively well-documented level of information, consisting of the results of surveys on the type of waste prevention activities performed by several federal states[54], the waste prevention activities recorded in the EWWR database (see action card VKU o.J.b) and documentation of individual best practice examples. Significantly less information is available about

- the formal and practical significance of the WPP for the municipalities,
- the limits and obstacles regarding the implementation of the WPP/municipal waste prevention activities from the perspective of the municipalities and
- the possibilities and starting points for strengthening and supporting municipal waste prevention efforts.

[54] More than 10% of the German public waste management authorities have evaluable findings on this.

It was thus considered useful and expedient to specifically survey the perspective of the operationally responsible "waste centres" (i.e. the municipal waste management companies).

2.5.2.2 Assessment of waste prevention activities of municipal "non-waste" centres on possible starting points for waste prevention activities

In line with the basic character of waste prevention, the WPP addresses activities in broad range of areas pertaining to "non-waste" and which therefore systematically fall under the responsibility of administrative departments that usually have no direct connection with waste management or waste disposal. There are so far no specifically evaluable literature sources or other compilations of implementation activities for this wide range of municipal "non-waste centres". The evaluators believe that it is particularly important for the targeted review and further development of the WPP to survey the current perception and awareness of the WPP through such "non-waste centres"[55] and to find out how they could be more closely involved in the implementation of the WPP. With that in mind, the evaluators proposed two research approaches in accordance with UBA and BMU:

- In order to specifically identify possible networking points between waste prevention and other professional responsibilities, the evaluators of the WPP's prevention measures asked (non-waste) professionals affected by waste prevention measures (e.g. municipal economic development, municipal procurement offices, building authorities, school authorities) whether they were aware of the WPP itself and existing implementation activities and where at the municipal level (or at higher levels) there were approaches to cohere with the WPP implementation or how these could be established.
- The evaluators thus surveyed the authorities that have an appropriate overview of various areas and activities at the municipal level due to their scope of activity (e.g. municipal environmental commissioners or municipal climate protection commissioners) in order to determine the possibilities and limits for facilitating the integration of waste prevention into other municipal activities including those pertaining to environmental protection.

2.5.2.3 Surveyed municipal authorities and stakeholders

The survey of local authorities and stakeholders was conducted amid specific circumstances and challenges that arose for the evaluators as a result. First, there is little organised access to the WPP by local government bodies and second, local stakeholders often do not consider the implementation of the WPP to be within their (regular) scope of responsibility. This resulted in a particular challenge to ask municipal stakeholders about activities, assessments and obstacles in this field. Therefore, the selection and approach of the interview partners was based on work relations, which result from completely different work from Ökopol in most cases.

The following tables (Table 8 and Table 9) show an overview of the bodies and stakeholders interviewed as part of the project during Q3 and Q4 of 2017. The evaluators have kept the first and last names of the individuals interviewed confidential. The interviewees were promised non-disclosure of personal information prior to the interviews for the purpose of collecting information that was as authentic and as detailed as possible.

[55] The term "non-waste centres" refers to the responsibilities apart from the public waste management authorities and local waste authorities.

Table 8: Overview of the surveyed municipal "waste" centres and stakeholders (as of: 30/10/2017

No.	Surveyed entity
1	District of Pinneberg, Pinneberg Citizen Service District
2	District of Schleswig-Flensburg, Abfallwirtschaft Schleswig-Flensburg GmbH (ASF)
3	City of Munich, Abfallwirtschaftsbetrieb München (Munich Waste Management Company, AWM)
4	City of Straubing and District of Straubing-Bogen, Abfallwirtschafts-Gesellschaft Straubing mbH
5	City of Wolfsburg, Wolfsburg waste management and street cleaning, municipal public agency

Source: Own compilation.

Table 9: Overview of the surveyed "non-waste" stakeholders (as of: 30/10/2017)

No.	Surveyed entity
1	Schleswig-Holstein Building Management
2	Klimaschutz- und Energieagentur Niedersachsen GmbH
3	Schleswig-Holstein Climate Protection Network
4	Local Sustainability Initiative (Baden-Württemberg)
5	Landesarbeitsgemeinschaft Agenda 21 NRW e.V. (LAG 21)
6	Regio Augsburg Wirtschaft GmbH
7	Service and Competence Centre: Local Climate Protection
8	City of Hannover Department of Economy and Environment
9	City of Norderstedt, Norderstedt Sustainability Office
10	City of Regensburg (Environmental) Mayor
11	Centre for Sustainable Community Development (Bavaria)

Source: Own compilation.

2.5.3 Results of the assessment on the current implementation status of the Waste Prevention Programme

Below are the results of the survey regarding the implementation status of the WPP as presented from the perspective of the surveyed municipal "waste" centres and municipal "non-waste" centres.

2.5.3.1 Status of the implementation of the Waste Prevention Programme from the perspective of the municipal "waste" centres

The waste prevention activities of the surveyed "waste" authorities are listed below in Table 10 to evaluate the results. According to the survey, all the interviewed authorities/centres are active in the field of waste prevention, albeit in different areas and to a different extent. In total, the surveyed centres cover a wide range of possible waste prevention activities.

Table 10: Current waste prevention activities of the interviewed "waste" centres (as of: 30/10/2017)

No.	Entity	Waste prevention activities
1	Schleswig-Flensburg Waste Management	Preparation of an online exchange and donation platform
2	Abfallwirtschaftsbetrieb München (Munich Waste Management)	Operation of a used goods department store, including Repair Café Exhibition at the Kinder- und Jugendmuseum on waste generation and prevention Used goods guide (online) Flea market portal (online) Repair guide (online) Rental encyclopaedia (online) Donation portal (online) Waste prevention campaigns
3	Abfallwirtschafts-Gesellschaft Straubing (Straubing Waste Management Company)	Consulting and educational work on waste prevention Support for a reusable cup initiative Operation of an extracurricular learning centre on waste prevention
4	Pinneberg District Citizens Service	Provision of an online used goods department store
5	Wolfsburg Waste Management and Street Cleaning	Educational and consulting work Collaboration with a social department store

Source: Own compilation.

Awareness of the Waste Prevention Programme

Four of the five interviewed waste centres are aware of the existence of the WPP. One centre was unaware of the WPP. None of the respondents could answer the question who is responsible or accountable for implementing the WPP in the municipality. One interviewee explained that although there was officially no central municipal responsibility for the WPP, he "had a feeling" that if someone was responsible, it would "most likely" be the waste management company. Another interviewee reported that the WPP "plays virtually no role in municipal waste management practices".

Two of the centres stated that they had read the programme. Only one of these two centres could specifically remember having officially received the WPP. The State Ministry had sent out a notification by email for review and information purposes. The centre then examined the WPP to see whether it contained "anything new or useful", which could justify "shifting the focus of previous activities". However, it did not. The second centre noted that "almost all" of the

measures identified in the WPP that are "under the control of the municipalities" are already being implemented.

One interviewee made a "tentative hypothesis" that, based on his personal experience through discussions with colleagues, only about one third of the waste stakeholders in German municipalities have probably read the WPP and a small number of them have examined the WPP with regard to possible measures that could be implemented locally. Another third have possibly received the WPP but have not read it and one third of the municipalities have probably never even received the WPP.

Significance of the Waste Prevention Programme

None of the interviewees were able to recall during the course of their respective conversations that the WPP or the measures mentioned therein had been the subject of discussion or debate by other local government authorities or institutions since it was adopted in 2013. One interviewee explained regarding his municipality that the WPP had neither "reached local politics", nor had there been "requests or inquiries from the environment committee or a similar authority". Another interviewee stated that to the best of his belief, the topic of "wasting resources and waste" had already been more firmly incorporated as a strategic issue in local politics in the past ("in the '90s") "than today". The priority seems to continue to decrease.

The discussions revealed that the adoption of the WPP at the federal and state levels neither had nor has any influence on the nature or intensity of waste prevention activities of the respondents.

Requests and recommendations for a Waste Prevention Programme

In view of possibly updating the programme, the interviewers welcomed any potential suggestions for improvement to the programme and its implementation during the interviews. The following requests and recommendations were specifically mentioned:

- The programme should clearly state the ecological significance of waste prevention, both in the programme itself and in its application to all participating authorities addressed therein.[56]
- The conception and implementation of nationwide campaigns that attract media attention on selected, concrete topics and action areas in waste prevention would be very helpful to then be able to "tack on" with relevant municipal activities. However, the term "waste prevention" should not be the main subject of communication.
- At the same time, it must be made clear that the main activity of local "waste" centres (i.e. waste management) is identified and recognised as such and that the possibilities of taking effective waste prevention measures in this respect are limited.
- Waste prevention must be supported more strongly as a strategic issue by additional, overarching institutions and bodies of local politics and must not be considered a "negligible" additional task.

[56] For example, the "plastic bag phenomenon" was cited as being noteworthy. The topic or the term "waste prevention" has not found its way into the social and media debate on the subject matter, but has been successfully conveyed primarily through the topic of protecting marine environments.

- A central online ideas exchange for municipalities with practical, implemented examples in the field of waste prevention as well as concrete assistance in the form of checklists for municipalities[57] should be established and maintained.

2.5.3.2 Obstacles to implementing the Waste Prevention Programme

When asked why the WPP had no relevance in municipal practice, the interviewees cited various aspects that can be roughly divided into impact-related, system-related and content-related assumptions and justifications.

Three of the respondents specified, that "many" of the measures mentioned in the programme are useful in terms of content, especially educational and public awareness raising. However, the extent of the environmental impact of the measures is rated as rather insignificant. The respondents expressed the evaluation of the impact as being very limited in different ways:

- The positive contribution that municipalities can make towards the conservation of resources is relatively small compared to "what should actually be done".
- There is "a lot of frustration among waste management companies", as "hardly any effective measures" are taken "at the beginning of the production and consumption chain"
- "The idea of growth continues to" dominates economic policy and "a reduction in material consumption" is "not genuinely" supported

It became equally clear that the respondents are under the impressionthat no consistent, effective measures to reduce the amount of waste are being implemented either at state or federal level, and that there is also a lack of serious municipal and federal political willingness to implement waste prevention. It was explained that:

- there is no real specific material support at municipal, state and federal level
- no targets have been set and implementation is not being monitored.

This creates the feeling that no one is really interested in implementation or "non-implementation".

One interviewee attested to the theoretical potential of the WPP to be a driving force for municipal waste prevention efforts. However, when referring to the "WPP of the German Government with the Involvement of the Federal States", he pointed out deficiencies in terms of content. Some of the links between the proposed measures and their alleged impact are presented as causal links, although they are logical misconceptions.[58]

2.5.3.3 Assessments from stakeholders in the municipal "non-waste" sector

On the term "waste prevention"

Acceptance of the term "waste prevention" and identification with the topic vary greatly among stakeholders from "non-waste sectors" that intersect with waste prevention, such as sustainability, resource efficiency or climate protection. Upon hearing the term waste prevention, something immediately came to mind for the majority of the interviewees from the "non-waste sector" and they have indeed worked on waste prevention in the past (although

[57] The interviewees were not aware of existing instruments in these areas, such as the "collection of ideas", which can be found on the page of the European Week for Waste Reduction by presenting the performed waste prevention activities, or the guide to municipal waste prevention from Bavaria.

[58] The interviewee specifically described the measure "volume-based fee systems". For example, this does not lead to a reduction in household-related waste as a direct effect, but rather to incorrect or illegal disposal.

mostly not with this label, but rather through events on topics such as resource efficiency, sufficiency etc.). However, the other interviewees clearly rejected the topic and pointed out that other waste authorities were responsible.

One interviewee pointed out that the term "waste prevention" is too unattractive to reach the public or businesses, for example, to encourage them to participate in events. Even the term "resource efficiency" with its more positive connotations is not a strong "driving force" to get people curious. It is important to choose topics and headings that are attractive, for example associated with the term "innovation".

The interviewees who do not work in the environmental sector but rather in municipal economic administration had to be explained why exactly the WPP – which none of the interviewees was aware of – does not (only) directly concern waste management or the public waste management authorities.

Intersecting content with waste prevention

Almost all of the respondents were able to report on measures and activities which (also) pertained to waste prevention or which are mentioned in the WPP. In many cases however, the interviewees were only able to cite these activities, which were often under different headlines, after the evaluators had given them specific references to the activities.

Many of the specific municipal activities mentioned by several interviewees include support for repair cafés and repair in general, adoption of reusable "coffee to go" cups in municipalities and the exclusive use of cups and bottles with deposit refunds at city and street festivals. Activities in the area of public procurement were also mentioned several times, although it is unclear whether waste prevention aspects were targeted or others such as energy-saving product acquisition. The following specific measures were also mentioned: Activities to prevent plastic bags, introduce lunch boxes and water bottles into daycare centres instead of disposable packaging; awareness raising activities (collecting and exhibiting a week's worth of plastic waste, information and events on "sharing" possibilities and "unpackaged" shopping, call for people to impose a "climate protection challenge" on themselves, including topics such as "package free shopping" etc., and to report on their respective experiences), as well as "food sharing" initiatives (through civil society initiatives, not by local authorities themselves).

In the opinion of the surveyed individuals, there is definitely an awareness of, for instance, climate protection potentials of waste prevention activities among municipalities active in environmental and climate protection. Municipalities active in the field of sustainability in most cases also have strategies/activities on issues falling within the scope of waste prevention. In the surveyed stakeholders' consultations and events with municipalities, topics relating to waste prevention do play a role (although not under this label, see above), even if "classic" topics such as "thermal insulation", "transport" and "energy saving" tend to dominate, especially in climate protection.

On their own accord, some interviewees mentioned nationwide support programmes, in which activities aimed at waste prevention would also be supported and eligible (e.g. "go-efficient"[59]).

Connection to existing municipal networks

As outlined above, there currently does not (yet) exist a municipal waste prevention network to the best of the respondents' knowledge. In response to the question of additional possibly suitable specialist networks in which waste prevention issues could also be addressed, some

[59] The intention of the "go-efficient" module within BMWi' "go-Inno" programme is to provide comprehensive consulting for SMEs regarding an increase in their material efficiency in manufacturing processes and products. SMEs receive support from professional consultants via "innovation vouchers", which are proportionately financed by the BMWi (see DLR. o.J.).

climate protection and sustainability networks were mentioned in particular. According to one interviewee, significantly more municipalities throughout Germany are active in the field of climate protection than in sustainability.

The surveyed stakeholders who are directly involved in existing climate protection and sustainability networks, stated that there too only a part (often only a minority (e.g. 10-30 %)) of the municipalities in the respective federal state are reached. The Schleswig-Holstein Climate Protection Network at least has members "statewide" in all districts and independent cities (see EKSH o.J.).

The municipalities active in the specialist networks are often those that are also quite involved in the environmental sector. In many cases, this results from the commitment of individual responsible administrative staff or from corresponding constellations in local politics in which "green" positions are particularly relevant.

Systematic integration of waste prevention into municipal government

The original goal of the study, which was also planned to find out in which various ways waste prevention can be systematically integrated into municipal administrative activities, could not be realised during the survey. In fact, even in the large number of exploratory discussions that went well beyond the scope of the individual interviews, no municipality could (thus far) be identified where the implementation of the WPP or a broad set of waste prevention measures was based on active decision-making by municipal bodies and/or an overarching systematic concept.

One interviewee suspected that it would be difficult to accommodate the topic of waste prevention in the municipal structure, as there is usually a rather classic division of responsibilities with a clearly delineated waste area whose focus is on waste recycling (and thus on measures that "look good" on waste balances). The municipalities' scope for action is limited, as proper waste disposal/management is a system that has grown over a long period of time and it is difficult to enforce approaches that are at odds with it. According to another interviewee, one reason why many municipalities have not yet taken initiatives in waste prevention is that the issue of the need to save resources has not yet been sufficiently taken up in public debate (as opposed to climate protection for example).

There is also a lack of awareness of the problem in municipal work with companies, as companies believe that they are already resource-efficient and operate in a waste-saving manner and that the potential for further cost savings is too small.

Starting points to strengthen the implementation of the Waste Prevention Programme

The following suggestions for improvement and requests for support were mentioned by the interviewees:

- The topic of waste prevention needs to be prepared much more clearly and in such a way that it will be easier to see where it intersects with other environmental issues such as climate protection, resource protection or nature conservation. This makes it much easier to integrate/connect with existing activities from various (sustainability or climate protection) networks.
- The concept of "waste prevention" is too general. The topic should to be made more specific based on best practice examples and processes.
- Given the fact that there are very limited resources and in view of the very direct "feedback" from municipal politics, priorities for municipal government activities always have to be set

very closely in line with the wishes and perceptions of the citizens. For this reason, it would be particularly necessary to run nationwide campaigns with a high media profile, for example on selected aspects of waste prevention, so that appropriate measures can be taken at municipal level.

- It would help if there were a concrete funding programme to go deeper into the subject matter, especially with regard to structures that promote initial consulting; for example, a funding framework on food waste is lacking.
- The topic must be attractively "sold" in order to be linked to topics that are "modern" and "going well", "digitalisation" for example.

3 Ecological assessment of selected waste prevention measures

3.1 Assessment of eight selected waste prevention measures

The aim of work package 2 is to analyse the implementation status of the WPP and to evaluate relevant progress towards waste prevention on a scientific basis, in order to then develop supplementary measures to target waste prevention potentials that have not yet been identified and/or exploited. During the first stage, the implementation status of the programme will be evaluated on the basis of a survey of the current situation at federal level and in the states and municipalities. During the second stage, the environmental impacts of the implementation of individual waste prevetion measures will be assessed.

In the course of the discussion between the commissioning body and the service provider, it was agreed that it was not advisable to carry out a comprehensive environmental assessment of the implementation of the WPP. In view of the uncertainties involved, it was instead deemed sensible to assess the concrete measures which, on the one hand, highlight the achievements of the WPP, and, on the other hand, offer approaches for assessing the future development of the programme. In addition, it was considered advisable to set aside the plan of appealing more strongly to specific stakeholders than in the previous WPP and also of specifying individual measures. In the course of decision-making, the assessment of the environmental impacts of specific measures serves to evaluate which measures and initiatives can really provide support for these concepts.

The direct assessment of specific environmental impacts resulting from implementation of the measures also presents a particular challenge, amongst other things due to the heterogeneous and variable nature of the product and waste streams targeted and the complexity of the direct and indirect effects of many waste prevention measures. For this reason, various approaches need to be used which will allow the required conclusions to be drawn regarding the contribution to environmental mitigation from an overall perspective. The first approach involves an analysis of the assessment methods used in other EU member states, particularly, Sweden, Austria and Flanders. The second approach involves considering the specific environmental assessment of individual measures. Based on the assessment of examples of proposed waste prevention measures in the context of the scientific background report to the existing WPP, a specific and qualified environmental assessment will be undertaken using selected examples of waste prevention measures. For these eight measures, the quantities of material/waste saved will be converted into the quantity of (total) raw material saved or greenhouse gas emissions avoided with the help of material footprint/carbon footprint indicators. In addition to this gross estimate, as far as is possible at reasonable expense, the additional use of material and energy necessary to implement the waste prevention measure will be offset.

This method offers several advantages. On the one hand, achievements of the WPP can be identified and communicated on the basis of specific measures. Furthermore, the analysis allows a comprehensive environmental assessment that goes beyond the pure quantities of waste and thereby makes it possible to prioritise the measures in the updated programme. Further indicators of environmental assessment (e.g. energy savings or land requirement) are possible in principle. However, each additional indicator involves further expense.

A selection of representative measures was made in consultation with the commissioning body. The following measures were initially discussed by the commissioning body and the service

provider at an internal project meeting. At this point, the following critical points were included in the discussion and taken into account in the subsequent course of the project: Can the specific effects of such representative measures be determined? Do assumptions potentially need to be made which would help to determine these specific effects? Can the effects really be attributed to the measures and would they not exist without a WPP? On this note, a further critical point was the question of whether the waste prevention achieved could be completely or only partially attributed to the WPP.

The selected measures were analysed in 4 stages:

1. Based on Chapters 4 and 6 of the WPP, measures were selected where specific success in terms of waste prevention could be assumed (e.g. in contrast to campaigns aimed at raising awareness)
2. Specification of the measures so that they can be evaluated in a direct way
3. Discussion of the assumptions to be made
4. Environmental assessment of the individual waste or material streams

Stage 1: Preselection and preliminary assessment to determine the 8 measures to be examined

Measure 2: Cooperation between stakeholders
E.g. on the subject of reducing food waste in the eating-out sector **Specific cooperation: "Restlos genießen" (Enjoying every little bit) campaign (www.restlos-geniessen.de)**
• Specific data which make it possible to estimate the volume of food waste that can be prevented • This volume can be converted into specific food categories (wheat, beef, etc.) using the Federal Environment Agency (UBA) "Texte" series, no. 85/2016 • These foodstuffs can be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand, land requirement) using ecoinvent data and LCA calculations
Assessment: appropriate measure for evaluating environmental impact

Measure 7: Identification of product-specific requirements for product design that prevents waste within the framework of the implementation measures of the EU Ecodesign Directive (2009/125/EC)
E.g. initiatives for standardised chargers for smartphones
• Standardised chargers do not initially prevent waste • Necessary to sell smartphone and charger separately • By means of assumptions (proportion of smartphones sold without chargers in Germany) and life cycle inventory data, the volume of prevented waste could be estimated • Alternatively, there are estimates of the potential savings in the EU (51,000 t), definition of the share for Germany using sales figures • These volumes of raw materials from the life cycle inventory data can be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations
Assessment: appropriate measure for evaluating environmental impact

Measure 8: Disseminate information and raise awareness for waste-preventing product design
E.g. winner of the German Federal Ecodesign Award
• Presentation of specific best practices • In principle, appropriate descriptions for product design are available • From these, it would be possible to deduce the volumes of waste prevented and the associated reduction in required resources • These volumes of raw materials can be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations • It is questionable, however, whether causality exists between competition and the implementation of the specific product design. The purpose of this type of measure is based more on the question of market diffusion and generating awareness/free advertising effect
Assessment: not pursued further due to the lack of causality

Measure 16: Waste prevention cooperations among industrial companies
E.g. regional material and energy networking on the Henstedt-Ulzburg industrial estate – funded by the German Federal Environmental Foundation (DBU)
Presentation using specific examples: • As a result of the funding measures, there are documented results for the project carried out • Clarification as regards which of the proposals developed in the course of the project were implemented • In so far as this information is available and documented in specific volumes of waste prevented, the reduced requirement for resources can also be deduced • These volumes of raw materials can be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations
Assessment: appropriate measure for evaluating environmental impact

Measure 17: Voluntary agreements with retail and gastronomy on training measures aimed at ensuring that stores and restaurants are supplied with food in accordance with their needs
E.g. catering Guidelines/Courtauld Commitment in UK
• Guidelines consist of various check lists • Unclear how frequently the guidelines are used and what specific saving potentials can be realised using them • The effects of the Courtauld Commitment are documented (e.g. in the Federal Environment Agency (UBA) “Texte” series, no. 85/2016, p. 133 et seq.) • Using the same procedure as in Measure 2, the environmental impact of the results of the Courtauld Commitment could be estimated • It may be possible to estimate what this would mean for Germany, if similar agreements could also be made in Germany and produced similar results.
Assessment: since no specific data are available for Germany, this measure cannot yet be evaluated

Measure 18: Agreements between industry/trade and government agencies on waste prevention
E.g. voluntary ban on plastic carrier bags
• It needs to be clarified whether there is a 1:1 substitution of single-use plastic carrier bags with single use paper bags, or whether a stronger trend towards reusable bags/baskets can be ascertained • Has the general demand for bags decreased due to the ban on plastic carrier bags? • What impact on life cycle assessment do these outcomes have with regard to material footprint, carbon footprint and cumulative raw material demand?
Assessment: appropriate measure for evaluating environmental impact

Measure 21: Promotion of waste preventing product service systems
E.g. municipal hire schemes/municipal promotion of car sharing
• Identification of municipalities with such hire services (e.g. tools) • Assumptions regarding the substitution effect (total number of rentals, proportion of multiple rentals by customers) • Municipal promotion of car sharing services (e.g. by providing special parking spaces) would also be conceivable • However, there are some methodological problems: the impact needs to be estimated comparing a municipality with promotion and one without • There are, however, too many other factors to consider, which influence the use of car sharing, so the proportion of municipal promotion would be difficult to estimate
Assessment: use municipal rental schemes as an example, e.g. city cleaning in Berlin. It should at least point out the current legal position in the assessment of municipal promotion of car sharing.

Measure 22: Promotion of waste disposal structures and systems that promote waste prevention
E.g. waste collection charges based on weight or volume
• Identification of municipalities with corresponding waste disposal structures • If possible where there has been a recent change in the charging structure • Comparison of the volumes of waste accruing before and after the change in charging structure • The disposal processes can also be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations
Assessment: appropriate if suitable municipalities are identified. There needs to be a stronger focus on industrial waste since a higher correlation can be assumed here. It has been confirmed that these enquiries will be made with the Association for Local Waste Management and Refuse Collection (VKS)

Measure 25: Practical introduction and implementation of sustainable, resource-friendly waste concepts in schools
E.g. 50:50 Project
• A large part of the 50:50 projects is focused on saving energy • But the basic idea is also appropriate for reducing the volume of waste in schools • Identification of appropriate examples of best practice • Waste disposal processes can also be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations
Assessment: appropriate if suitable projects are identified

Measure 29: Consideration of waste prevention aspects in public procurement
E.g. competence centre for sustainable procurement
• Waste prevention aspects of sustainable procurement are currently still in the design phase or are being discussed by panels of experts • Consequently, it would only be possible to make hypothetical assessments of potential measures, such as a specification of longer running times for IT equipment and the preference for technology providers who sell devices separately from chargers. • Using relevant sets of data (current levels of public procurement) and assumptions, the volume of potential waste avoided could be extrapolated • Waste disposal processes can also be linked to environmental assessment categories (material footprint, carbon footprint, cumulative raw material demand) using ecoinvent data and LCA calculations
Assessment: not pursued due to the hypothetical nature of the results

Measure 30: Promotion of the re-use or multiple use of products (second-hand goods)
E.g. waste disposal provider platforms such as second-hand stores
• Specific examples can be identified using information from waste disposal providers and the current level of waste prevention can be determined • It is unclear, however, in the case of this further use, to what extent new products are substituted by second-hand ones • Attempts must be made to assess whether, for example, the second-hand fridge replaces buying a new fridge or whether it is purchased additionally, e.g. for the summerhouse in the garden. In the latter case, waste would not be prevented, but simply postponed until a later date • Furthermore, when assessing the environmental impact, it should be taken into account that, although using second-hand products for longer may initially prevent waste, older (electrical) appliances are frequently less energy-efficient
Assessment: appropriate in principal for evaluating environmental impact. Interesting in substance, since potential conflicting aims may be identified

Measure 31: Support for repair networks
E.g. Reuse facilities
• Specific examples can be identified using information from various projects and the current level of waste prevention can be determined • It is unclear, however, in the case of this further use, to what extent new products are substituted by repaired ones

• Attempts must be made to assess whether repaired items replace new products or whether they are acquired additionally. In the latter case, waste would not be prevented, but simply postponed until a later date. • Furthermore, when assessing the environmental impact, it should be taken into account that, although using repaired items for longer may initially prevent waste, older (electrical) appliances are frequently less energy-efficient
Assessment: appropriate in principal for evaluating environmental impact. Interesting in substance, since potential conflicting aims may be identified

Measure 33: Designing events in public institutions to prevent waste (reusable instead of disposable)
E.g. various events in Germany (e. g. Oktoberfest beer festival, sports events)
• The volume of disposable tableware that is avoided is frequently documented • There are relevant calculations that compare the savings achieved with the extra energy/resources consumed in producing the thicker plastic used for reusable items and the additional environmental burden involved in logistics and washing reusable items (e.g. guidelines for drawing up municipal waste prevention concepts) • The volumes for individual documented events could potentially be grossed up to give a figure for the whole of Germany • Research into the number of similar events in Germany with corresponding information on the accrued quantities of disposable tableware
Assessment: appropriate measure for evaluating environmental impact

3.1.1 Final selection and methodological approach

On the basis of these preliminary considerations and further research, and in collaboration with the commissioning body, the following eight measures were selected, where it was possible to see that the measures were described in sufficient detail and at the same time to deduce data on the waste prevention potential involved.

- Measure 2: Cooperation between stakeholders: using the example of the "Restlos genießen" (Enjoying every little bit) campaign, which involves food waste in the gastronomy sector
- Measure 7: Identification of product-specific requirements for product design that prevents waste within the framework of the implementation measures of the EU Ecodesign Directive: using the example of the envisaged requirement for mobile phone chargers to be compatible
- Measure 18: Agreements between industry/trade and government agencies on waste prevention: using the example of the agreement on reducing single-use plastic bags in the retail industry
- Measure 21: Promotion of waste preventing product service systems: using the example of municipal hire schemes/municipal promotion of car sharing
- Measure 22: Promotion of waste disposal structures and systems that promote waste prevention, e.g. waste collection charges based on weight and volume
- Measure 30: Promotion of the re-use or multiple use of products, e.g. waste disposal provider platforms such as second-hand shops

- Measure 31: Support for repair networks, e.g. reuse facilities
- Measure 33: Designing events in public institutions to prevent waste, reusable instead of disposable

The specific measures are very different in nature, in terms of the tools they use and also the waste streams that they reduce, so it is not advisable to use a standardised procedure to evaluate their environmental impact. In the case of some of the measures, voluntary agreements or new legislation result in reduced waste streams, where no direct investment can be identified. Some other measures are associated with greater investment, involving both monetary and material expenditure. While the investment costs are known, e.g. from the individual case studies of the German Environmental Innovation Programme, the material costs of the investments cannot, however, be deduced from the available information and cannot therefore be compared to the reduced waste streams.

In life cycle assessments, the system limits of the investigation can be decisive and may substantially influence the results of the investigated alternatives. In order to evaluate the environmental impact of the various WPP measures, however, a complete life cycle assessment is not carried out, but a coefficient-based approach chosen, making it possible to assess the material footprint or carbon footprint of implementing a specific measure. Fairly narrow system limits are defined, therefore, in the assessment of the environmental impact, whereby, e.g. in the case of Measure 2 (Cooperation between stakeholders) only the material costs for the take-away boxes made of coated kraft paper or EPS plastic are compared to the reduced quantities of food waste. In a full life cycle assessment, the system limits would be more broadly defined and compare, for example, the substitution effect of the leftover food that is taken home, including the energy required to reheat it, to an alternative preparation of meals at home, with the associated substituted food and the energy saved in preparation.

For the majority of the measures investigated, specific information on the volume of waste prevented could be researched. This may involve direct raw materials such as copper or limestone, or waste categories, such as electronic waste which consists of products that are composed of different materials. In the latter case, a life cycle inventory of the products that are not utilised needs to be initially researched, in order to link the raw materials they contain with the material footprint or carbon footprint coefficients. For example, Measure 7 (Identification of product-specific requirements for product design that prevents waste within the framework of the implementation measures of the EU Ecodesign Directive) is investigated on the basis of the requirement for mobile phone chargers to be compatible. In terms of specific information, however, there is only an estimate of the number of chargers that are not discarded in electronic waste due to this requirement. Before evaluating the environmental impact of this measure using a material footprint or carbon footprint, it is therefore first of all necessary to produce a life cycle inventory that makes it possible to determine the amounts of copper, polyethylene or steel contained in a typical mobile phone charger. The coefficients for the calculation of the material or carbon footprint are then determined for each individual raw material and this indicates the volume of raw material needed or the level of GHG emissions produced in the production of one unit of copper, polyethylene or steel. The relevant process data from ecoinvent are used to link the coefficients for the two footprints. For some individual measures, however, a full life cycle inventory was not produced, but only the main materials were included in the estimate (Measure 18), or only simplified descriptions of the material composition were available (Measure 31).

In addition, for some individual measures, it was necessary to specify usage intervals or the substitution ratio in order to determine the actual volumes of raw materials saved or the levels of GHG emissions avoided. In this case external information is referred to as far as possible. If this information is not available the assumptions made by the project team are clearly stated. This applies, for example, to the ratio of how many single-use plastic bags are replaced by reusable bags, to what extent they are replaced by reusable plastic, paper or cotton bags, how often the latter are used and what proportion of single-use plastic bags are replaced exclusively by single-use paper bags.

3.1.2 Presentation of the specific measures and the volumes of waste they prevent

3.1.2.1 Measure 2: Cooperation between stakeholders, specification: reducing food waste in the eating-out sector through the "Restlos genießen" (Enjoying every little bit) campaign

Background

Around 11 million tonnes of food a year are not consumed and are disposed of as waste. About 1.9 million tonnes of this waste food are generated by large-scale consumers such as restaurants, cafeterias, hospitals and school canteens. Of this amount, around one million tonnes can, in turn, be attributed to the restaurant sector (926,000 t) (Kranert et al. 2012). The "Restlos genießen" campaign wants to motivate restaurants to actively offer their guests boxes to take their left-over food home, thereby reducing food waste due to leftovers on plates. "Restlos genießen" is a joint initiative between Greentable (the platform for sustainable catering) and the "Zu gut für die Tonne!" (Too Good for the Bin!) initiative run by the German Federal Ministry of Food and Agriculture. The respective boxes can be purchased from retail shops or online. Each box holds up to 1,350 ml, and is made of FSC-certified kraft paper with a water-based coating. The box is recyclable, 100% biodegradable and can be disposed of in an industrial composting plant.

According to a recent survey carried out by the Emnid research institute, around 52% of Germans said they have their leftover food wrapped up to take home with them at least occasionally. Around 25% of the respondents said that they always take their leftover food home with them, and 54% said they would take food home if this was actively encouraged by restaurants (EUWID 38/2017).

However, the amount of leftover food in the restaurant sector needs to be further reduced, since leftovers from food preparation (so-called cooking losses), buffet leftovers or unused food stocks are not included in the food waste that could be reduced by taking food home in boxes. While Hrad et al. (2016) estimate the proportion of food left on plates as part of the avoidable food waste that is generated in the gastronomy sector at 33% for Austria, Kranert et al. (2012) conclude it amounts to around 12-15% of the portion size in the restaurant case studies they investigated. One portion weighs 400-500 g, whereby the average amount of leftover food is 50-60 g per portion.

In order to link the amount of food left on plates using the serving size with the willingness to take this leftover food home, data on the number of restaurant visits per year finally needs to be determined. According to statistics, every German went to a restaurant 136 times in 2010. This amounts to 2.5 restaurant visits per week, i.e. almost every other day. It is assumed that these figures include both business meals and lunch breaks for employees without a company canteen. On both of these occasions it is assumed that taking leftover food home would occur less frequently. According to the Emnid survey "Das isst Deutschland" (What Germany eats) (2013) 37% of the respondents said that they go out to eat once or twice a month. 12% said that they eat out up to three times a week. If it is assumed that the 63% of respondents, who go to a

restaurant less than once a month, go at least once a quarter[60], this amounts to around 20 restaurant visits per head per year.[61]

Based on these assumptions, (1.6 billion portions and 50-60 g of leftover food per portion) the annual quantity of food left on plates amounts to 80,000 to 96,000 tonnes. This is significantly less than the volume determined by the assessment, if the proportion of food left on plates in Austria (33%) (Hrad et al. 2016) is applied to the overall volume of food waste in the restaurant sector (926,000 tonnes) (Kranert et al 2012) (which would amount to 305,580 tonnes). The reason for this is presumed to lie in the fact that restaurant visits by tourists as well as business meals and company employees eating out at lunchtime were not considered in the assumed 20 restaurant visits per year. Although food leftovers also accrue on these occasions, it is highly likely that they are less frequently taken away in these situations than in the case of private visits to restaurants made by the local population. On the one hand, the level of social inhibition is higher as regards taking leftover food home after a business meal, and, on the other hand, many professionals may be daunted by the idea of leaving the leftovers of their meal at their workplace for half a day, potentially without access to a fridge. Neither will tourists take leftover food back to their hotel room. Even if the number of full service restaurants for 2010 from Kranert et al. (2012) is used as a basis, the volume of food leftovers that could potentially be taken home only increases to 105,000 –126,000 tonnes.

The "Restlos genießen" joint campaign wants to ensure that restaurants actively give their guests the option of taking their leftover food home. As mentioned above, 54% of people would be willing to do this, if they were actively given the opportunity. Based on these assumptions, the potential reduction in food waste as a result of the "Restlos genießen" campaign can be calculated at around 54% of the accrued volume of leftover food of 80,000 –126,000 tonnes per year.

Assumptions regarding the life cycle inventory

In order to evaluate the volume of food waste in an ecological way with the help of life cycle assessments, the leftover food needs to be converted into agricultural ingredients. In theory, it would be possible to transfer the distribution of food waste in private households according to product groups to the quantities of leftover food[62], and thus subdivide the leftovers further into specific product groups and finally into typical exponents per product group. In this way, 6.3% of the leftover food would be identified as meat and fish products and assumptions would then need to be made about the proportion of pork or chicken. The result would include a breakdown of the leftover food per portion according to food categories, which either consist of unprocessed products such as potatoes and apples or foodstuffs that have already been processed from the primary processing stage such as milk or butter. However, this approach is very strongly influenced by assumptions, which overestimate or underestimate certain product groups (see footnote 66).

This assessment therefore refers to other data. As part of the Federal Ministry of Education and Research's "NAHGAST" project[63] , the Wuppertal Institute, in collaboration with its partners

[60] A ranking by age, both in terms of number of visits and portion sizes, was not carried out.

[61] Own assumption based on the above mentioned survey results: 63 % of the population goes out to eat 4 times a year, 25 % of the population goes out to eat 1.5 times a month, 12 % of the population goes out to eat 2 times a week. Altogether, with a population of 82.2 million people, this results in a total number of restaurant visits of 1.6 billion per year. This figure is within the range of the estimate from Kranert et al. (2012), which locates around 2.1 billion of the 11.34 billion out-of-home visits in the full-service sector.

[62] This would probably not be correct in terms of content, as it would overestimate the proportion of bakery products and fruit, which are unlikely to be a component of leftovers.

[63] „Initiierung, Unterstützung und Verbreitung von Transformationsprozessen zum nachhaltigen Wirtschaften in der Außer-Haus-Gastronomie [Initiation, support and dissemination of transformation processes for sustainable management in out-of-home gastronomy.]" (www.nahgast.de)

(which were admittedly more often catering companies and refectories than restaurants), compiled recipes with lists of ingredients. In this project, the material[64] or carbon footprints were determined for these recipes. It involves a total of 100 recipes which can be subdivided into 11 different categories (stews, pasta dishes, lasagne, goulash, poultry, potato dishes, schnitzel, fish dishes, pan-fried vegetarian dishes, grilled sausages with accompaniments and rice pudding). The categories were further differentiated – as far as possible – according to whether they were vegetarian or contained ingredients obtained from animals. Dishes that have a proportion of less than 10% of the ingredients of animal origin are categorised as vegetarian. For all the dishes (different) portion sizes were stated so the footprint indicators had to be standardised to a portion size of 1 g. Subsequently, the median value of the footprint indicators was established for all the recipes of one category and from these 17 median values a median value for all the recipe categories was then calculated. This median value for all the recipes analysed in the NAHGAST project can be considered an average value for the material or carbon footprint for all restaurant food and can therefore be linked to the quantity of leftover food.

The outlay for the takeaway box[65] made from coated kraft paper or alternatively from EPS plastic must be offset. For the "Restlos genießen" campaign, leftover boxes made from kraft paper with a capacity of 1,350 ml are used. These weigh about 40 g per box according to the manufacturer's specifications. A weight of 15 g is indicated for takeaway boxes made of EPS, like the ones used in many fast-food facilities. We assume that these takeaway boxes are only used once. No credits are used for potential substitution effects in the subsequent recycling process of the takeaway boxes or food waste (waste paper, fermentation) and they are not part of the environmental assessment. Table 11 shows the basic information on the environmental assessment for Measure 2. The first column shows either the type of material that could be saved by means of the measure, or the type of material that was necessary to implement the measure, in this case kraft paper or alternatively a takeaway box made of EPS. The second column gives information about the ecoinvent process, which was used to calculate the footprint indicators. Columns 3 and 4 document the respective footprint coefficients and columns 5 and 6 give a final summary of the actual result of the environmental assessment with regard to the respective volumes previously described in the text.

[64] The Material Footprint in the NAHGAST project differs methodically from Footprint indicators as they are usually used. The NAHGAST Project uses the MIPS or TMR perspective, which considers unused domestic extraction as well as imports. However, in the majority of studies that calculate a Material Footprint, the Footprint is used in raw material equivalents. Accordingly, the Material Footprint was calculated with the RME coefficients and not the TMR coefficients in the other measures investigated in this project.

[65] There are also other forms, such as solid, dishwasher-safe transport boxes made of PE or PP.

Table 11: Overview of the coefficients and results for Measure 2, reducing food waste

Material	Ecoinvent process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material Footprint in t	Carbon footprint in t CO_2-equivalents
Food ingredients	Data adopted from NAHGAST project	5.361	1.437	294,828	79,013
Kraft paper	market for folding boxboard/chip board | folding boxboard/chip board | APOS, U, GLO	4.674	1.533	- 77,118	- 25,299
EPS	market for polystyrene, expandable | polystyrene, expandable | APOS, U, GLO	3.300	3.464	- 24,751	- 25,977
Total				**192,958**	**27,737**

Source: Own calculation based on data from Ecoinvent, NAHGAST 2018 and Kranert et al. 2012

Conclusion

It is evident from Table 11 that activating the potential for reducing leftover food in the gastronomy sector could save large volumes of raw materials as well as greatly reduce the level of GHG emissions. The calculations included the assumption that half of the leftover food would be taken home in boxes made from kraft paper and half in boxes made from EPS. It can be seen from the coefficients that takeaway boxes made of EPS are more beneficial as regards the material footprint, whereas boxes made of kraft paper are more advantageous in terms of avoiding GHG emissions.

3.1.2.2 Measure 7: Identification of product-specific requirements for product design that prevents waste using the example of the initiative requiring that smartphone chargers are compatible

Description of the measure

In 2014, the European Parliament and the Council of the European Union adopted a directive which includes the provision that radio units, particularly mobile phones that are available commercially, must be compatible with a standard charger from 2017 onwards. This is intended to contribute towards reducing unnecessary waste and cutting costs (European Parliament 2014a). Through this measure, the EU Parliament anticipates that it will be possible to prevent up to 51,000 tonnes of electronic waste by eliminating superfluous chargers (European Parliament 2014b). The corresponding communication does not state how the 51,000 t estimate was determined and which assumptions were made. It is doubtful whether the obligation to provide standard chargers alone can prevent waste, if it is not simultaneously possible to buy mobile phones without a charger. RPA (2014) report that only 0.05 % of the smartphones sold in the 28 EU member states in 2013 were sold without a charger. Neither will this percentage have increased in recent years. It would therefore not only be necessary for the chargers to have

standard plugs but also for mobile phones to be sold entirely without chargers and for customers to be able to buy a charger separately if they need one.

Assumptions regarding the life cycle inventory

In this case, which is currently still a hypothetical one, the material savings need to be assessed based on the current sales figures for mobile phones. Since the percentage of people who own a mobile phone in Germany is already very high and the majority of smartphone owners probably already use chargers with micro USB connectors, it is entirely realistic to assume that all the mobile phones sold in a year could also be sold without chargers. According to Bitkom (2017), 24.2 million smartphones were sold in Germany in 2016. For the life cycle inventory of a typical charger, we use data from Anders et al. (2014)[66], who have published the relevant data for a Huawei U8350 charger. The charger weighs 56.3 grams and comprises the following (main) material components:

Table 12: Material composition of a smartphone charger

Material	Iron/ Steel	Alumini-um	Copper	Silver	Gold	Plastic	Palladi-um	Silicone
Volume in grams	6.1	3.4	10.9	0.004	0.018	20.0	0.00006	0.0473

Source: Anders et al. 2014

From the life cycle inventory data, the relevant ecoinvent process data for the individual material components and the total sales figures for smartphones, it is possible to calculate the material and carbon footprints linked to the 24.2 million chargers sold in Germany every year, which could theoretically be avoided if smartphones were sold separately from chargers.

Table 13: Overview of the coefficients and results for Measure 7, product design that prevents waste

Material	Ecoinvent process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
Iron/Steel	market for steel, low-alloyed | steel, low-alloyed | APOS, U	7.227	1.89	1,067	288
Aluminium	market for aluminium, cast alloy | aluminium, cast alloy | APOS, U	7.5	5.83	616	480
Copper	market for copper, cathode |	184	7.90	48,654	2,083

[66] The figures are consistent with data obtained for the EU-28 by RPA (2014), which then breaks down these data to the sales figures of the German market as a proportion of total sales in the EU-28.

Material	Ecoinvent process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
	copper, cathode | APOS, U				
Silver	market for silver | silver | APOS, U	6336	400	613	38.78
Gold	market for gold | gold | APOS, U	836,302	16,185	364,293	7,050
Plastic (PVC)	market for polyvinylchloride, suspension polymerised | polyvinylchloride, suspension polymerised | APOS, U	1.99	1.99	966	963
Palladium	market for palladium | palladium | APOS, U	50,470	7,704	73.28	11.19
Silicone	silicone product production | silicone product | Europe	3.27	2.82	3.75	3.23
Total				**416,362**	**11,011**

Source: Own calculation based on data from Ecoinvent and Anders et al. 2014

Conclusion

Although the direct material savings would only amount to 980 tonnes as a result of the separate sale of chargers and smartphones (56.3 grams x 24.2 million smartphones), the material footprint is extremely high due to the gold, copper and palladium contained in chargers. Avoiding the production of superfluous chargers would therefore lead to a reduction in the material footprint of over 400,000 tonnes. The environmental relief linked to this reduction would take place primarily in the countries where copper and gold are mined. In addition, around 11,230 tonnes of GHG emissions can be avoided by implementing this measure.

3.1.2.3 Measure 18: Agreements between industry/trade and government agencies on waste prevention using the "Agreement on reducing the use of plastic carrier bags"

Background

On 26 April 2016, the Minister of the Environment at the time, Barbara Hendricks, and the President of the German Retail Trade Federation (HDE), Josef Sanktjohanser, signed an

agreement which aimed to make it compulsory to charge for 80% of plastic carrier bags within two years.[67] The essential content of the agreement is as follows:

- At least 80% of the lightweight plastic carrier bags introduced onto the market by the participating companies and member companies of the trade federations will only be distributed in exchange for an appropriate fee in future.
- Reduction in the annual consumption of lightweight plastic carrier bags to a maximum of 90 per person per year by 31 December 2019 and to a maximum of 40 plastic carrier bags per person per year by 31 December 2025.
- In the agreement, plastic carrier bags are defined as carrier bags with or without plastic handles, with a wall thickness below 50 µm, which are supplied to consumers at the point of sale of goods or products.

This excludes:

1. Long-life carrier bags and freezer bags with a wall thickness above 50 µm which are designed and suitable to be reused multiple times
2. "Very lightweight" plastic carrier bags for buying loose smaller products such as screws
3. "Very lightweight" plastic carrier bags, which are required for hygiene purposes or provided as primary packaging for loose food

In addition, the participating companies undertake to have a report on the effectiveness of the agreement written annually by an independent third party. This agreement came into force on 1 July 2016 (HDE, 2016). The Gesellschaft für Verpackungsmarktforschung (GVM) (Society for Packaging Market Research) was commissioned to monitor the total volume, weight and material of the plastic carrier bags and to provide the relevant data and information on an official information website (GVM, 2017a).

In general, the agreement refers to the EU reduction target (Directive 2015/720) that, by 2020, a maximum of 90 lightweight plastic bags per person per year and, by 2025, a maximum of 40 lightweight plastic carrier bags per person per year will be put on the market (European Parliament & Council of the European Union 2015).

Impact of the agreements

Since the year 2000, the GVM has been able to identify a slight downward trend in the use of plastic carrier bags. Consumption dropped from 85 bags per person per year in 2000 to 76 and 68 bags per person per year in 2012 and 2015 respectively. This equates to a reduction of 12% over the period of 12 years (2000 to 2012) and 20% over the period of 15 years (2000 to 2015). The overall quantity of plastic carrier bags put into circulation was 7 billion (2000), 6.1 billion (2012) and 5.6 billion (2015). In 2017, the number of plastic carrier bags distributed in check-out areas fell to a total of 2.43 billion (or 29 carrier bags per head) (GVM 2018). This is a substantial reduction compared to the previous year and continues the marked decline that has been recorded since 2015 (GVM 2018). With the total of 25 bags/head per year, the EU target, which envisages the use of carrier bags with a wall thickness below 50 µm dropping to 40 bags/head per year by 2025, has already been surpassed to a significant extent.

It was only after the introduction of EU Directive 2015/720 that the differentiation between plastic carrier bags with a wall thickness up to 50 µm (lightweight plastic bags) and those with a

[67] See http://kunststofftragetasche.info/wordpress/wp-content/themes/kunststofftragetasche/files/Vereinbarung_Tragetaschen.pdf

wall thickness over 50 µm was observed when collecting data. The primary focus of the agreement lies on the types of plastic carrier bags that are included in this classification. The overall use of plastic carrier bags with a wall thickness below 50 µm is accordingly lower.

A more precise differentiation of the overall market for plastic carrier bags according to wall thickness for the period 2015–2017 is given in GVM (2018). The plastic carrier bags are classified in wall thicknesses of < 15 µm, 15-50 µm and > 50 µm. The first category covers "very lightweight" plastic carrier bags such as those frequently used for packing portions of fruit and vegetables. The second category covers plastic carrier bags that are made available to transport products, for example in check-out areas. Long-life carrier bags are an example of the final category. The categorisation of the examples arises from the research into the life cycle inventories described in the next section.

The middle category of plastic carrier bag with a wall thickness of 15–50 µm clearly has the highest proportion of overall use. The largest annual reduction can also be identified here with 40% for each year. The overall use of very lightweight plastic carrier bags fell by 15% and 22% respectively. The distribution of heavyweight plastic carrier bags also decreased, although these are officially excluded from the agreement and it can be assumed that these were more in demand as a substitute for simple carrier bags. The reduction amounted to 33% and 42% respectively. However, this category also includes bags for frozen goods, etc.

The data show that voluntary commitment is working and since 2015 the distribution of plastic bags has fallen drastically. Voluntary commitment has thus further reinforced and perpetuated a trend.

Life cycle inventories for various carrier bags

In order to produce a holistic result for the effectiveness of the agreement and the measure, it is necessary to analyse the alternative courses of action available to consumers. The overall use of plastic carrier bags with a wall thickness below 50 µm for transporting products is the highest, according to GVM (2018), compared to plastic carrier bags with a higher wall thickness. The agreement aims to significantly reduce plastic carrier bags. At the same time, the consumer needs other carrier bags and boxes to transport their shopping, for example. At this point it is necessary to investigate which alternatives the consumer has, which ones he/she uses and how, and which resources are needed for this.

In preparation for an analysis of life cycle assessment, therefore, various alternative bags and their characteristics are listed in Table 14 below.

As well as the data mentioned, there is also other literature which provides details on various plastic carrier bags and alternatives. (Sustainable Packaging Alliance Limited 2009), for example, publishes a list of different carrier bags, including a description and assumptions as regards their material composition. The capacity is stated as "relative capacity", however, and is thus based on a defined average capacity value of 7 products.

Table 14: Overview of evaluated life cycle assessments for carrier bags

Description	Weight (g)	Dimensions HxWxD (cm)	Volume (l)	Thickness (µm)	Description
Plastic carrier bag (LDPE)	30.3	46 x 52 x 10	26	55	Plastic carrier bag (LDPE)
> 80% Blue Angel recycled carrier bag	30.3	46 x 52 x 10	26	55	> 80% Blue Angel recycled carrier bag
Plastic carrier bag made of renewable raw materials	30.3	46 x 52 x 10	26	55	Plastic carrier bag made of renewable raw materials
Compostable plastic carrier bag (EN 13432)	44.8	46 x 52 x 10	26	55	Compostable plastic carrier bag (EN 13432)
Paper carrier bag	42	32 x 44 x 17	24	90	Paper carrier bag
Cotton bag	62	42 x 38			Cotton bag
Recycled plastic (HDPE)	5.78	53 x 30			Recycled plastic (HDPE)
Biodegradable plastic carrier bag	15.78	55 x 28			Biodegradable plastic carrier bag
Recycled plastic carrier bag	51.82	43 x 28			Recycled plastic carrier bag
Plastic carrier bag (LDPE)	14.8		16.2		Plastic carrier bag (LDPE)
Long-life PP bag	127		39.6		Long-life PP bag
Biodegradable plastic carrier bag (Mater-BI)	20.21		16.2		Biodegradable plastic carrier bag (Mater-BI)
Plastic carrier bag (HDPE)	7.5-12.6		17.9-21.8		Plastic carrier bag (HDPE)
Long-life heavy-duty bag (LDPE)	27.5-42.5		19.1-23.9		Long-life heavy-duty bag (LDPE)
Non-woven PP bag	107.6-124.1		17.7-21.8		Non-woven PP bag
Paper carrier bag	55.2		20.1		Paper carrier bag
Bag made of biopolymers	15.8		18.3		Bag made of biopolymers
					Cotton bag

Description	Weight (g)	Dimensions HxWxD (cm)	Volume (l)	Thickness (µm)	Description
Cotton bag	78.7		17-33.4		

In their report, Edwards & Fry Meyhoff (2011) list further alternatives, for which no other information has yet been found, including a PP vacuum-formed box. In addition, a woven PP bag is mentioned, which is presumably comparable to the long-life PP bag mentioned by Mori (Mori 2013), but an explicit description is not available. The jute bag, which offers another alternative to the plastic carrier bag, is also not listed in Table 14.

For the assessment of the environmental relevance of reducing plastic carrier bags, relevant assumptions need to be made regarding the substitution of behaviours while shopping and how frequently these alternatives are used. There are no literature references or other sources available for this information, however. Therefore the commissioning body made some assumptions that portray a possible scenario and thus allow an assessment of the environmental impact. If other assumptions were made, the results of the ecological assessment would certainly be different. The assessments refer to the period of a year, so the frequency of using alternative carrier bags per year is the criteria used and not the frequency of use for the entire life cycle of alternative sturdier carrier bags.

The number of plastic carrier bags distributed, with a wall thickness below 50 µm, decreased by 1.3 billion from 2016 to 2017. The following assumptions were made regarding their substitution:

- The amount of shopping bought remains unchanged, so the 1.3 billion carrier bags must have been replaced by other transport options.
- All previously distributed plastic carrier bags with a wall thickness below 50 µm were only used once
- 10% of the plastic carrier bags were replaced by paper carrier bags, which were also used only once; this equates to a total of 130 million paper carrier bags
- A further 50% of shopping is transported in already-existing, long-life carrier bags made of PP, in fabric bags or in the shopper's own rucksack, etc. The substitution of plastic carrier bags made of PE therefore started before the period under review and cannot be included as a burden in the environmental assessment. It is assumed that around 650 million plastic carrier bags were replaced without incurring any environmental burden.
- Of the remaining 520 million plastic carrier bags to be substituted, it is assumed that 20% are replaced by cotton bags and 80% by long-life carrier bags made of PP.
- Furthermore, it is assumed that both options are used multiple times, e.g. for the weekly shop at the supermarket. Therefore a frequency of occurrence of 40 shopping trips per year is assumed where the long-life carrier bags and cotton bags are used.
- And finally it is also assumed that, due to its size, a long-life carrier bag made of PP replaces two conventional carrier bags made of PE.

- Under these assumptions, the 1.3 billion plastic carrier bags that were not distributed between 2016 and 2017 were replaced by 130 million paper carrier bags, 2.6 million cotton bags and 5.2 million long-life carrier bags made of PP.

For the environmental assessment, no complete life cycle assessment was carried out for different types of carrier bag. Relevant results can be found in the sources listed in Table 14 or also currently in the Danish Environmental Protection Agency study (2018). For the environmental assessment of Measure 18 of the WPP, only the main material categories for the corresponding carrier bags were taken into account (LDPE for conventional plastic carrier bags, PP for long-life carrier bags made of plastic, kraft paper for paper carrier bags and cotton for carrier bags made of fabric). Other material components such as the glue or the coating on paper bags or the ink for the printing on the various bags are not taken into account.

Table 15: Overview of the coefficients and result for Measure 18, voluntary commitment to avoiding plastic carrier bags

Material	Ecoinvent-process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
LDPE (30.3g/bag)	market for polyethylene, low density, granulate | polyethylene, low density, granulate | APOS, U	1.802	2.185	70,985	86,050
PP (127g/bag)	market for polypropylene, granulate | polypropylene, granulate | APOS, U	1.752	2.064	- 1,157	- 1,363
Kraft paper (42g/bag)	market for kraft paper, bleached | kraft paper, bleached | APOS, U	4.334	1.608	- 23,665	- 8,780
Cotton (80g/bag)	market for textile, woven cotton | textile, woven cotton | APOS, U	17.124	25.750	- 3,562	- 5,356
Total				**42,601**	**70,550**

Conclusion

The 1.3 billion plastic bags that were avoided have a material footprint of nearly 71,000 tonnes and reduced emissions of GHGs of 86,000 tonnes. However, this must be compared to the material and carbon footprints of the alternatives used in place of the conventional carrier bags. Taking into account the raw materials needed to manufacture the alternative products and the

GHG emissions caused, the avoided material footprint is reduced by nearly 28,000 tonnes to 42,600 tonnes, while the carbon footprint decreases considerably less: from 86,000 tonnes to 70,500 tonnes. Even when taking into account the alternative bags that were substituted, it was possible to save a large volume of raw materials and avoid the associated GHG emissions through the reduced distribution of plastic carrier bags, which is largely supported by the voluntary commitment of the retail sector.

3.1.2.4 Measure 21: Promotion of waste preventing product service systems using the example of hire service outlets

Background

Brief outline

The first step is to define and clarify the activities covered by this measure. Product service systems that prevent waste include exchange, loans, gifting and trading involving second-hand goods. Numerous approaches and forms are to be found at the municipal level:

- Private loans, gifting, exchanges,
- Commercial hire and trading involving second-hand goods
- Non-commercial loans and gifting,
- Activities organised by charitable institutions such as free offers, donations and trading in second-hand goods,
- Online portals and apps.

Among these approaches, hire service outlets represent only a small percentage of the activities, which are handled via a wide range of channels and by very different players. The transactions carried out may sometimes be free of charge, but lucrative business models are also involved.

The current study is intended to concentrate on loan services which operate at the municipal level. As will be demonstrated, very diverse players, products and, to some extent, very small-scale structures are involved in the municipal loan sector. Insights into the magnitude of the prevented waste or the avoided adverse environmental impacts related to this measure cannot be reliably drawn from examining individual examples.

To do this, the above-mentioned transaction channels and players would first need to be identified and in addition the shared product range in the various areas of need would have to be measured quantitatively. Furthermore, the substitution rates for the respective relationships between people and goods would need to be investigated by means of observation. In this respect, particular attention must be paid to the occurrence of rebound effects, i.e. increased consumption due to shared use. Rebound effects were identified, for example, in the case of free-floating car sharing in contrast to stationary car sharing during a three-year study (Hülsmann et al. 2018).

The extensive groundwork and in-depth information and indicators required for the projection cannot be inferred from either the Federal Statistical Office or other literary sources. To collect this information separately is clearly beyond the scope of this study. Therefore a quantitative projection of the diverse range of waste prevention effects connected with the measure cannot be reliably made for the many different constellations.

To make it possible to indicate the magnitude of the environmental impact of shared use, however, reference is made to the partial results of the study published by the German Federal Environment Agency (UBA) "Nutzen statt Besitzen: Neue Ansätze für eine Collaborative Economy" (using instead of owning: new approaches for a collaborative economy) (FKZ 371314105), published in the Federal Environment Agency (UBA) "Texte" series 03/2015 (Gsell et al. 2015). In this publication, the potential of reduced adverse environmental impacts resulting from the shared use of durable household goods in the private residential sector through a community approach to living was calculated using scenarios.

Implementation status in Germany

The approach of "using instead of owning" has increasingly gained in popularity in recent years. According to one survey, Germans would mainly use sharing initiatives for travel in the form of hitch-a-ride schemes, and bike- and car-sharing. In terms of everyday objects, the greatest demand is for tool-hire services (Statista 2015).

Loan services at the municipal level offering the shared use of items exist in many forms. Libraries have long been a successful alternative to owning books. In contrast, other conventional business models for loaning items, e.g. video rental shops, have been greatly suppressed by digitisation, apart from some specialist video rental companies. Car sharing and similar schemes represent a form of shared use that has now become prevalent at the municipal level.

Approaches in the realm of civil society include swap shops, give-away shops and free shops, also run by the charity sector. In Berlin alone, there are more than 70 gifting initiatives, where clothes, furniture, toys and books, household items, electrical equipment, baby accessories and bicycles are gifted, distributed or sold (Fischer 2017). As well as hire service outlets, there are a wide range of online sites for hiring a variety of products. These offer enormous additional potential since they are constantly available and simple to access. In this case, it is somewhat difficult to differentiate between hired and second-hand goods (see Measure 30, section 3.1.2.6).

In general, it is possible to list a number of criteria which make a product suitable for shared use (Jepsen et al. 2016; Gsell 2015; Scholl et al. 2010):

- High costs involved in purchase, maintenance and repair
- Long idle time (low frequency of use)
- High predictability of usage
- Standardised product
- Low product loyalty and low level of social distinction
- Long lifespan/durability
- Possible to repair

If a product fulfils several of these criteria, it is generally better suited to shared use. Typical examples of objects that are suitable for hire are lawnmowers, drills and fondue or raclette sets.

Whether using a product service system has a positive influence on the environmental impact is also determined by the circumstances and the user's behaviour. The route taken to reach the hire agency and the means of transport used also play a role, as well as careful handling of the hired product.

In addition, good visibility, publicity and communications, high reliability and ease of use of the offer are important for the success of a hire scheme and make it easier to access. High quality service and a complete, well-presented and expandable range are also important (Jepsen et al. 2016). From the point of view of the service provider, the issue of liability is also important, particularly in the case of electrical devices.

The following section describes various types of hire schemes at the municipal level.

Tool-hire outlets:

A temporary hire service for machines and tools is offered for a fee by the majority of DIY stores in Germany, either directly or through external service providers. It was possible to gather experiences regarding the hiring situation from interviews with the employees responsible from various DIY stores. The equipment most frequently hired includes vibratory plate compactors, combi hammer drills and building dehumidifiers. In view of this selection, it can be assumed that the hire service is mainly used by commercial customers and less by private individuals. A DIY store signs around 5,000 hire contracts per year for tools and machines, which need to be replaced after about three years, depending on their particular purpose (telephone interviews with hire services in DIY stores)[68].The commercial tool-hire business model benefits from high purchase costs and long idle times, as well as low frequency of use of the goods on offer. Cost considerations are a crucial reason behind the demand for commercial hire services.

Libraries:

Libraries have existed in Germany since the 19th century. Borrowing books, games and other media is still very popular. For 2016, the Deutsche Bibliotheksstatistik (German Library Statistics) identified nearly 10,000 public and research libraries with a media collection of 370 million items. More than 10 million people in Germany are recorded as active users, which equates to 12.5% of the population (Statista 2018; DBS - Deutsche Bibliotheksstatistik 2017). Whether and how regularly a library is used depends largely on how accessible it is (Kny et al. 2015). Moreover, digital media in libraries also play an increasingly important role (e.g. e-books).

Hire services in the leisure sector:

Additional equipment and specialised products can be hired for events or trips. Sports gear such as skis, snowboards or tennis racquets can be hired from many sports shops or on location. Nowadays around a third of all the skis manufactured go directly for ski-hire (Scholl et al. 2010). There are also hire services for outdoor equipment and musical instruments.

Clothing:

Hire services in the clothing sector are not widespread, apart from outlets offering items for special occasions such as suits or evening dresses and events such as clothing swap parties. There is greater potential in online platforms such as “Kleiderkreisel” (Clothing gyroscope), which enables its 20 million members to sell clothing to private individuals around the world or to exchange items of clothing. According to the company website there is a total of 52 million articles available.[69]

[68] Telephone interview of 23.07.2018

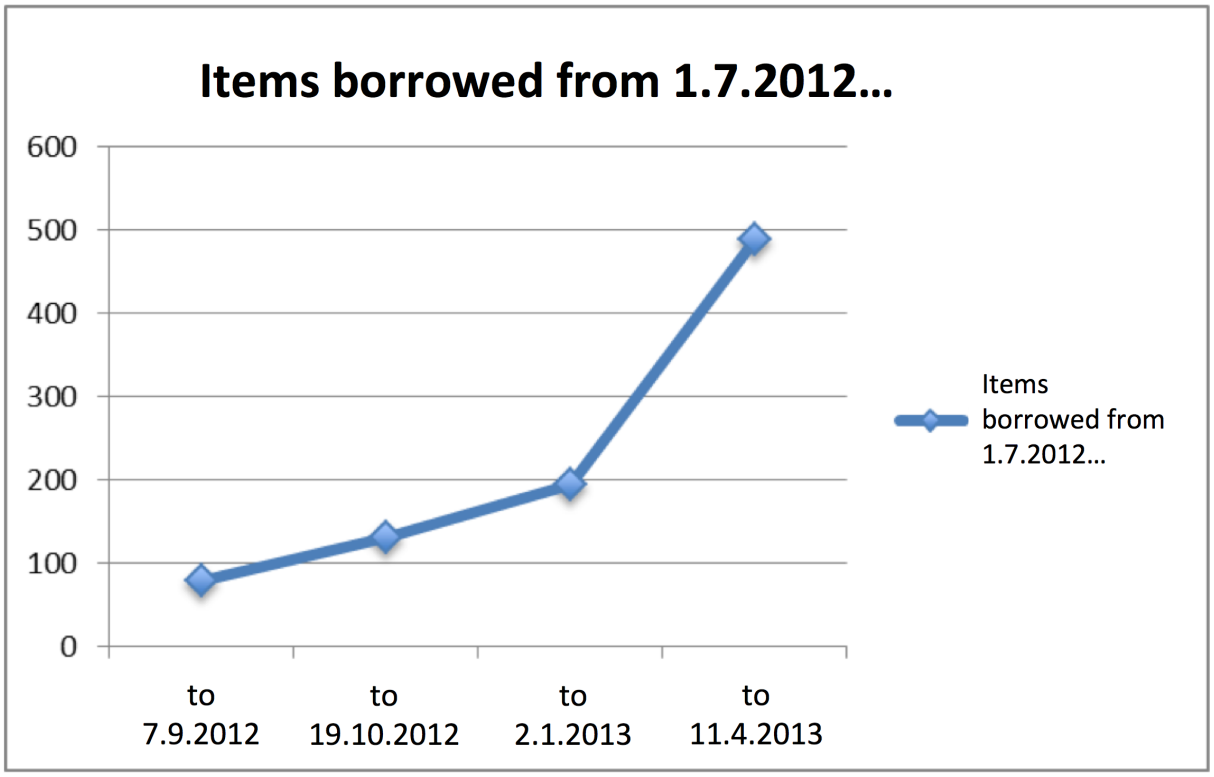
[69] https://www.kleiderkreisel.de/about, retrieved on 31.7.2018

Borrowing shops:

The borrowing shop "Leila" was founded by Nikolai Wolfert in Berlin in 2010, as the first one of its kind in Germany. Each member hands in at least one item to the shop and thereby makes it available for all the users to borrow. The range of products includes items in the categories baby and child, garden, household, outdoor, sport and games, tools, and so on. Statistics on the items most frequently borrowed show that the greatest demand is for tools such as drills or power screwdrivers and travel accessories such as tents or suitcases. Utensils for large groups of people such as sets of crockery and large cooking pans are often borrowed, as well as the cargo bike and packing cases. There are other borrowing shops in Eberswalde, Leipzig and Heidelberg; and there are further ones planned in Maintal and Karlsruhe.

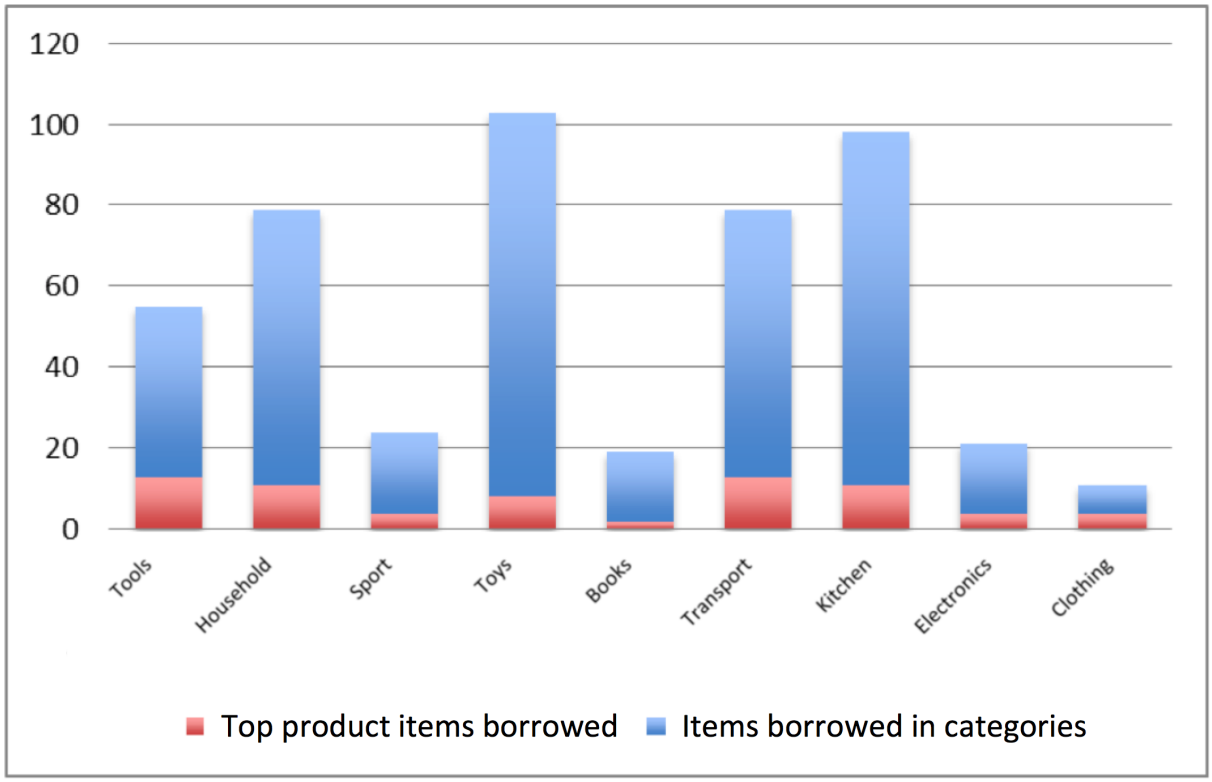
Internal statistics from Leila in Berlin show that a total of 489 items were borrowed between July 2012 and April 2013 (Figure 11) and these were predominantly from the sections for tools, household, toys, transport (cargo bike) and kitchen utensils (Table 12).

Figure 11: Items borrowed from Leila in Berlin between July 2012 and April 2013



Source: internal statistics from Leila, Berlin 2013, own translation.

Figure 12: Distribution of the items borrowed by area of need



Source: internal statistics from Leila, Berlin 2013, own translation.

Description of the data and assumptions

Based on an analysis of potential in (Gsell et al. 2015), the possible environmental impacts of communal forms of living are outlined to demonstrate the waste prevention effects of hire service outlets and the shared use of goods.

To determine the savings in terms of domestic fittings and furnishings, it was first of all established, assuming a representative selection of products (Quack und Rüdenauer 2007), how many households could save on which of their durable items of equipment by sharing their use between the residents of a household or apartment block. The items saved cover those goods that are part of average household equipment (Destatis 2013), where it can be assumed that shared, more intensive use within communal forms of living is possible and practical. This includes the shared use of cars, white goods, brown goods and ICT.

For the calculation, the items of equipment are discounted for their long-term technical service life and thus identified as depreciable assets and annual replacement costs. Table 16 shows the changed level of equipment in terms of durable goods due to a communal approach to living.

Table 16: Changes in household inventory as a result of potential from communal living

Product category	Total (in 1000)
New car	-143
Second-hand car	-182
Refrigerator, combined fridge-freezer	-573
Upright/chest freezer	-205

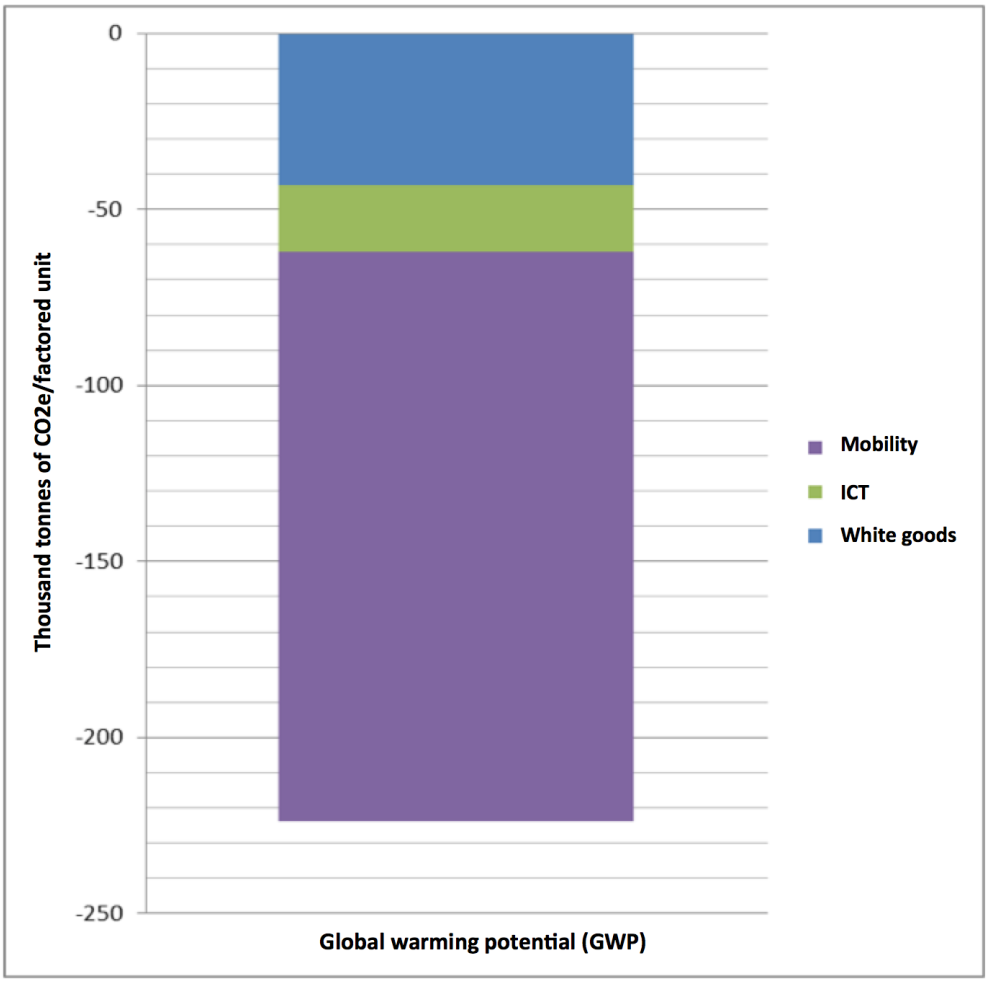
Product category	Total (in 1000)
Dishwasher	-261
Microwave oven	-337
Washing machine	-483
Clothes dryer	-123
Television	-641
Games console	-50
Printer	-340
Exercise bike	-103

Source: Gsell et al. 2015

Ecological impacts

The potential savings for the items of equipment that are not purchased by individual households in terms of the impact on the climate amount to around 220,000 tonnes of CO_2-equivalents per year. 72.3% of this total relates to the reduced number of cars, 19.3% to white goods and 8.4% to information and communication technology and consumer electronics (Figure 13).

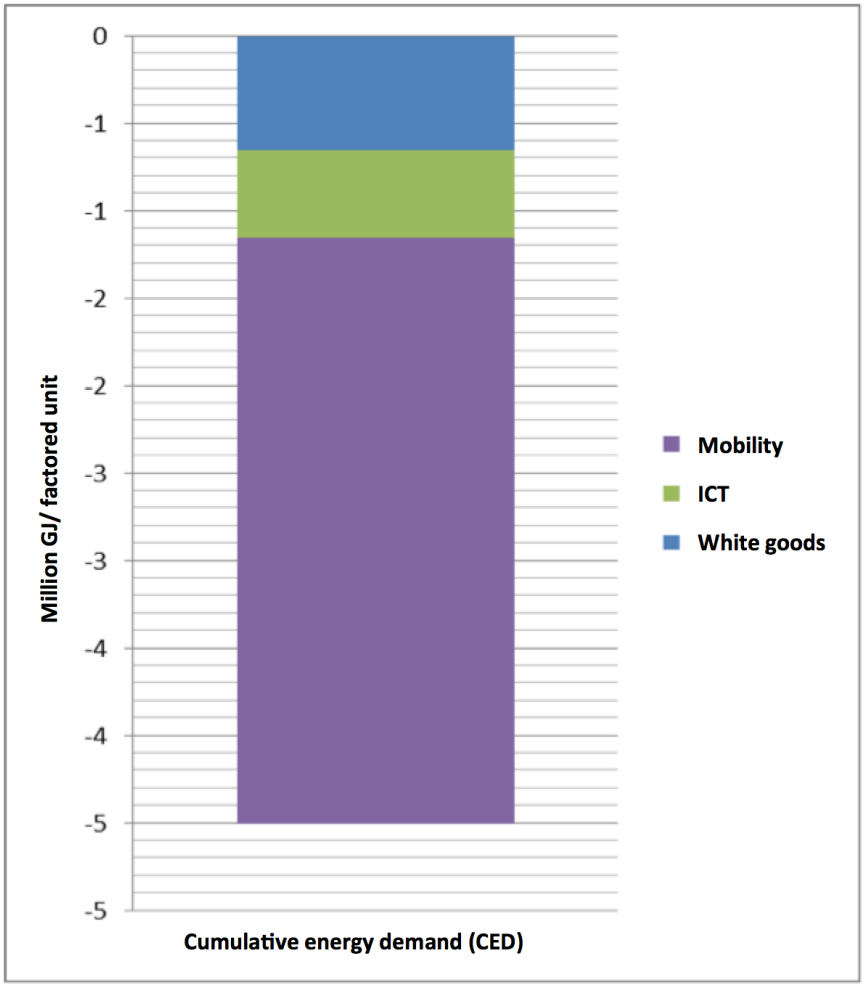
Figure 13: Reduction in global climate impact (GWP per year) due to communal forms of living (discounted over the service life of the product)



Source: Gsell et al. 2015.

The potential savings in terms of cumulative energy demand stand at around 5 million GJ per year and, similar to the climate-relevant emissions, 74% of this total relates to the reduced number of cars (mobility), 14% to white goods and 11% to information and communication technology and consumer electronics (Figure 14).

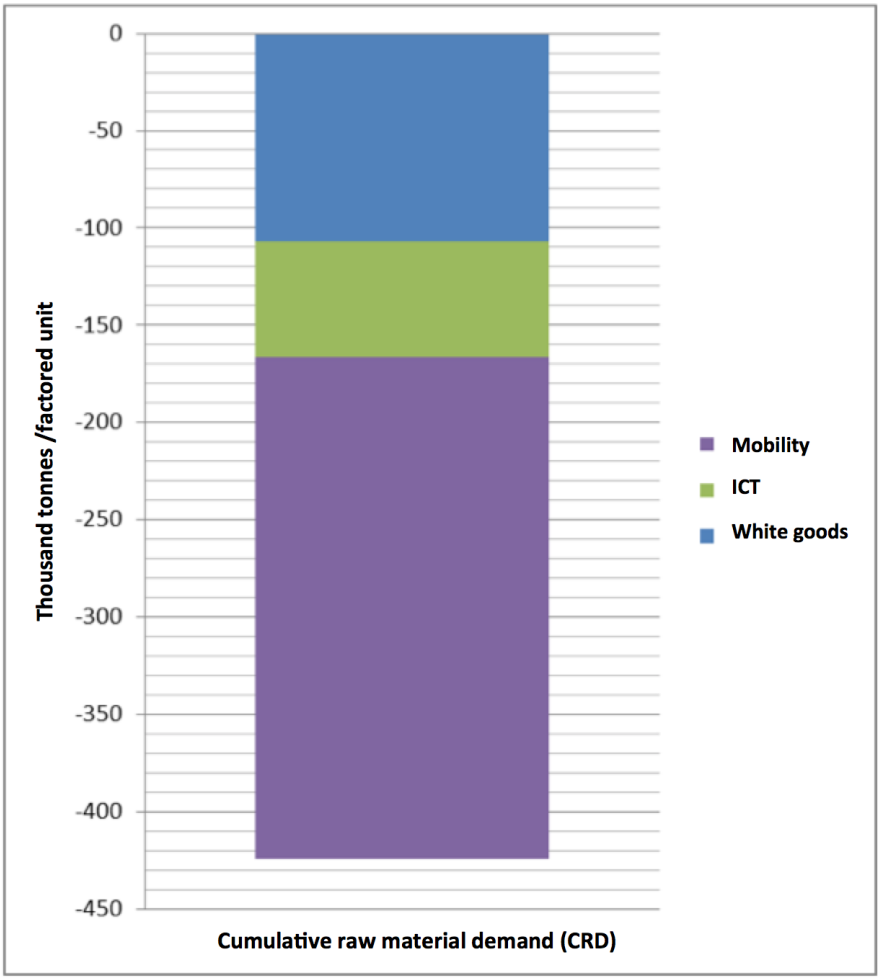
Figure 14: Reduction in cumulative energy demand (CED per year) due to communal forms of living (discounted over the service life of the product)



Source: Gsell et al. 2015.

The savings in cumulative raw material demand per year amount to 420 million tonnes. The percentage attributed to mobility stands at 61% which is slightly lower in contrast to white goods which account for 25% and information and communication technology and consumer electronics which account for 14%.

Figure 15: Reduction in cumulative raw material demand (CRD per year) due to communal forms of living (discounted over the service life of the product)



Source: Gsell et al. 2015.

Economic impacts

Some of the approaches described have developed business models that operate the hire or transfer of goods for profit or at least to cover costs. These include digital services in particular, which are able to massively increase their coverage using digital technology (network effect) and to offer their products to a wide range of users at minimum additional costs (economies of scale).

In comparison, commercial and non-commercial services operating in-store face the difficulty of generating a sufficient range with their services. On the other hand, voluntary services are also social places where people meet and interact. Many give-away shops and swap shops also offer cultural or culinary programmes, often involving the participation of its customers. This low-threshold approach promotes social and practical skills as well as an exchange of experiences, e.g. in the case of upcycling.

Conclusion

The diversity and fragmentation of the approaches investigated make it impossible to determine the reduced environmental impact in a direct or quantitative manner. However, as shown in the evaluations of the potential savings, pertinent reductions can be and are being achieved through shared use of items in the home environment. At the same time, the approaches mentioned show that encounters and exchanges promoting sustainable consumption have an impact on people's

immediate living environments and they can thus be inspired to implement sustainable patterns of consumption in a way that they can experience and grasp. As regards updating WPP, , hire services and gifting schemes should be promoted and receive practical support in the case of shop rent in particular, or municipally-owned properties or buildings should be made available to them.

3.1.2.5 Measure 22: Promotion of waste disposal structures and systems that promote waste prevention: a fee structure linked to the originator, for example through waste collection fees based on weight or volume accompanied by advice on avoiding waste

Background

Brief outline

This section presents an analysis of the waste prevention effects of different systems of charging for waste disposal. This includes studies of the waste data of local authorities and municipalities who use fee systems based on weight or volume for residential waste collection. The objective is to investigate these in terms of how far they contribute to waste prevention in the residential waste collection sector, to determine the implementation status and to show the magnitude of the ecological and economic impacts.

Implementation status in Germany

In Germany, the fees for the disposal of different waste fractions, particularly residual waste from private households, are for the most part currently determined irrespective of the quantity of waste produced. The local authorities specify the fees for waste disposal in accordance with the guidelines of the municipal regulations for waste charges. In the case of regular collections the costs are made up of a basic fee and an demand-related component. The first depends on the size of the household or property and the second depends on the collection interval and the size of the container (Graichen 2015; Miofsky and Souren 2010; Dehoust et al. 2010a; Dehoust et al. 2013). The fees are differently graded according to the waste fraction, whereby the fees for residual waste are generally the highest. Citizens usually pay a lower fee for organic waste. The disposal of material flows that are subject to producer responsibility as per section 23 of the Circular Economy Act (KrWG) are not financed by fees. System-relevant packaging must be registered under a dual system by the manufacturer. For this purpose, the manufacturer pays participation fees to a dual system. These systems are then obliged to ensure that all empty packaging is collected free of charge from private end users, separately from mixed household waste, on a nationwide basis (collection system), or provide collection points in the local area (drop-off system). Lightweight packaging is usually collected in yellow bags or yellow containers and wastepaper in blue containers as part of the collection system. Glass, electronic devices and other waste fractions are collected via decentralised drop-off systems such as containers or recycling banks (Berliner Stadtreinigungsbetriebe (Berlin city cleaning companies) 2017; Stadtverordnetenversammlung Potsdam (Potsdam municipal council) 2017).

In the case of fee systems based on the volume of waste thrown away (identification systems), greater consideration is given to the principle of linking the fee structure to the originator of the waste. Pay as you throw (PAYT) schemes, in particular, which are based on volume or weight, give households an additional financial incentive to reduce the amount of residual waste they throw away because of the variable charges. The use of identification systems is the most common approach. According to a representative survey conducted by the German Association of Local Utilities (VKU) amongst their members in 2014, a fee-sensitive identification or weighing system is used to calculate waste fees in 29% of the collection areas, for organic waste the figure is 15% (VKU specialist committee "Logistik" 2015).

In the case of pay as you throw (PAYT) schemes, the waste bins are equipped with chips, transponders or tags and can therefore be clearly assigned to a household or property. The variable charge is based on how often the containers (which are available in different capacities – e.g 60 litres, 120 litres, etc.) are actually emptied. Particularly in large apartment blocks, a weighing system is also used as part of PAYT schemes. The weight of the waste is calculated as it is thrown away, it is then assigned to an individual household and the level of the fee is determined, depending on the waste category. The system of fees linked to the originator is more frequently used in large apartment blocks, in particular, where several households use the same waste container, while it is less common in detached and semi-detached houses. Locked waste containers are also used in some versions of the system, whereby the volume of waste and the originator are clearly identified (e.g. using chips in Berlin or gravity locks in Gera (Buchert et al. 2017)). The basic fees tend to be lower when using a PAYT system, but the variable charges are higher in order to achieve a greater impact on the originator of the waste (Buchert et al. 2017; Huthmann and Lössl 2015).

The VKU regularly conducts surveys amongst its members. The current edition of business data for 2016 lists 35 municipalities where fee-sensitive identification or weighing systems are used for residual waste (26.3% of 133 responses). Unfortunately, no information exists on the proportion of the population covered by the system, so it is not possible to extrapolate an overall result based on the data available. At the same time, it must be assumed that the actual number of municipalities in Germany with a fee system linked to the originator of the waste is considerably higher than that stated in the VKU figures. In Baden-Württemberg alone, 30 out of 44 municipalities are recorded as having a fee structure linked to the originator with fees based on weight or volume using identification or tag systems (Ministry of the Environment, Climate Protection and the Energy Sector Baden-Württemberg 2017).

Description of the data and assumptions

For the analysis of the waste prevention effects of fee systems based on weight or volume, on the one hand, individual measures were directly compared with one another prior and subsequent to their introduction (Berlin-Wedding). In addition, a statistical evaluation was carried out which looks at several fee systems based on weight and volume that have already existed for a long time in relation to the German per capita average for the collection of household and bulky waste, separate collection of organic waste and separately collected recyclable materials. The Genesis regional database serves as a basis for data.

On a pilot project in Berlin-Wedding with nine locked waste containers, it was possible to compare the amount of waste before and after introducing the new measures and gross up the figures. On this pilot project in Berlin-Wedding, in addition to the locked waste containers, extensive advice was provided for tenants on the subject of waste by the housing developer involved at the time the locked containers were introduced, and this made a substantial contribution to the success of the project. Altogether, the contents of the nine locked waste containers were weighed each time they were emptied for two weeks in 2009 before the changeover and for six weeks in 2012 after the changeover (Becker 2014a).

Literature-based research was carried out to allow wider statistical comparison of fee systems based on weight and volume that have already existed for a long time with the German average. In this way, the local authorities of Aschaffenburg, Landsberg am Lech, Schweinfurt, Calw, Heidenheim and Wetterau were identified as having introduced pay as you throw systems (PAYT) across their districts, in some cases as early as the 1990s (Morlok et al. 2017; Hogg 2006).

The statistics of the public waste management system 2016 were taken as the basis of data on the volume of household waste (without electronic waste), and the per capita volumes of household and bulky waste, amounts of organic waste collected and separately collected recyclable materials were compared to the German average.

In addition, one urban district using the identification system was compared with a local authority without the identification system (the waste management association (AVW) of Ostthüringen in Gera (Thüringen) compared with the city of Weimar (Thüringen)). Gera is classed as an urban district with concentrations of population (Kuhlmann 2015). The area of the district is 152 km^2 with around 100,000 inhabitants (Thuringian Regional Office for the Environment and Geology 2017). The region's demographic situation is marked by a steadily aging population and an overall sharp decline in absolute population size. For the comparison, the city of Weimar is used; this is also classed as an urban district with concentrations of population, and therefore represents a comparable local authority in terms of social structure where, however, no identification systems were introduced (Kuhlmann 2015). This selection is intended to guarantee that the effects of the identification system can be analysed in districts with as a similar structure as possible without known influence factors on waste data (such as income, lifestyle, population density, etc.) affecting the results. At the same time, a municipality with an identification system was chosen which can provide relevant experience over a long period and uses locked waste containers in large apartment blocks and identification systems, for example (Gera model) (AWV Ostthüringen 2015; Buchert et al. 2018). In contrast, a system of regular collections is used in the city of Weimar (City of Weimar 2011).

According to information from the managing director of the waste management association of Ostthüringen[70], a district-wide fee-sensitive identification system is used for residual waste in the district of Greiz and the city of Gera. In 1999, the so-called Gera model was introduced, which aimed to improve the handling of waste and waste separation in large apartment blocks, where residual waste is collected according to demand. Three to four entrances form a mutually supportive group and share a large lockable waste container. This acts as a direct incentive to reduce the volume of waste and the associated waste fees. In addition to consultations and informative events with the housing developer and the tenants before the system was introduced, a caretaker for each entrance hall supervises the delivery of the waste container, the cleanliness of the equipment and is also responsible for preventing incorrect sorting. The city of Gera achieved a significant improvement in waste separation with the PAYT system in a region where the population is not particularly interested in this subject (Buchert et al. 2017).

As a result of introducing locked waste containers in large apartment blocks in Berlin-Wedding, the volume of residual waste was reduced by 64%, while the separation of organic waste in the nine apartment blocks in the study increased almost threefold. These high improvement rates, which also applied to lightweight packaging, and clear and coloured glass, indicate that it is possible to significantly increase the volume of waste collected separately by setting up new containers. In the case of some waste categories, it can be assumed that these were also previously collected locally to some extent in containers set up in the urban area (decentralised drop-off system). Overall, the studies show that, before the introduction of the locked waste containers and specific waste consultation measures, around 15% more waste was produced (based on weight) that could now be avoided. It was also possible to demonstrate that changed consumer habits have led to complete avoidance, for instance, and the volumes of waste did not just accrue in a different place (see Table 17) (Dehoust et al. 2014a; Bratfisch 2009; Becker 2014).

[70] To this end, a telephone interview was conducted with the head of AVW Ostthüringen.

Table 17: Volumes of waste in large apartment blocks prior and subsequent to the introduction of locked waste containers in Berlin-Wedding

Waste category	Prior to the introduction of locked waste containers in 2009 (kg/res/yr)	Subsequent to the introduction of locked waste containers in 2012 (kg/ res/yr)	Change in %
Residual waste	231.1	84.2	-64
Organic waste	23.1	65.2	182
Lightweight plastic	4.5	42.3	840
Paper/cardboard	24.6	33.1	35
Clear glass	0.8	13.5	1588
Coloured glass	2.6	6.8	162
Total	286.8	245.1	-15

Source: Dehoust et al. 2014a

The comparison of the volumes of waste for the cities of Weimar and Gera show that savings of 10% in 2012 and 7% in 2016 were achieved on the part of AWV Ostthüringen in the areas of household waste and bulky waste. As for the comparison of the total volumes of household waste (without biodegradable garden and park waste), the data reflect a saving of 13% (2012) and 15% (2016) in favour of Gera. In terms of organic waste, the data show that the amount collected in Weimar, with 67 kg/resident/year, was approx. 40% higher in 2012 and 43% in 2016. As regards separately collected recyclable materials, a slightly higher volume is also indicated for Weimar with 6 % (2012) and 8 % (2016) (see Table 18).

Table 18: Comparison of the near-household waste collection in urban districts (Weimar and Gera, 2012 and 2016)

	2012				2016			
City	Total	Household and bulky waste	Organic waste	Separately collected recyclable materials	Total	Household and bulky waste	Organic waste	Separately collected recyclable materials
Weimar (kg/ res/yr)	406.6	207.2	67.0	131.9	418.5	205.1	67.3	135.9
Gera (kg/ res/yr)	352.2	186.5	41.3	123.3	354.9	190.6	38.3	124.6
Difference Weimar vs. Gera (%)	-13	-10	-38	-6	-15	-7	-43	-8

Source: Own calculation according to the Genesis regional database

In other model projects with identification systems, improved separation of waste was evident as a result of a shift of residual waste to the organic waste container. In the district of Greiz and the city of Gera, the volume of organic waste is very low, however, because organic waste containers are only deployed in cities with over 5,000 inhabitants (AWV Ostthüringen 2018). In smaller communities they are rarely used, which suggests there is a preference for home-

composting and therefore the volume of organic waste is not identifiable (Buchert et al. 2017). An enquiry made with the spokesperson for Erfurt public utilities revealed that home-composting is also carried out in Weimar, where about 80% of households have their own organic waste bin.

The above findings are also supported by statistical assessments from local authorities comparing identification and PAYT systems with the German average (see Table 19). As regards the data on public waste collection, as presented in Table 19, the local authorities identified with district-wide waste collection fees based on weight or volume perform significantly better than the German average. This applies in terms of both the total volume of waste and household and bulky waste per person and the separately collected organic waste and recyclable materials. At the same time, these local authorities are rural districts with concentrations of population and a high proportion of detached and semi-detached houses, offering more favourable conditions for introducing and implementing identification systems (e.g. lower population density).

In Table 19, the absolute per capita volumes are listed on the left-hand side and the percentage compared to the German national average for 2016 is given on the right-hand side. The proportion of household and bulky waste is between approx. 40% and approx. 70% lower than the German national average. At the same time, the proportion of recyclable materials increased by between approx. 20% and approx. 50%. The result for organic waste is less conclusive; in the case of Aschaffenburg it is around 50% lower than the German national average, which is attributed to a higher proportion of home-composting and illegal dumping (Morlok et al. 2017). The rate of waste prevention associated with waste fees based on volume or weight in terms of the total volume of waste amounts to between approx. 5% and approx. 30% in the local authorities investigated (see Table 19).

Table 19: Comparison of near-household waste in waste collection fee systems based on volume or weight

District / municipality	Total	Household and bulky waste	Organic waste	Separately collected recyclable materials	Total	Household and bulky waste	Organic waste	Separately collected recyclable materials
	Per capita in kg, 2016				Comparison to Germany in %, 2016			
Germany	396.5	189.1	58.8	148.6	-	-	-	-
Aschaffenburg, district	287.6	58.1	32.7	196.8	-27.5	-69	-44	32
Landsberg am Lech, district	363.7	101.0	65.2	197.5	-8.3	-47	11	33
Schweinfurt, district	342.9	102.9	63.9	176.0	-13.5	-46	9	18
Calw, district	359.4	65.8	78.8	214.9	-9.3	-65	34	45
Heidenheim, district	339.9	104.7	58.9	176.2	-14.3	-45	0	19
Wetteraukreis[71]	379,8	121,3	84,3	174,1	-4,2	-36	44	17

Source: Own calculation according to the Genesis regional database

[71] In the Wetterau district, the nationwide introduction of PAYT systems has only been implemented to 75 % (Morlok et al. 2017).

Identification systems are often criticised for potentially encouraging users to dump their waste illegally in the countryside or in public waste bins, or to burn it or have it removed by third parties. This was scientifically investigated as part of accompanying research in the district of Kinzing before and after the introduction of an identification system. The results revealed no increase in illegal dumping or littering. Instead it was shown that illegal dumping occurs regardless of the respective collection system, but it is decreasing in terms of total volume, particularly in the case of waste components for which a fee is levied (Hoeß et al. 2014).

In order to counter a higher percentage of contaminant material, minimum volumes are often prescribed and these are calculated (Huthmann und Lössl 2015). Furthermore, the residents' levels of acceptance and awareness play an important role. Comprehensive consultation measures and training are absolutely essential, as well as social monitoring of the waste disposal area (Buchert et al. 2017). The managing director of the AVW Ostthüringen was able to register no increase in incorrect sorting, partly as a result of these measures.

Ecological impacts

The ecological contributions of the measure are achieved primarily due to the reduction in total waste and better separation of recyclable materials and reusable organic material. By means of in-depth waste prevention consultations with households, the total volume of waste can also be reduced by avoiding certain products or those involving production-specific environmental burdens. However, these savings in environmental burden cannot be quantified in figures on the basis of this information, since no data is available on which products and which associated burdens were saved by avoiding the waste. The reduced emissions and reduced consumption of energy and resources related to the avoided waste streams can only be approximately determined. For this purpose, data from waste analyses on the composition of typical household and bulky waste are used and then taken as the basis for calculating the magnitude of the reduced global warming potential (GWP), primary energy demand (CED) and cumulative raw material demand (CRD). The waste prevention effects thus extrapolated arise globally.

Based on the above-mentioned data, values per head of population can be deduced (see Table 20). These show that, in 2016, a total volume of about 47 kg of waste per resident per year (approx. 16%) could be avoided completely on average in the districts and municipalities with identification systems under investigation, and that

- around 94 kg per resident per year (ca. 16 %) less household and bulky waste accrued,
- around 8 kg per resident per year (ca. 25 %) more organic waste was collected via the organic waste bins,
- around 39 kg per resident per year (ca. 16 %) additional recyclable materials were collected via the recycling bins.

Overall, the figures in the towns and districts investigated are based on around one million residents linked to identification systems.

Table 20: Savings per head of population when using identification systems

	Total	Household and bulky waste	Organic waste	Separately collected recyclable materials
(kg/res/yr)	-47.37	-94.22	7.74	39.12
Percentage value	-15.5	-16.2	24.6	16.0

Source: Own calculation

If all municipalities in Germany were linked to identification systems (and if results similar to those investigated were produced), a maximum potential volume of approx. 4 million tonnes (approx. 12%) of near-household waste could be avoided across the whole of Germany; household and bulky waste would be reduced by approx. 8 million tonnes (approx. 50%), separately collected organic waste would increase by approx. 600,000 tonnes (approx. 13%) and separately collected recyclable materials by around 3 million tonnes (approx. 26%).

In order to estimate the approximate potential values for reduced greenhouse gas emissions (GWP), cumulative energy demand (CED) and cumulative raw material demand (CRD), the proportions of the materials contained in household and bulky waste were estimated using material flow analysis. This makes it possible to estimate the environmental burden of manufacturing the materials contained in the waste, which are saved by avoiding this waste. To this end, generic data from life cycle assessment studies and the ecoinvent 3.0 database for the materials contained in waste were used and evaluated (Dehoust et al. 2010b; Giegrich et al. 2012; Dehoust et al. 2014b, ecoinvent 3.0).

Table 21: Reduction of environmental impacts relating to the production-specific burden involved in household and bulky waste extrapolated to Germany (estimate)

Reduction	Volume (Mg)	GWP (t)	CED (GJ)	CRD (t)
Organic	-2,572,789	-9,576,560	-	-
Iron	-171,858	-327,803	-2,943,246	-1,722,536
Aluminium	-171,858	-1,640,474	-15,796,876	-1,789,389
Plastics	-477,201	-954,402	-34,835,685	-804,561
Composites	-527,752	-1,854,334	-30,174,408	-2,090,318
Paper/cardboard	-880,724	-440,362	-26,421,724	-880,724
Glass	-395,814	-395,814	-5,739,298	-633,302
Wood	-674,661	-276,246	-6,593,989	-978
Textiles	-164,922	-3,133,443	-45,096,373	-2,091,710
Nappies	-263,876	-738,852	-	-
Refrigerators	-22,565	-245,057	-4,115,503	-593,416
E-waste	-95,606	-817,530	-26,476,528	-1,464,997
Other (incl. mineral)	-1,322,966	-	-	-
Total reduction	-7,742,593	-20,400,876	-198,193,631	-12,071,933

Source: Own calculation according to Dehoust et al. 2010b; Giegrich et al. 2012; Dehoust et al. 2014b, ecoinvent 3.0.

Table 21 shows the results of the reduced production-specific environmental burden related to the household and bulky waste currently collected. According to this, the accrued production-specific burden related to household and bulky waste dropped by a total of approx. 20 million tonnes of CO_2-equivalents, around 200 million GJ in terms of cumulative energy demand and around 12 million tonnes in reduced cumulative raw material demand. It must be noted here that the production-specific burden does not just accrue in Germany, but is distributed across the entire global supply chain.

Economic impacts

The economic impacts of a fee structure linked to the originator must be evaluated differently depending on the stakeholder group. From the system operator's perspective, a fee structure linked to the originator can imply, for the waste disposal provider or their commissioned third party from the private sector, that the necessary revenue for operating the system that is generated by fees, especially during the introductory or implementation stage, can no longer be guaranteed and appropriate reserves must be built up for this purpose. The discrepancy results from the high fixed cost elements that exist in the waste management industry and the resultant risk that investments are not amortised and plants operate below capacity since residual waste volumes are decreasing as a result of the incentives in place. In order to guarantee that the mandatory supply is not constantly undercut by households, a minimum container volume (e.g. 71 per resident per week) can ensure that a guaranteed utilisation rate exists (Intecus GmbH 2016). On the other hand, overall disposal costs fall as a result of the reduced volumes of residual waste and the increased volumes of organic waste and recyclable materials, from which revenue can also potentially be made.

From the point of view of householders, a fee structure linked to the originator offers financial incentives as a result of the increase in the specific costs for the disposal of residual waste. In contrast, the specific costs for organic or recyclable waste fall. With appropriate effort by means of additional consultations on waste disposal, the incidental costs incurred by households for waste disposal can be reduced. If an in-depth consultation on waste prevention is provided, it can result in a lower volume of waste overall and thereby save costs for households. Since the residual waste category is more expensive than the recyclable material categories, separating waste offers additional financial incentives. Depending on the percentages contributed by the basic and variable fees to the overall costs, the motivation to separate waste, or avoid waste, is correspondingly high or low. The waste fees tend to decrease by up to 20% if a polluter-pays system is used (Buchert et al. 2017; Huthmann and Lössl 2015; Vogt et al. 2012).

There is an obstacle for tenants in particular here, in that landlords or property management companies have no personal interest in decreasing waste fees or in the respective measures for doing this, since the fees can be passed on directly to tenants via utility bills (the so-called user/investor dilemma). This dilemma could be solved to some extent by means of appropriate waste contracting models, e.g. using a locked waste container provider for large apartment blocks, who takes over the supervision, cleaning, invoicing and consultancy for locked waste containers in large apartment blocks. The costs saved for waste disposal then finance the contractor's services. Depending on the system and implementation costs, the waste disposal fees can then also be reduced for tenants to some degree or invoiced via operating charges according to usage of the system. In this case an effort is still required from the party responsible for the property, however, who can often balk at this.

These contracting models will not be able to develop the required force to achieve more than small-scale progress under the present conditions, however, in the opinion of the reviewers. To this end, an appropriate clause needs to be introduced to the federal Circular Economy Act

(KrWG) to oblige waste disposal providers to only offer fee systems linked to the originator with the relevant types of container, especially in multi-storey buildings (e.g. involving more than 7 households) and at the same time to equip municipal waste advice centres with enough facilities to provide waste prevention consultations in a comprehensive and systematic way. The federal government needs to establish extensive investment and funding programmes to support this additional effort, particularly for the initial investments, and community activities should be supported by scientific expertise (e.g. for monitoring the measures).

Conclusion

As shown above, waste fees linked to the originator combined with in-depth consultations regarding waste can contribute to an outright avoidance of waste (here approx. 15 % of the total volume of waste). At the same time, incentives are offered to separate waste and a greater proportion of organic and dry recyclable materials are separated from residual waste by households to achieve a higher quality of waste disposal.

As the magnitude of the avoided adverse environmental impacts show, this measure can make a relevant contribution to prevention.

In order to further exploit the existing potential as part of WWP II and to solve the existing dilemma in the area of rented apartments and multi-storey buildings, it is essential to introduce fee systems linked to the originator – with the appropriate types of container – right across Germany, and community activities should be supported by means of extensive funding from the government.

3.1.2.6 Measure 30: Promotion of the reuse or multiple use of products (second-hand goods), using the example of the sales figures of the "Stilbruch" second-hand department store in Hamburg in 2015

Background

The Hamburg city cleaning department, Stadtreinigung Hamburg, is the parent company of Stilbruch Betriebsgesellschaft mbH, which was founded in 2001 and runs two department stores (Wandsbek and Harburg) and a pop-up store for second-hand furniture and other used items such as bicycles, books, clothing, toys, electrical appliances, crockery and CDs/DVDs in Hamburg. The goods on offer come from the collection of recyclable materials, recycling centres and customers.

Stadtreinigung Hamburg introduced the concept of collecting bulky waste for recycling. It refers to the process of separating reusable second-hand products from actual waste. Second-hand items which are suitable for reuse are thus selected at source. In addition, the concept includes the introduction of individual appointments to prevent people looting and rummaging through the goods that are made available. The project has evolved in reaction to political and social developments towards sustainability and has been set up in collaboration with the local Agenda 21 initiative.

The company is commercially successful and achieves an annual turnover of approx. 3 million euros, making it financially self-sufficient (Bernhard 2017b). At the same time it supports the reintegration of the long-term unemployed by giving them jobs in the business. Stilbruch employs a total of 61 people, of whom 56 are full time staff. Over time, the success of the second-hand stores led to the diversification of its product range. The original sole product category of furniture has since been expanded to include second-hand clothing, other household items and electrical appliances. In the latter case, the items must be closely inspected due to legal regulations and some may need repairing. The company set up a workshop to enable them to take care of this (Bernhard 2017a).

Table 22 shows the volume of goods that Stilbruch put back into circulation in 2015. The sales price for second-hand goods is given as an average price per item for the product category. These data form the basis for the environmental assessment.

Table 22: Volume and average price by product category

Product category	Share in %	Volume/number of items	Sales price
Textiles	14.9	59,437	8.55 €
Electrical appliances	14.4	33,236	14.82 €
Glass/porcelain	12.8	91,997	4.76 €
Books	7.4	53,202	4.77 €
Small items of furniture	5.9	17,063	11.71 €
Upholstered furniture	5.2	3,380	52.55 €
CDs/LPs/DVDs	4.7	31,432	5.12 €
Pictures	3.6	10,013	12.10 €
Tables	3.2	4,968	21.77 €
Chairs	3.2	11,095	9.74 €
Toys	2.9	27,759	3.57 €
Bicycles	2.7	2,924	31.20 €
Antique furniture	2.5	1,870	46.38 €
Large items of furniture	1.8	1,352	44.51 €
Sports equipment	1.7	5,946	9.71 €
Bed/bed frames	1.6	1,753	31.51 €
Garden/DIY	1.6	6,439	8.53 €
Office furniture	1.5	3,327	15.65 €
Carpets/rugs	1.0	709	49.49 €
Seasonal items	0.9	8,543	3.55 €

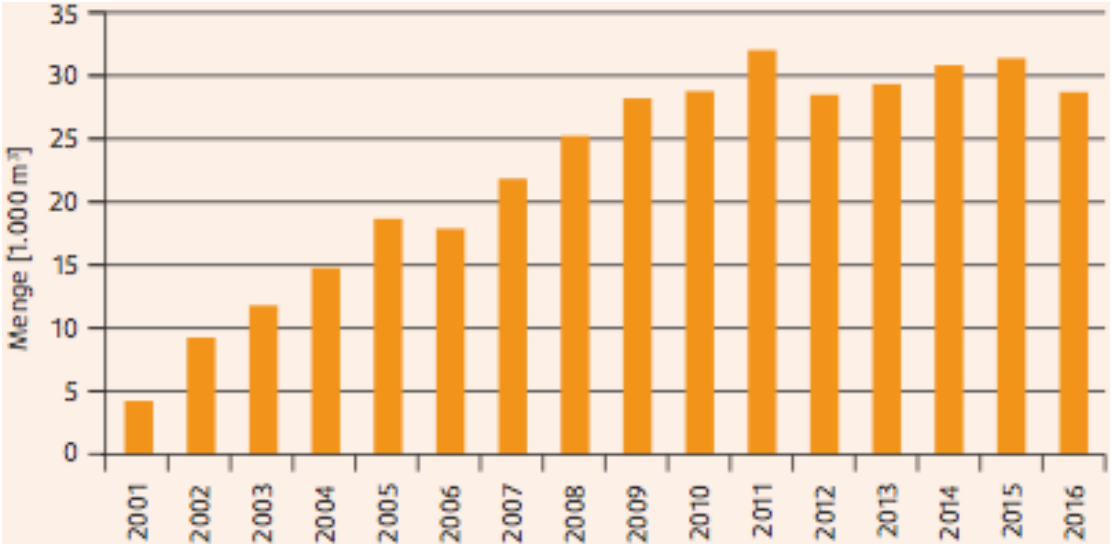
Source: Bernhard (2017b)

The growth of volume shown in Figure 16 illustrates how large the volume for reuse is. The total volume of more than 30,000 m^3 amounted to a total weight of 2.67 million kg in 2015; it was assumed for the purposes of simplification that the respective percentage share shown in Table 22 also applied to the magnitude of the overall weight of all the second-hand goods sold by Stilbruch.

Through a customer survey, Stilbruch discovered that the number of customers linked to this volume of second-hand goods lived within a 5 km radius of the two stores. In order to reach even more residents of Hamburg and to exploit the potential market volume, a further store was opened in Hamburg-Altona.

Of the stated volume of goods brought to the stores for reuse, approx. 8% are returned to recycling centres as waste to be recycled (Stilbruch n.d.).

Figure 16: Growth of total volume



Source: Berhard 2017b [Legend: Menge = volume].

Ways of reusing second-hand goods

A key aspect when considering the changed ecological impacts of reused goods compared to the recovery of second-hand goods is the change in the service life of products. WRAP (James, 2011) published a methodology and accompanying Excel tool to calculate changed environmental impacts. The tool was used and tested on common household goods, including product categories such as clothing, household appliances, furniture and electronic devices. The assumptions made by WRAP regarding the extended service life of items and the replacement of new goods are summarised in the following section. These assumptions were taken into account for the relevant product categories in the environmental assessment.

Case Study – Textiles (Fisher, James, & Maddox, 2011a)

Four routes are presumed to lead to the reuse of items: networks of family and friends, internet-based platforms and car boot/jumble sales, charity shops, and collection banks at recycling centres, etc. The most widespread form of distribution is via not-for-profit organisations such as charity shops and NGOs. A further assumption is that 70% of its useful service life remains when consumers discard clothing. In addition the following assumptions are made on the reuse of textiles:

- 60 % of the second-hand clothing items replace new products on a one-to-one basis.
- 16 % of the second-hand clothing items replace old items which were also purchased second-hand. In this case, no avoided production for new items is allocated in this calculation to avoid double-counting the benefits.
- 24 % of the second-hand clothing items do not replace other items, but are additional purchases. In this case no avoided production is allocated.

Case Study – Domestic furniture (Fisher, James, & Maddox, 2011b)

In another case study, the tool was used in the context of domestic furniture, more specifically sofas and dining tables. One assumption made in this case, is that sofas make up 34% and dining tables 3% of the furniture that reaches the end of its service life every year. Other items of domestic furniture such as wardrobes, cabinets, chests of drawers, beds, chairs and other types

of tables resemble dining tables rather than sofas, since they are considered to be simple wooden products.

According to the assumptions made, the following distribution routes exist for second-hand domestic furniture: charity shops, commercial exchange networks and free exchange networks. 50% of the second-hand goods distributed by these channels replace new products and 50% replace furniture items that were already purchased second-hand. In the latter case, no avoided production is allocated in order to avoid double-counting the benefits. In addition, it can be assumed that 10% of the furniture distributed second-hand is refurbished, which, in the case of sofas, mainly involves replacing the cotton covers.

Case Study – Office furniture (Fisher, James, & Maddox, 2011c)

This study makes the assumption that discarded office furniture accrues in large quantities and therefore only specialist second-hand shops buy up and sell this type of used goods. According to the case study, charity shops cannot accommodate such a large volume of furniture on their limited storage and sales premises. Accordingly, second-hand dealers are the only distribution channel for this product category.

In the case of office desks, the authors assume that 20% of the reused second-hand furniture replaces the purchase of new products. 80 % of the reused office desks replace older second-hand items. In the latter case, no avoided production of new goods is allocated to avoid double-counting the benefits.

50 % of the reused office chairs that are put into circulation replace the purchase of new goods. 10 % of these second-hand goods are refurbished beforehand. The other 50% of second-hand office chairs replace older second-hand items. To avoid double-counting the benefits, no avoided production is allocated here.

Case Study – Electrical appliances (Fisher, James, & Maddox, 2011d)

This study uses the tool in the product sector of electrical appliances, particularly regarding washing machines and televisions.

In terms of washing machines, it is assumed that only a small proportion is sold through charity shops (12%) and also only a very small proportion via second-hand dealers, so this proportion is not included. Consumers pass on the majority of second-hand washing machines in return for payment via online marketplaces, etc. In the case of using second-hand washing machines, the authors estimate, based on various data, that 93% replace the purchase of new products and 3% replace older second-hand items. 4% of the second-hand items displace the use of laundry services such as laundrettes or laundries. In the case of replacing older second-hand machines, the avoided production of new machines is not allocated to avoid the double-counting of such benefits. In the case where laundry services are displaced, the replaced washing machines from laundrettes are considered to be identical to those in private households due to a lack of available data. In addition, it is assumed that the technical lifetime of a washing machine is 12 years and new machines are sold on after being used for 4 to 5 years. The second-hand machines therefore have a potential remaining service life of 7 to 8 years. For purposes of simplification, it is assumed that a second-hand washing machine only replaces half a new washing machine in each case, due to the fact that its technical life has already to some extent elapsed.[72]

[72] The shortened remaining useful life for used equipment (7-8 years compared to 12 years for new equipment) and the associated assumptions on the substitution rate for new equipment were only used for white goods (refrigerators and washing machines), as these appliances are more often used according to their actual technical life, whereas electrical appliances (televisions, PCs, telephones, etc.) are often renewed well in advance, even in the case of used goods, despite their longer technical life.

Second-hand televisions are very different to washing machines in terms of the assumptions made. The distribution of second-hand TV sets is divided between charity shops (38%), free exchange (31%) and paid exchange (31%). 50% of the sets replace the purchase of new televisions and 50% replace older second-hand sets.

As regards the case studies mentioned, it should generally be noted that the assumptions are estimated, particularly regarding the proportion of reuse and whether the second-hand goods replace new products. The authors stress that there is a need for further research into the areas of reuse, replacement of new products and refurbishment of second-hand goods.

For the other product categories where no WRAP case studies are available, assumptions were made in-house regarding the proportion of second-hand goods that substitute new products. The volumes of goods sold were accordingly adjusted by the proportion that in turn replaced other second-hand goods or was purchased additionally, but did not substitute new purchases. On account of the assumptions regarding the ratio of substitution of new and second-hand goods, only about half of the afore-mentioned total weight of 2.67 million kg of second-hand goods (1.34 million kg.) is used for the environmental assessment. The proportions assumed for the substitution of new goods are shown in Table 23.

Assumptions regarding the life cycle inventory

Stilbruch only presents its sales of second-hand goods in terms of product categories. Upon further inquiry, Stilbruch was unfortunately not able to break these product categories down further to allow potential work on life cycle assessments (and the life cycle inventories they comprise) for individual products such as washing machines or individual items of sports equipment such as tennis racquets. For many product categories, no life cycle assessments are known that can provide relevant data on the material composition of the individual household items, such as garden tools or DIY equipment. Furthermore, Stilbruch's "electrical appliances" product category is very broad, comprising white goods as well as home electronics and small kitchen appliances.

For this reason, data from De Kringwinkel[73] were referred to, which are published again in Kujanpää/Vatanen (2014). Table 9 in that study gives an overview of the material composition in terms of percentages for each product category. De Kringwinkel used a product classification which is not as broad as that of Stilbruch. It is still fundamentally suitable for use even with the data from Stilbruch. In Kujanpää/Vatanen (2014), the "electrical appliances" group is divided into four WEEE categories, the proportions of which were derived from the De Kringwinkel data. By contrast, other Stilbruch product categories were evaluated using the same percentages of material categories. For example, in De Kringwinkel, there is only one category covering "furniture", and the data from this were used for small items of furniture, tables, upholstered furniture, antique furniture and large items of furniture for this project.

[73] De Kringwinkel is a similar institution to Stilbruch and Belgium (https://www.dekringwinkel.be/)

Table 23: Distribution by product category and proportion of the volumes considered

Stilbruch product categories	De Kringwinkel product categories	Proportion replacing new goods in %	Proportional weight in kg
Textiles	Textiles	60%	240,300
Electrical appliances	WEEE large white	97%	46,618
	WEEE refrig./freezer	41%	9,955
	WEEE other	51%	98,866
	WEEE television	50%	24,030
Glass/porcelain	Household goods	38%	129,381
Books	Books & Media	44%	87,500
Furniture	Furniture	50%	284,355
CDs/LPs/DVDs	Books & Media	34%	43,025
Pictures	Household goods	36%	96,120
Toys	Leisure-time equipment	45%	77,430
Bicycles	Transportation	53%	72,090
Sports equipment	Leisure-time equipment	42%	45,390
Garden/DIY	Household goods	53%	42,720
Office furniture	Furniture		
Office desks	Furniture	20%	4,005
Office chairs	Furniture	50%	10,013
Seasonal items	Household goods	46%	24,030
Total			**1,335,828**

Source: Own compilation based on Berhard (2017b) and Kujanpää/Vatanen (2014)

Based on these data and the material components expressed as percentages for each product category as per De Kringwinkel, it was possible to convert the considered volumes of second-hand goods amounting to 1.34 million kg into respective volumes of material (Table 24).

Table 24: Overview of coefficients and result for Measure 30, promotion of reuse

Material	Ecoinvent-process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
Iron	market for cast iron | cast iron | APOS, U	4.888	2.089	9.73	4.16
Low-alloyed steel	market for steel, low-alloyed | steel, low-alloyed |	7.227	1.890	1,557	407

Material	Ecoinvent-process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
	APOS, U				
Chromium steel	market for steel, chromium steel 18/8 | steel, chromium steel 18/8 | APOS, U	23.877	4.733	76.61	15.18
Copper	market for copper, cathode | copper, cathode | APOS, U	184.449	7.898	662	28.35
Aluminium	market for aluminium, wrought alloy | aluminium, wrought alloy | APOS, U	11.454	18.811	780	1,281
PE	market for polyethylene, high density, granulate | polyethylene, high density, granulate | APOS, U	1.794	2.030	377	427
PS	market for polystyrene, general purpose | polystyrene, general purpose | APOS, U	2.166	3.596	1.51	2.51
Glass	market for flat glass, uncoated | flat glass, uncoated | APOS, U	1.891	1.049	188	104
Hardwood[74]	market for sawn wood, hardwood, dried (u=10 %), planed | sawn wood,	2213.706	150.920	463	31.53

[74] For wood the coefficients refer to t/m3.

Material	Ecoinvent-process	Material footprint coefficient in t/t	Carbon footprint coefficient in t/t	Material footprint in t	Carbon footprint in t CO_2-equivalents
	hardwood, dried (u=10 %), planed | APOS, U				
Synthetic rubber	synthetic rubber production | synthetic rubber | APOS, U	3.317	2.789	72.57	61.02
PUR	market for polyurethane, flexible foam | polyurethane, flexible foam | APOS, U	4.825	5.026	120	125
Polyester	fleece production, polyethylene | fleece, polyethylene | APOS, U	2,517	2,709	260	280
Wool	market for sheep fleece in the grease | sheep fleece in the grease | APOS, U	18.323	48.326	1,562	4,121
Cotton	market for textile, woven cotton | textile, woven cotton | APOS, U	17.124	25.750	1,378	2,072
Concrete	concrete block production | concrete block | APOS, U	1.093	0.109	11.21	1.12
Paper	market for paper, newsprint | paper, newsprint | APOS, U	2.332	1.344	152	87.74
Total				**7,671**	**9,049**

Source: Own compilation based on Berhard (2017b) and Kujanpää/Vatanen (2014).

Conclusion

It is evident from the results shown in this table that prolonging the life of goods through second-hand stores and correspondingly avoiding the purchase of new goods helps to reduce the volume of the respective raw materials consumed and prevent GHG emissions. In 2015, the two Stilbruch stores in Hamburg alone succeeded in selling 1,336 tonnes of second-hand goods that replaced the purchase of new products and thus reduced Germany's material footprint by 7,671 tonnes. At the same time, over 9,000 tonnes of GHG emissions were avoided.

3.1.2.7 Measure 31: Support for repair networks (e.g. Repair cafés)

Background

Brief outline

From the point of view of waste prevention, the subjects of repair, second-hand goods and (the promotion of) reuse are closely related and have the same effect in terms of their ecological impacts. At the same time, very different framework conditions and stakeholders need to be considered from a legal and organisational perspective.

The measure "Support for repair networks" focuses on the product sector, so a stage well before goods have legitimately become waste. At the same time, it is difficult to distinguish from the waste management regime if, in the course of (preparation for) reuse, repair measures lead to the removal of the waste status and allow the goods to be reused.

This section shows the extent to which new products are avoided and environmental impacts are reduced as a result of private and commercial repair work in Germany, and the economic impact that is achieved through repair services in Germany.

Implementation status in Germany

In 2018, there were around 800 repair café initiatives scattered across the whole of Germany. According to information from the Anstiftung & Ertomis foundation, which supports the founding and networking of these initiatives, an average of around 20 repairs are carried out on 10 scheduled dates per year per initiative, amounting to a total of approx. 160,000 repair attempts per year across the whole country. Repair initiatives represent the DIY sector in the area of repairs. The main items repaired here are electrical household appliances and consumer electronics (coffee machines, vacuum cleaners, TV sets, consoles, etc.), ICT equipment such as notebooks and printers, textiles and bicycles.

Underlying data and assumptions

The data for assessing the activities in the repair sector presented in this section are based on estimates and previous experience from the Anstiftung & Ertomis foundation, Vangerow GmbH and the MeinMacher.de. repair portal. In addition, data sets on the repair sector from Destatis were also included for extrapolations relating to Germany as a whole. The Anstiftung & Ertomis foundation supports private, predominantly voluntary repair café initiatives in Germany. It helps to set up networks and share experience amongst the initiatives. Other data are based on the Stichting foundation in the Netherlands, and emissions data from ecoinvent 3.0 and data from other life cycle assessment studies were used for the ecological assessment.

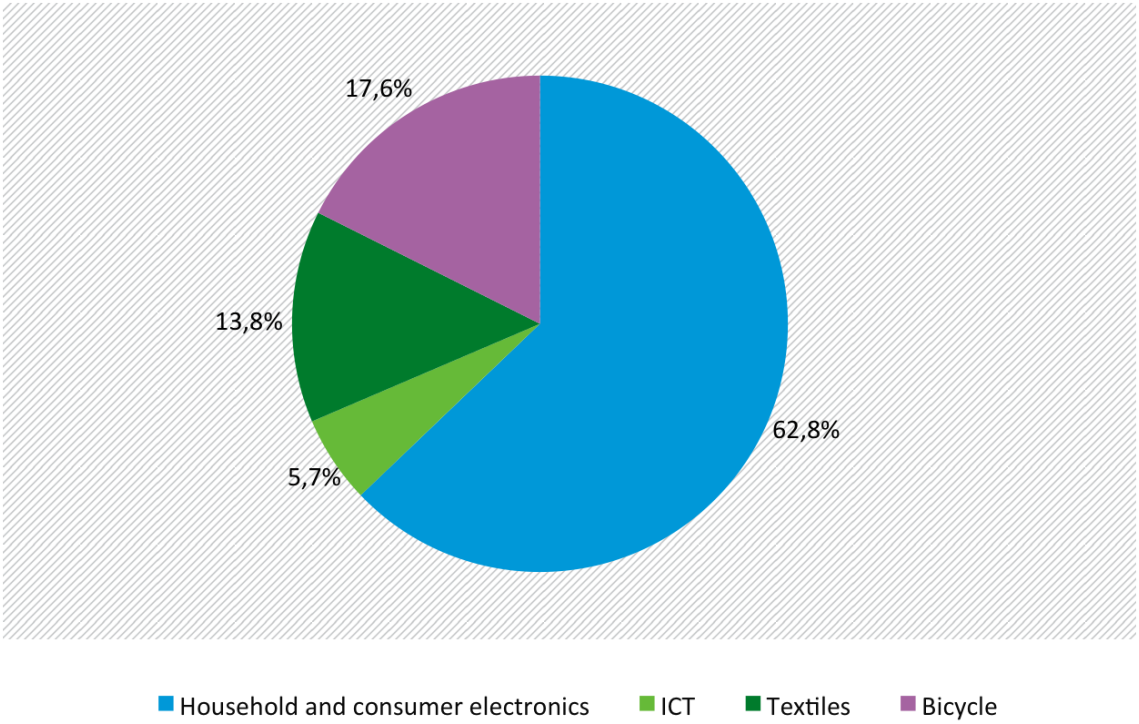
For the extrapolation, various assumptions had to be made and evaluated; in each case these are founded on the experience-based presumptions of experts and were validated on this basis and adjusted as necessary. During this process, well-founded assumptions on the life cycle and service life of new and repaired appliances were made on the one hand. On the other hand, differentiated assumptions were made regarding the substitution rate of repaired products,

since not every repaired item fully replaces a new product, but may be used or kept in reserve as a back-up for the household.

Since a statistical database for repair cafés is currently still in its infancy in Germany [75], information on the likelihood of repair and the proportion of individual product categories being repaired was taken from data produced by the Stichting foundation in the Netherlands and transferred to Germany (Natuur & Milieu 2018).

In terms of magnitude, it can be concluded, based on the available data for the area of repair cafés, that a total of around 100,000 of the 160,000 attempted repairs are successful and lead to a prolonged service life for products, thereby reducing the need for new products. On this basis, approx. 55,000 new products in various product categories are not required as a result of repairs made in repair cafés (see Figure 17).

Figure 17: Proportion of new products avoided as a result of repairs made in repair cafés in Germany by product category

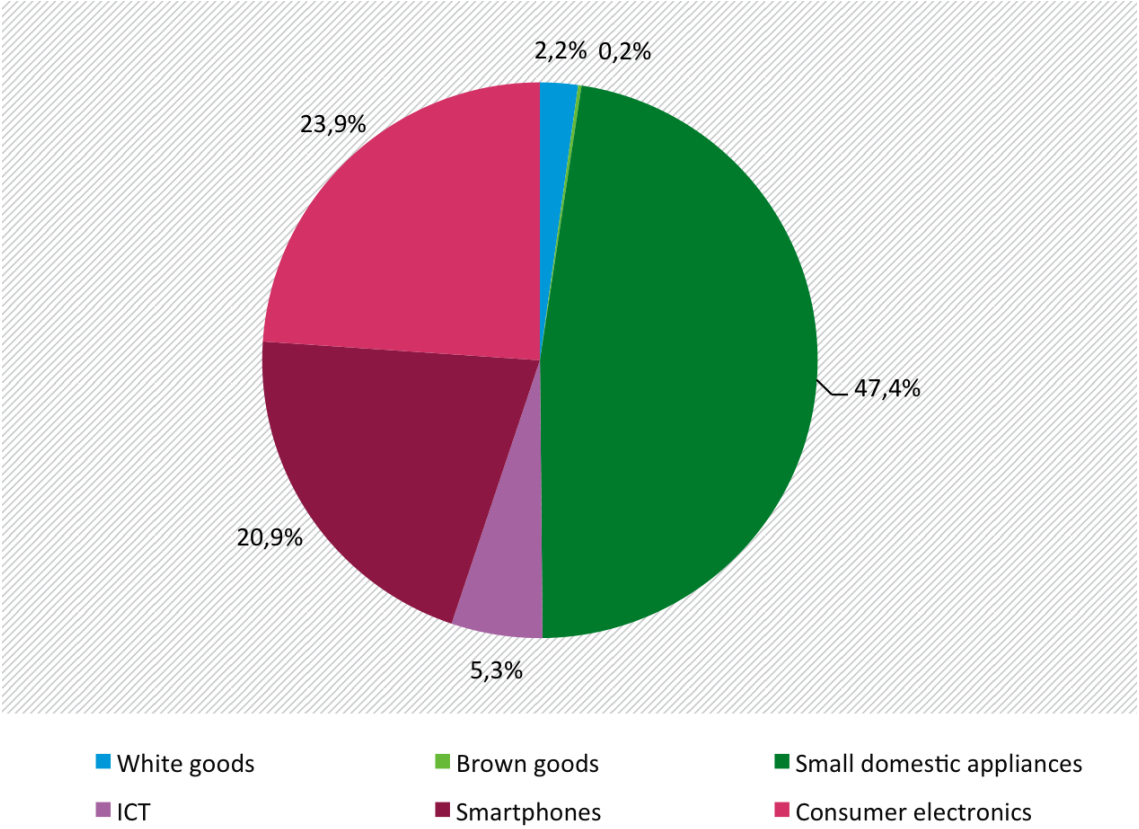


Source: Oeko Institut.

The data for the commercial repair sector are based on internal statistics from the MeinMacher.de repair network which represent around 1,200 repair workshops throughout Germany. These statistics provided information about which items of equipment were repaired and in what quantities each year. To extrapolate these figures to the whole of Germany, the current statistics on the repair sector from the Federal Statistical Office provided a further set of data (Destatis 2018). As part of the activities of the MeinMacher network around 310,000 different new products are avoided as a result of repairs (see Figure 18).

[75] https://www.reparatur-initiativen.de/post/auf-dem-weg-zur-reparatur-statistik, retrieved on 20.07.2018

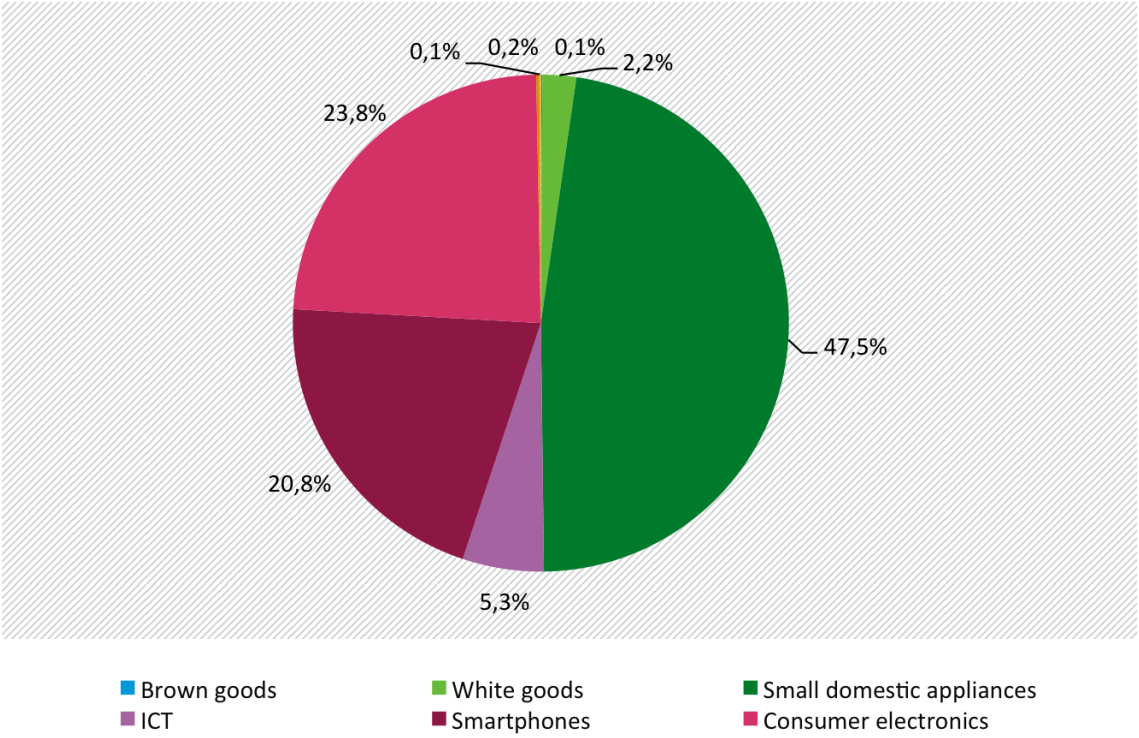
Figure 18: Proportion of new products avoided as a result of repairs in the MeinMacher network by product category



Source: Oeko Institut.

In order to extrapolate these figures to the whole of Germany, the results for the MeinMacher network were grossed up based on data from Destatis service sector statistics on the repair of computers and consumer goods. As a basis, the results of the MeinMacher network were considered in relation to the distribution of company size and the personnel employed in the repair trade according to Destatis. The extrapolation revealed that around 12 million different new products are avoided each year in Germany as a result of repair activities, see Figure 19 below.

Figure 19: Proportion of new products avoided as a result of repairs in the MeinMacher network by product category



Source: Oeko-Institut.

Since the repair trade is organised in a compartmentalised way and repair services are to some extent offered in the retail sector as an ancillary activity, the official statistics that exist regarding the repair trade exhibit systematic omissions (Poppe 2014).

Ecological impacts

In order to reach an assessment of the reduced ecological burden resulting from repair activities, the potential greenhouse gas emissions (GWP), cumulative energy demand (CED) and cumulative raw material demand (CRD) were deduced for each product category (if available) from previously published material flow analyses and life cycle assessment studies and from the ecoinvent database.

In order to assess the scale of the ecological contributions resulting from repairs undertaken in repair cafés and by the MeinMacher.de network, the new equipment that was avoided, as identified in the previous section, was linked to its production-specific burden. Energy is consumed and raw materials are used as a result of repair work (e.g. for spare parts and transport, etc.), although these can be disregarded for the rough assessment, as shown in a current study for smartphones and tablets, where their contribution amounts to under 1% of production-related greenhouse gas emissions (Maga et al. 2018).

Table 25: Environmental impacts avoided each year as a result of repair activities in Germany

	GWP (t CO2eq)	CED (GJ)	CRD (t/t)
Brown goods	-2,053	-20	-
White goods	-91,700	-1,311	-229,168
Small household appliances	-291,787	-5,951	-714,259
ICT	-121,011	-523	-172,734
Smartphones	-149,766	-2,047	-34,945
Consumer electronics	-502,073	-9,531	-1,831,383
Textiles	-72	-1	-48
Bicycles	-951	-11	-1,329
Total	-1,159,414	-19,395	-2,983,867

Source: Oeko-Institut

The assessment shows that around one million tonnes of greenhouse gases can be avoided and a reduction of around 19,000 GJ in primary energy equivalents can be achieved through repair activities. Furthermore, around 3 million tonnes of raw materials can be saved as a result of repair work (incl. all the raw materials in upstream production chains).

Economic impacts

Alongside the ecological impacts of repair activities, the economic impacts of the sector are also highlighted as making a positive contribution to society. For 2016, the Federal Statistical Office reported a total of 12,620 repair workshops, around 80% of which generated a turnover of less than 250,000 euros. According to these figures, around 0.1% of the total creation of value in Germany, equating to a total value added of 3.4 billion euros, is generated by around 46,000 people in the repair industry (Destatis 2018). As Poppe 2014 emphasises, these statistics only represent one part of the repair sector and its real contribution should thus be rated higher (Poppe 2014).

Conclusion

As the assessments have indicated, large emissions of greenhouse gases and high volumes of resource extraction are avoided as a result of the repair sector in Germany. At the same time, the situation of many repair workshops is marked by numerous problems. On the one hand, unduly low prices for new goods present a problem since the work-intensive processes involved in repairing items mean these are exceeded if fair salaries are paid. On the other hand, according to those working in the sector, it is suffering from a shortage of employees and new recruits with the relevant technical skills and competencies. Furthermore, the repair sector faces other obstacles in terms of the availability of information on carrying out repairs and access to spare parts. Many manufacturers only offer their own licensed repair workshops non-discriminatory access to spare parts and independent repair workshops are excluded. In order to create a fair competitive environment for independent repair workshops, the regulations that apply to the automotive industry must be transferred to other product lines and all repair workshops must be guaranteed open and unlimited access to spare parts.

With regard to WWP II, the existing potential for repair activities needs to be more actively promoted. To do this, design specifications are required within the framework of the eco-design directive, on the one hand, in order to improve the repairability of products, and on the other

hand, issues affecting the general circumstances (such as the supply of spare parts, repair information, repair costs, etc.) need to be addressed using a combination of measures to improve conditions overall.

4 Establishing principles for the further development and revision of the WPP

On the basis of the evaluations of the current level of implementation of the WPP at national, federal state and municipal level in addition to feedback from the participating stakeholders obtained through expert interviews conducted as part of the research project, we have found that the numerous measures stated in the existing WPP have lost none of their relevance. However, the wide-ranging scope of the issues means that the question of which areas the various stakeholders should or can prioritise has been left unresolved. At the same time, analysis of the present situation indicates that, with areas requiring action outlined with a somewhat broad brush in Chapter 4 of the WPP followed by relatively detailed case studies in Chapter 6 of the WPP, the current structure of the WPP has itself also led to a lack of clarity in terms of what the stakeholders should be guided by when formulating their own waste prevention strategies.

Against this background, this chapter seeks to develop proposals for the revision of the WPP, which,

- on the one hand, are aimed at giving higher priority to waste streams (see Chapter 4.1) and at defining firm concepts for waste prevention (see Chapter 4.2) and,
- on the other, have the potential to establish a more stable institutional footing and a structure for the WPP that puts greater focus on action (see Chapter 4.3).

As far as both aspects are concerned, ensuring that the WPP is as compatible as possible with existing structures and initiatives in terms of content and form has been an important consideration. In view of the cross-sectoral nature of waste prevention, it is not the intention that the WPP develop parallel structures, but instead to interlink ongoing projects and processes with the greatest possible synergies as regards preventing waste.

4.1 Strategies for prioritising waste streams

When it comes to prioritising waste streams as part of a WPP, a wide range of different criteria may be consulted. As a general principle, the main focus should be on the specific effects on the environment and human health resulting from the volume of waste, which are to be reduced in accordance with the objectives of the WPP. With such impact-related data being in short supply, however, additional aspects such as the actual potential to prevent waste and waste generation trends as well as the actual recycling pathways can be taken into consideration (areas given priority for waste prevention should include those streams where it has thus far not been possible to recycle the resources contained in high-quality processes and put them back into circulation).

For the purposes of this project, the following three-stage prioritisation procedure was chosen:

- Systematic analysis using German waste statistics
- Analysis of the development of aggregated waste streams in comparison with other EU member states
- Analysis of priority waste streams in the WPPs published by other EU member states and of the regions responsible for producing waste prevention programmes, as applicable.

The key findings of these analyses are presented below; detailed results can be found in Appendix A.

4.1.1 Absolute and relative growth of waste streams in Germany from 2006 to 2015 or 2006 to 2014

This analysis of the development of waste streams in Germany is based on data sourced from the German Federal Statistical Office (Fachserie 19.1). The findings relate to the period between 2006 and 2015 or 2014; the intervening years were not analysed. Because the data in the Fachserie 19.1 publication from 2006 was structured differently, it had to be adjusted before it could be compared with the data from 2015 and 2014.

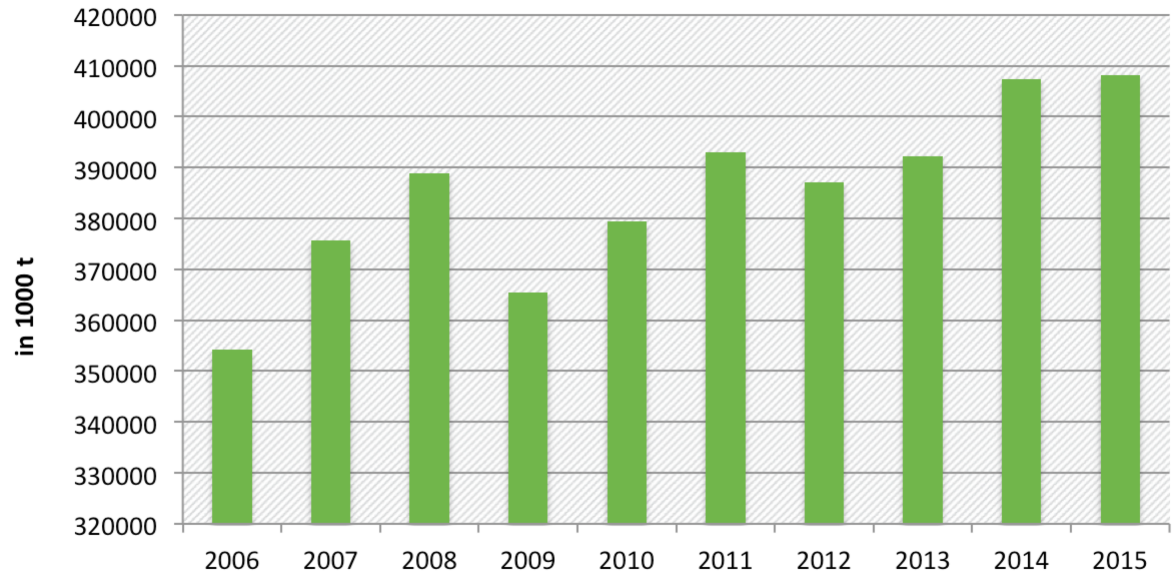
At this juncture, it should be noted that it was not possible to determine the growth of each of the 890 waste codes, as almost 30 per cent of them do not contain any values in either the first or last year. In the case of the 2006–2015 comparison specifically, no data on the growth/decline in volumes was available for 244 waste codes. For 84 of these 244 waste codes, there was only one value, either in 2006 or in 2015. No information was given as to the reason why values were available for only one of the two years in the case of 84 waste codes. It may be that waste of a particular kind was, in fact, no longer produced in 2015 or that data on the waste codes in question was not yet being collected in 2006. Likewise, it is possible that the assignment of certain waste categories to waste codes has changed in the period under review.

In addition to the period from 2006 to 2015, the time frame from 2006 to 2014 was studied to allow for a more effective international comparison of European waste statistics, for which only values up until 2014 are available. For the period until 2014, no figures are available for 253 waste codes in either year, and 86 of those waste codes (28 per cent) only have data for one year.

Findings in terms of absolute growth

To begin with, we present the findings for absolute growth. As can be seen from Figure 20, the total amount of waste increased continuously in the period from 2006 onwards, with the exception of the brief dip in 2009. The total volume of waste rose by 54 million tonnes between 2006 and 2015.

Figure 20: Overall inputs at waste management facilities (in 1,000 t)



Source: Own illustration by the Wuppertal Institute based on data from Destatis, Fachserie 19, Reihe 1. Abfallentsorgung. ["Waste disposal"]. German Federal Statistical Office, 2008–2017 (Statistisches Bundesamt 2018).

The details of the absolute change in the individual waste codes for years 2006–2015 or 2006–2014, as applicable, are shown in Table 26 and Table 27. These two tables each present the 30 waste codes with the highest level of absolute growth between 2006 and 2015 or 2014. The fourth column in these tables indicates the percentage rise in these waste categories. The waste codes marked in green figure in the top 30 of both the absolute and the percentage growth rates.

The ranking of the contents of the two tables clearly differs, even though the waste category "170504 – soil and stones, other than those mentioned in 170503" shows the greatest increase by far in both periods under consideration. Nevertheless, this waste code clearly demonstrates how strongly the results depend on the chosen review period: growth between 2006 and 2014 is lower (+22.4 million tonnes) than between 2014 and 2015 (+91.6 million tonnes). Overall, it is apparent that the absolute increases are primarily attributable to waste codes in the categories beginning with the digits 17 (construction and demolition wastes) and those beginning with 19 (wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use).

Table 26: The 30 waste codes showing the highest absolute rise between 2006 and 2015

Waste code	Waste streams	Total growth 2006–2015 (in 1,000 t)	Percentage rise between 2006 and 2015
170504	Soil and stones, other than those mentioned in 170503	113,969.0	122.0%
170107	Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 170106	25,202.4	116.4%
170101	Concrete	19,942.8	86.5%
19120904	Products for use in asphalt mixing plants	15,999.8	442.3%

Waste code	Waste streams	Total growth 2006–2015 (in 1,000 t)	Percentage rise between 2006 and 2015
010102	Wastes from mineral non-metalliferous excavation	12,347.9	29.4%
170302	Bituminous mixtures other than those mentioned in 170301	12,141.1	85.9%
191210	Combustible waste (refuse-derived fuel)	4,240.3	191.1%
190112	Bottom ash and slag other than those mentioned in 190111	4,220.0	99.2%
190805	Sludges from treatment of urban waste water	4,203.0	138.2%
20030100	Undifferentiable mixed municipal waste	3,740.4	107.0%
170301*[76]	Bituminous mixtures containing coal tar	2,367.0	162.2%
191212	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 191211	2,362.6	38.9%
100102	Coal fly ash	2,342.6	62.9%
170508	Track ballast other than that mentioned in 170507	2,228.3	165.4%
191207	Wood other than that mentioned in 191206	2,088.9	99.4%
170405	Iron and steel	2,027.9	42.0%
100117	Fly ash from co-incineration other than that mentioned in 100116	1,840.5	2,222.8%
170102	Bricks	1,776.6	22.3%
200201	Biodegradable waste	1,763.5	43.6%
150107	Glass packaging	1,386.8	167.6%
010411	Wastes from potash and rock salt processing other than those mentioned in 010407	1,189.2	2,426.9%
170103	Tiles, bricks and ceramics	1,189.2	72.8%
191202	Ferrous metal	1,097.1	559.5%
030305	De-inking sludges from paper recycling	1,051.2	62.4%
170904	Mixed construction and demolition wastes other than those mentioned in	959.9	33.1%

[76] The waste codes marked with * correspond to waste types deemed hazardous pursuant to Germany's Circular Economy and Waste Management Act (KrW-/AbfG).

Waste code	Waste streams	Total growth 2006–2015 (in 1,000 t)	Percentage rise between 2006 and 2015
	170901, 170902 and 170903		
191211*	Other wastes (including mixtures of materials) from mechanical treatment of waste containing hazardous substances	935.1	458.2%
030310	Fibre rejects, fibre-, filler- and coating-sludges from mechanical separation	878.6	192.3%
010408	Waste gravel and crushed rocks other than those mentioned in 010407	867.3	4,493.8%
190107*	Solid wastes from gas treatment	773.6	134.4%
191204	Plastic and rubber	742.1	144.2%

Source: Own calculations based on data from Destatis, Fachserie 19, Reihe 1. Abfallentsorgung. ["Waste disposal"]. German Federal Statistical Office, 2008–2017 (Statistisches Bundesamt 2018).

Table 27: The 30 waste codes showing the highest absolute rise between 2006 and 2014

Waste code	Waste streams	Total growth 2006–2014 (in 1,000 t)	Percentage rise between 2006 and 2014
170504	Soil and stones, other than those mentioned in 170503	22,384.7	24.0%
19120904	Products for use in asphalt mixing plants	6,191.1	262.3%
191210	Combustible waste (refuse-derived fuel)	4,346.7	195.9%
170107	Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 170106	4,309.1	19.9%
190805	Sludges from treatment of urban waste water	3,856.6	126.8%
190112	Bottom ash and slag other than those mentioned in 190111	3,614.4	84.9%
20030100	Undifferentiable mixed municipal waste	3,472.8	99.1%
191212	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 191211	2,330.8	38.4%
170405	Iron and steel	2,210.8	45.8%
191207	Wood other than that mentioned in 191206	2,033.6	96.7%
100117	Fly ash from co-incineration other than that mentioned in 100116	1,924.8	2,324.6%

Waste code	Waste streams	Total growth 2006–2014 (in 1,000 t)	Percentage rise between 2006 and 2014
200201	Biodegradable waste	1,755.4	43.4%
030305	De-inking sludges from paper recycling	1,339.6	79.5%
010411	Wastes from potash and rock salt processing other than those mentioned in 010407	1,334.2	2,722.9%
150107	Glass packaging	1,259.2	152.2%
191202	Ferrous metal	1,169.7	596.5%
170301*	Bituminous mixtures containing coal tar	1,139.0	78.1%
191211*	Other wastes (including mixtures of materials) from mechanical treatment of waste containing hazardous substances	994.3	487.2%
170904	Mixed construction and demolition wastes other than those mentioned in 170901, 170902 and 170903	922.5	31.9%
030310	Fibre rejects, fibre-, filler- and coating-sludges from mechanical separation	799.2	174.9%
191204	Plastic and rubber	785.6	152.7%
170508	Track ballast other than that mentioned in 170507	737.9	54.8%
100115	Bottom ash, slag and boiler dust from co-incineration other than those mentioned in 100114	716.3	768.6%
191206*	Wood containing hazardous substances	656.0	111.1%
190307	Solidified wastes other than those mentioned in 190306	596.7	2,210.0%
15010600	Undifferentiable mixed packaging	580.8	31.4%
150102	Plastic packaging	541.9	108.3%
020204	Sludges from on-site effluent treatment	497.5	113.2%
120101	Ferrous metal filings and turnings	393.2	159.9%
20030104	Municipal organic waste	381.2	10.2%

Source: Own calculations based on data from Destatis, Fachserie 19, Reihe 1. Abfallentsorgung. ["Waste disposal"]. German Federal Statistical Office, 2008–2016 (Statistisches Bundesamt 2018).

In both of the periods under consideration, four of the 30 waste codes (marked in green) appear in the top 30 with the highest growth rates in absolute and percentage terms. However, very high growth rates are also evident amongst the remaining waste codes, with volumes more than doubling in comparison with the 2006 figures.

Findings in terms of percentage growth

The 30 waste streams with the highest relative growth rates in the time frame from 2006 to 2015 or 2006 to 2014 are listed in descending order in Table 28 and Table 29. As shown, the percentage increases in the top 30 are in excess of 700 per cent (2006–2015) and 560 per cent (2006–2014) respectively. The highest relative growth in the period from 2006 to 2015 has been calculated at 17,183 per cent for the waste stream "020499 – wastes not otherwise specified," followed by "160804 – spent fluid catalytic cracking catalysts (except 160807)" at 5,700 per cent and "101006 – casting cores and moulds that have not undergone pouring, other than those mentioned in 101005" at 5,262 per cent. Two points are striking: 1) The waste code showing the highest percentage growth is more heterogeneous than that for absolute growth. 2) High relative growth does not necessarily mean high absolute growth or even a high volume of waste. In the case of over half of the top 30 waste codes, absolute growth was under 50,000 tonnes.

The waste stream "101006 – casting cores and moulds that have not undergone pouring, other than those mentioned in 101005" is a case in point. Its very high relative growth rate of 5,262 per cent puts it in third place in the top 30 waste streams showing the highest relative growth. This category was responsible for a total of 800 tonnes of waste in 2006 and 42,900 tonnes in 2015. In comparison with waste streams for construction and demolition wastes of the order of 43 million tonnes ("170101 – concrete") or 26 million tonnes ("170302 – bituminous mixtures other than those mentioned in 170301"), these are fairly small quantities of waste.

Here too, the ranking for the period between 2006 and 2015 is not identical to the top 30 for the period between 2006 and 2014. On the one hand, this can be explained by the low absolute quantities, where small annual changes can result in high percentage changes. To some extent, however, major changes between 2014 and 2015 are again key to the different rankings. For instance, at 70,700 tonnes, the volume of waste recorded under the waste code "010408 – waste gravel and crushed rocks other than those mentioned in 010407" in 2014 was only 3.5 times higher than the volume recorded in 2006 (19,300 tonnes), meaning that it did not feature in the ranking of the top 30 waste codes showing the highest percentage growth between 2006 and 2014. However, between 2014 and 2015, the volume of waste under this code rose to 886,600 tonnes, equating to an increase of almost 4,500 per cent when the 2006 and 2015 figures are compared.

Table 28: The 30 waste codes showing the highest percentage rise between 2006 and 2015

Waste code	Waste streams	Percentage rise between 2006 and 2015	Total growth 2006–2015 (in 1,000 t)
020499	Wastes not otherwise specified	17,183.3%	103.1
160804	Spent fluid catalytic cracking catalysts (except 160807)	5,700.0%	34.2
101006	Casting cores and moulds that have not undergone pouring, other than those mentioned in 101005	5,262.5%	42.1
010408	Waste gravel and crushed rocks other than those mentioned in 010407	4,493.8%	867.3
010407*	Wastes containing hazardous substances	3,140.0%	31.4

Waste code	Waste streams	Percentage rise between 2006 and 2015	Total growth 2006–2015 (in 1,000 t)
	from physical and chemical processing of non-metalliferous minerals		
101201	Waste preparation mixture before thermal processing	2,742.9%	38.4
020101	Sludges from washing and cleaning	2,587.5%	20.7
010411	Wastes from potash and rock salt processing other than those mentioned in 010407	2,426.9%	1,189.2
100117	Fly ash from co-incineration other than that mentioned in 100116	2,222.8%	1,840.5
190307	Solidified wastes other than those mentioned in 190306	2,152.6%	581.2
101209*	Solid wastes from gas treatment containing hazardous substances	1,566.7%	4.7
120113	Welding wastes	1,512.5%	12.1
070411*	Sludges from on-site effluent treatment containing hazardous substances	1,400.0%	1.4
160505	Gases in pressure containers other than those mentioned in 160504	1,300.0%	1.3
101105	Particles and dust	1,166.7%	3.5
100905*	Casting cores and moulds that have not undergone pouring containing hazardous substances	1,100.0%	1.1
020601	Materials unsuitable for consumption or processing	1,086.5%	241.2
190699	Wastes not otherwise specified	1,057.5%	42.3
101112	Waste glass other than that mentioned in 101111	1,023.8%	266.2
100116*	Fly ash from co-incineration containing hazardous substances	960.0%	19.2
190809	Grease and oil mixture from oil/water separation containing only edible oil and fats	900.0%	51.3
030308	Wastes from sorting of paper and cardboard destined for recycling	825.0%	13.2
060203*	Ammonium hydroxide	800.0%	6.4
130308*	Synthetic insulating and heat transmission oils	800.0%	0.8
030104*	Sawdust, shavings, cuttings, wood, particle board and veneer containing hazardous	796.0%	78.8

Waste code	Waste streams	Percentage rise between 2006 and 2015	Total growth 2006–2015 (in 1,000 t)
	substances		
100115	Bottom ash, slag and boiler dust from co-incineration other than those mentioned in 100114	788.5%	734.9
020102	Animal-tissue waste	784.8%	82.4
100701	Slags from primary and secondary production	775.0%	3.1
070199	Wastes not otherwise specified	721.1%	13.7
190206	Sludges from physico/chemical treatment other than those mentioned in 190205	715.2%	113

Source: Own calculations based on data from Destatis, Fachserie 19, Reihe 1. Abfallentsorgung. ["Waste disposal"]. German Federal Statistical Office, 2008–2017 (Statistisches Bundesamt 2018).

Table 29: The 30 waste codes showing the highest percentage rise between 2006 and 2014

Waste code	Waste streams	Percentage rise between 2006 and 2014	Total growth 2006–2014 (in 1,000 t)
020499	Wastes not otherwise specified	16,200.0%	97.2
160804	Spent fluid catalytic cracking catalysts (except 160807)	4,483.3%	26.9
101006	Casting cores and moulds that have not undergone pouring, other than those mentioned in 101005	3,087.5%	24.7
010411	Wastes from potash and rock salt processing other than those mentioned in 010407	2,722.9%	1,334.2
020101	Sludges from washing and cleaning	2,700.0%	21.6
100117	Fly ash from co-incineration other than that mentioned in 100116	2,324.6%	1,924.8
190307	Solidified wastes other than those mentioned in 190306	2,210.0%	596.7
120113	Welding wastes	2,000.0%	16.0
101209*	Solid wastes from gas treatment containing hazardous substances	1,833.3%	5.5
010407*	Wastes containing hazardous substances from physical and chemical processing of non-metalliferous minerals	1,700.0%	17.0
101201	Waste preparation mixture before thermal processing	1,457.1%	20.4
070411*	Sludges from on-site effluent treatment containing hazardous substances	1,300.0%	1.3

Waste code	Waste streams	Percentage rise between 2006 and 2014	Total growth 2006–2014 (in 1,000 t)
101105	Particles and dust	1,233.3%	3.7
101112	Waste glass other than that mentioned in 101111	968.8%	251.9
020601	Materials unsuitable for consumption or processing	952.7%	211.5
100701	Slags from primary and secondary production	875.0%	3.5
200110	Clothes	858.1%	137.3
070199	Wastes not otherwise specified	789.5%	15.0
100115	Bottom ash, slag and boiler dust from co-incineration other than those mentioned in 100114	768.6%	716.3
020102	Animal-tissue waste	743.8%	78.1
060203*	Ammonium hydroxide	725.0%	5.8
070399	Wastes not otherwise specified	700.0%	0.7
130308*	Synthetic insulating and heat transmission oils	700.0%	0.7
030199	Wastes not otherwise specified	680.0%	47.6
100116*	Fly ash from co-incineration containing hazardous substances	645.0%	12.9
19120100	Undifferentiable paper and cardboard	634.7%	109.8
170404	Zinc	622.0%	31.1
191202	Ferrous metal	596.5%	1,169.7
190809	Grease and oil mixture from oil/water separation containing only edible oil and fats	561.4%	32.0
190206	Sludges from physico/chemical treatment other than those mentioned in 190205	560.8%	88.6

Source: Own calculations based on data from Destatis, Fachserie 19, Reihe 1. Abfallentsorgung. ["Waste disposal"]. German Federal Statistical Office, 2008–2016 (Statistisches Bundesamt 2018).

Summary

By analysing the relative and absolute growth of the waste streams entering various waste management facilities as inputs, two sets of ranked data have been produced for each of the two periods 2006–2015 and 2006–2014. These are summarised in Table 26 to Table 29. The results of the rankings for percentage growth in comparison with absolute growth reveal little overlap. Only four, or respectively five, waste codes are present in the top 30 for both absolute and percentage rises. It is also clearly apparent that high percentage growth does not necessarily mean a high quantity of waste in absolute terms. For many waste codes, the absolute increases are negligible in view of the overall very small input quantities, even when the percentage rise is above 1,000 per cent. In cases where the initial values are very low in 2006, even comparatively low growth rates can result in very high percentage increases. Consequently, the data on absolute growth quantities is better suited for identifying priority waste streams, where the

potential for prevention is worth investigating. Based on these evaluations, the starting points for more in-depth investigations may therefore include the following areas:

- Construction and demolition waste
- Industrial waste
- Secondary waste from waste management processes
- Food waste
- Packaging waste.

In addition, it must be taken into account that 84 (2006–2015 time frame) or 86 waste codes (2006–2014 time frame) showed no growth, because no data was available or recorded either for the first or last year. Nevertheless, it is evident from examining these waste codes that – barring a few exceptions – those waste categories recording minimal quantities overall are particularly affected.

4.1.2 Development of volumes in comparison with other EU member states

In a second step, the waste statistics published by Eurostat were evaluated to see whether it was possible to identify varying trends in different member states on the basis of waste streams selected in step one. This was based on the initial hypothesis that different trends in terms waste volumes may signal successful waste prevention strategies that could be adopted when the WPP is revised (or, conversely, indicate where there may still be potential for improvement in Germany).

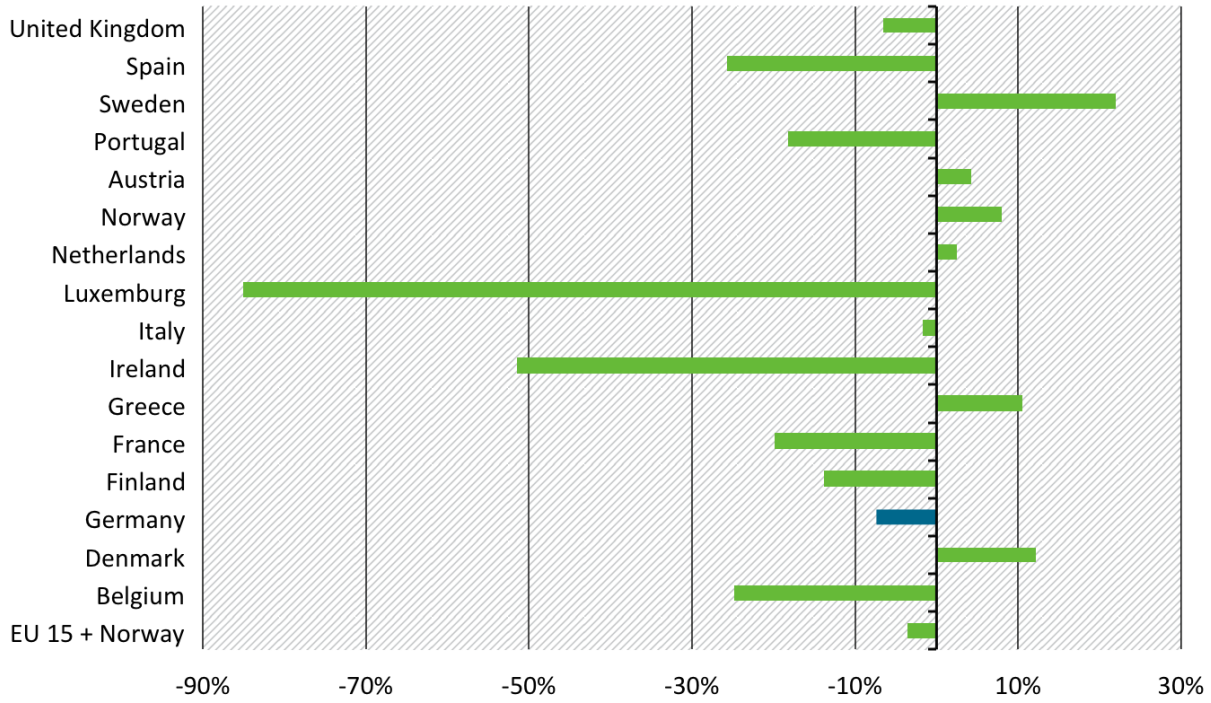
The following two separate aspects were chosen for the evaluation in order to compare developments in the various member states:

- Development of volume per capita
- Development of volume per euro GDP (waste intensity).

Because it is the most populous country in the EU, Germany's figures show the highest volume of waste for practically all relevant waste streams in absolute terms. Of course, this data does not give any indication of the effectiveness of waste prevention strategies. Normalising the values to the volume of waste per capita or per unit gross domestic product (GDP) allows for easier comparison, but still leads to varying results. Germany generally performs better when the focus is on waste intensity as opposed to per capita figures due to its above-average economic growth in the period under review.

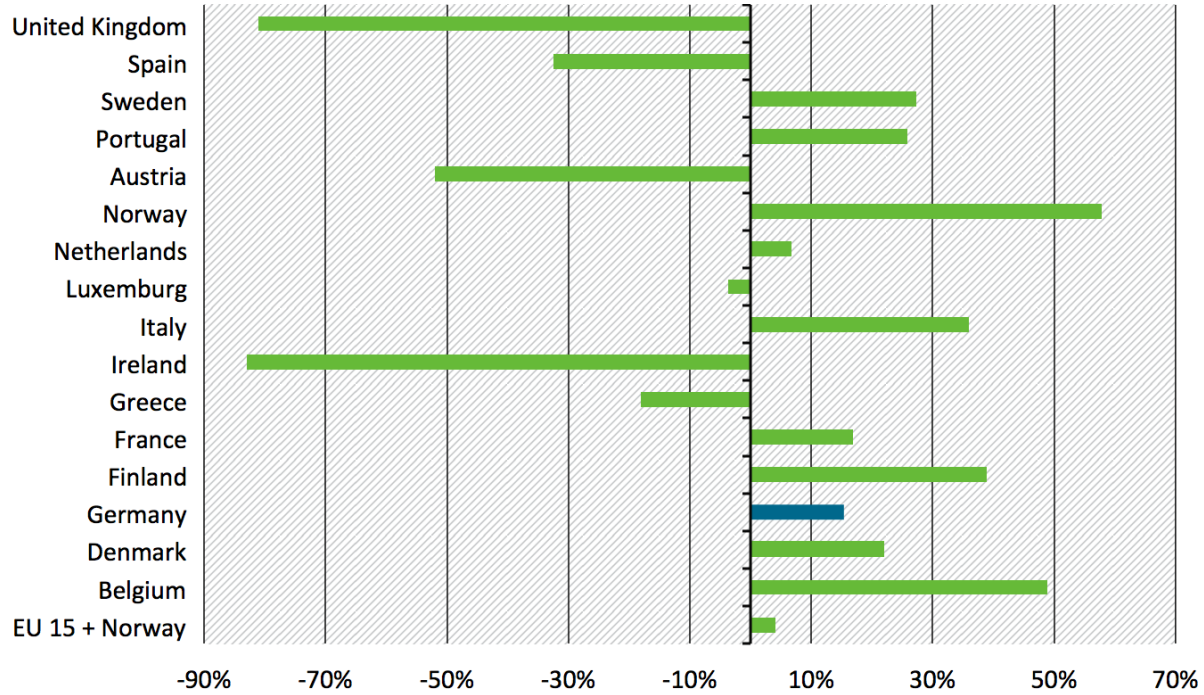
Figure 21 and Figure 22 (below) respectively show the percentage development of waste intensity in relation to the total volume of waste between 2010 and 2014 and the percentage development of the volume of packaging waste (for evaluations of other waste streams, see Appendix A). In terms of waste intensity, the figures for Germany reveal a slight decoupling of waste generation from economic growth, although the decline in construction and demolition wastes in particular is notable in the period under review. With regard to plastic waste, a significant rise is apparent both in Germany and in a host of other EU member states. Complex factors lie behind these developments in the various waste streams and cannot generally be understood on the basis of waste statistics alone.

Figure 21: Total waste 2010–2014, intensity in t/€ – change in %



Source: Own calculation and illustration by the Wuppertal Institute on the basis of Eurostat data (as at 26 October 2017, env_wasgen, unit: t/€ GDP (at current prices, million € purchasing power standard), hazardous and non-hazardous together).

Figure 22: Plastic waste 2010–2014, total volume of waste in t – change in %

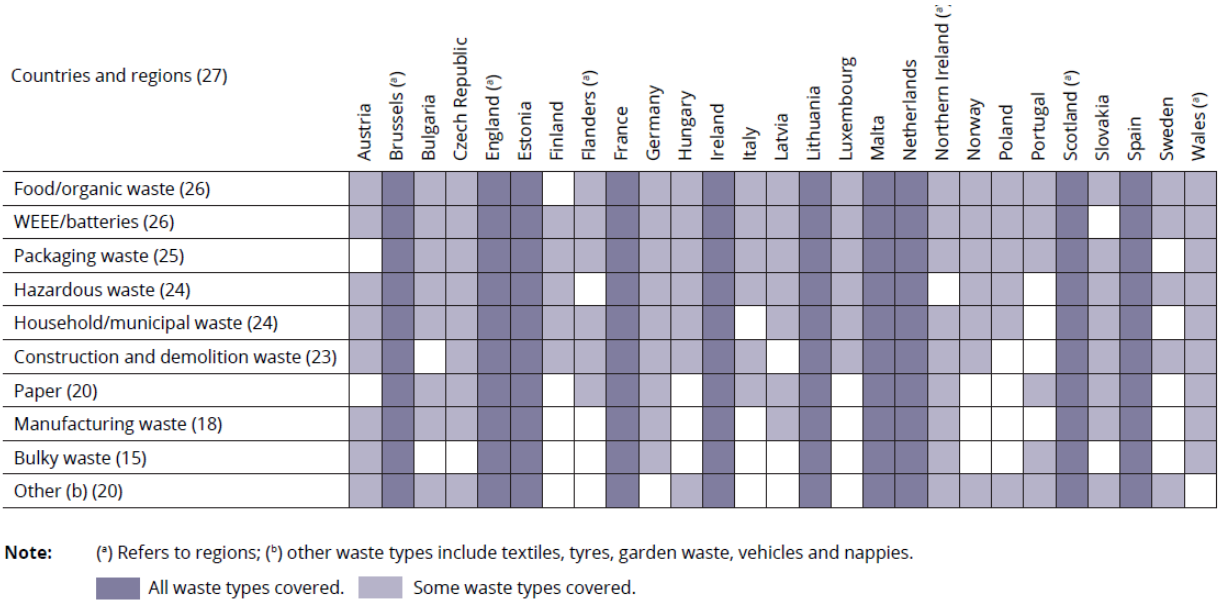


Source: Own calculation and illustration by the Wuppertal Institute on the basis of Eurostat data (as at 26 October 2017, env_wasgen, unit: t, hazardous and non-hazardous together).

4.1.3 Analysis of the available European waste prevention programmes by priority waste streams

In the final analysis step, the WPPs published so far in Europe were examined with regard to the individual waste streams or prevention concepts selected as priority areas in the respective programmes. In total, 32 programmes were studied on the basis of the waste prevention fact sheets published by the EEA (EEA 2018a).[77]

Figure 23: Priority waste streams in the available WPPs of EU member states and/or regions



Source: EEA 2015, p. 24

Figure 23 highlights the fact that the various WPPs are tackling this subject in distinctly different ways:

- Some programmes have not further defined the focus of their WPP and include practically all waste streams – and, where this is the case, their approach to addressing these waste streams also remains very general overall, with hardly any practical prevention strategies being mentioned for the individual categories.
- At the same time, some very extensive programmes have been produced, such as that for England, which cover all waste streams and do in fact specify practical measures to tackle every single one of them.
- Around half of the programmes focus – with varying degrees of justification – on selected waste streams, which they aim to reduce by means of practical measures led by the public sector.[78].

[77] This figure is higher than the number of EU member states. This is because, on the one hand, some additional members of the EEA were also studied (including Switzerland and Norway) and, on the other, the WPP is a regional responsibility in certain member states with the result that multiple programmes exist in Belgium, for example.

[78] However, it is apparent in the case of almost all programmes that, even where specific waste streams have been identified as priorities, this is not reflected in the selected indicators or targets.

4.1.4 Conclusions regarding prioritisation in the new WPP

The following potential priority areas have been identified based on the analysis steps described above and taking account of the experience at country level or in the evaluation of the European programmes of those preparing this report. In terms of analysis (and thus also according to the operating logic applied by many stakeholders), priority waste streams and priority waste prevention concepts have been treated separately. While a variety of instruments can certainly be used to address the waste streams, the prevention concepts likewise relate to different waste streams.

Priority product groups/waste streams

- Plastic packaging waste
- Food waste
- Waste electrical and electronic equipment
- Construction and demolition waste

Priority prevention strategies

- Public procurement
- Repair
- Promotion of product-service systems

4.2 Detailed proposed measures for addressing priority waste streams

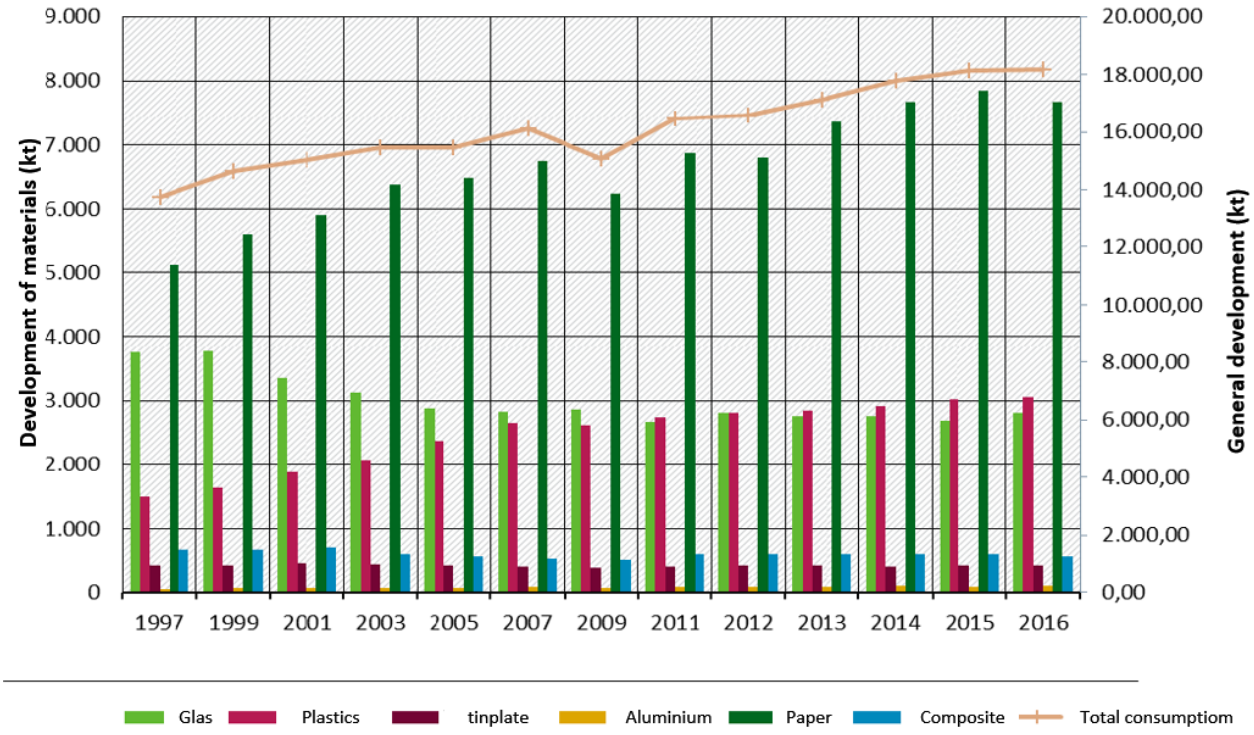
On the basis of the analyses of waste streams to be addressed as a matter of priority from a waste prevention perspective, this section seeks to outline specific proposed measures that could be taken up within the framework of a new WPP.

4.2.1 Plastic packaging waste

4.2.1.1 Justification for relevance

Of the total 18.16 million tonnes of packaging used in 2016, which consequently ended up as waste, 17.61 million tonnes were recovered (12.84 million tonnes used as a source of materials, 4.77 million tonnes used in energy recovery). Packaging consumption rose by 0.05 per cent or 8,700 tonnes compared with 2015 to reach the highest level recorded to date. Amounting to over 8.52 million tonnes, the consumption figures for packaging disposed of as waste by private end consumers in 2016 increased by 0.7 per cent or 62,200 tonnes compared with the previous year. Strikingly, the consumption of plastic packaging in particular has actually doubled when set against the figures for 1995 (Schüler 2018).

Figure 24: Development of packaging waste arising in Germany



Source: Schüler 2018, own translation.

According to a study by the German Federal Environment Agency (UBA) (Schüler 2017), various trends have been aiding this development – the increasing expansion of home shopping (online retail) in recent years has boosted the consumption of paper and cardboard packaging in particular. Distribution structures have also changed, and the volume of corrugated cardboard packaging has risen. In line with a strong orientation towards convenience, consumers are increasingly demanding smaller pack sizes or pre-portioned items, and, at the same time, the consumption of foodstuffs and drinks outside the home is growing as well – with both factors contributing to an upsurge in packaging consumption (Schüler 2017).

The study also shows that changing lifestyles and consumption patterns are at the root of these trends. In addition to their protection, storage and transport functions and use as information carriers, numerous forms of packaging are now designed to make the everyday lives of end consumers easier. This includes the increase in ready meals, ready-to-cook meal kits and components, frozen foods, microwaveable products and ready-to-eat food preparations like salad, fruit or sandwiches.

Furthermore, socio-demographic structures have changed such that the proportion of single-person households has grown substantially and is expected to continue growing in the long term. This trend is leading to smaller pack sizes, pre-portioned items and a rise in the consumption of products eaten or drunk outside the home, especially in the fast-food and takeaway sectors. The study likewise notes the growing proportion of elderly people and pensioner households in Germany and the fact that this demographic group prefers smaller packaging units and is thus also contributing to the increase in packaging waste.

Figure 25: Packaging requirements

Source: Schüler 2017, own translation.

As a result of these numerous requirements and functions, it will not be possible to dispense with packaging on a larger scale even in the long term, with the exception of examples from small, individual initiatives (e.g. "unpackaged" shops), or doing so might then be associated with a significantly higher volume of food waste (BVE 2016). Nevertheless, the amount of packaging waste suggests relevant waste prevention potential even in comparison with other European countries. With this in mind, the following courses of action could make up elements of a national WPP through which the public sector could help to prevent packaging waste.

4.2.1.2 Practical courses of action

4.2.1.2.1 Support of voluntary agreements to prevent occurrence of plastic products with the shortest service life

To support the implementation of the European Plastics Strategy, the EU has issued a directive addressed at certain single-use plastic products (Directive 2019/904, European Parliament and Council of the European Union 2019). Above all, the directive seeks to reduce that plastic waste, which is most frequently found on European beaches – referred to as the "top litter items" (based on strandline monitoring). It includes various measures: reduction targets, bans, product requirements, labelling, extended producer responsibility, separate collection, use of recycled material and activities aimed at raising awareness. The directive sets targets at European level that must be implemented through national measures. As long as the European targets are met, member states have a certain degree of freedom as regards the structure of these measures. After six years, a review process will take place at European level to assess the effectiveness of the directive and adjust it where necessary. The WPP could be a suitable instrument through which to act upon these guidelines and call for the development and implementation of voluntary agreements by the industrial and retail sectors in order to achieve real reductions in terms of packaging, too.

The Agreement to Reduce the Use of Plastic Carrier Bags (BMU and HDE 2016) may serve as a practical model, with the participating companies committing, amongst other actions, to curb the consumption of lightweight plastic carrier bags and no longer to give them away to their customers for free. In this context, the term "plastic carrier bags" includes single-use carrier bags, which are supplied in the retail trade when goods are purchased and may or may not be subject to a charge. The agreement does not cover thermally insulated carrier bags for frozen products, reusable shopping bags or very lightweight plastic carrier bags for small products such as nails and screws if they help to prevent packaging and product waste. Nor does it cover lightweight plastic carrier bags if they help to curb food waste. Plastic carrier bags fulfil various functions; however, they are mainly used to transport clothing, groceries and other retail products. In 2015, the year before the agreement was introduced, the rate of plastic carrier bag consumption was still 68 per capita in Germany. In 2017, the figure fell to 29 plastic carrier bags per inhabitant per year. In total, consumers in Germany used 7.0 billion plastic carrier bags in the year 2000. The figure was still 5.6 billion in 2015. In 2016, it dropped by 33 per cent to 3.7 billion, followed by a further 35 per cent fall, year on year, to 2.4 billion in 2017 (GVM 2018). Plastic carrier bags that are not properly disposed of in the yellow recycling bins or bags used in Germany may end up in the environment and be washed into the sea via rivers, for example. The decomposition of plastic bags can take decades and leaves microplastics behind (Verbraucherzentrale 2016).

In 2015, the EU adopted a corresponding directive (Directive 2015/720; European Parliament and Council of the European Union 2015) in order to reduce the annual consumption of lightweight plastic carrier bags to a maximum of 90 per person by 2019 and a maximum of 40 by 2025. So far, Germany has refrained from enacting legislation to this effect, instead giving retailers the option of making a voluntary commitment. This was formalised in 2016 with the voluntary Agreement to Reduce the Use of Plastic Carrier Bags concluded between the German Retail Federation (HDE) and the country's Federal Environment Minister.
In addition to a potential expansion of the Agreement to Reduce the Use of Plastic Carrier Bags to include especially lightweight bags like those used for fruit and vegetables, for example,[79] it would be advisable to extend such agreements to cover other items, particularly takeaway coffee cups. According to calculations by Environmental Action Germany (DUH), approximately 2.8 billion takeaway coffee cups are used each year in Germany (DUH 2015). This equates to an average of 34 cups per person. Producing this quantity of cups causes the emission of around 83,000 tonnes of CO_2, with an additional 28,000 tonnes of CO_2 emitted in the manufacture of the corresponding plastic lids. Following an estimated product life of about 15 minutes, use of these coffee cups results in a total of approximately 31,000 tonnes of waste annually – plus an additional 9,000 tonnes for the lids. This data is based on various studies as well as the DUH's own calculations. An investigation comparing the life-cycle assessment of reusable cups with that of single-use variants is currently being carried out on behalf of the German Federal Environment Agency (UBA). The study's findings also formed the basis for the certification of reusable cups with the Blue Angel ecolabel. The Blue Angel criteria for Reusable Cup Systems (DE-UZ 210) were published in early 2019 (RAL & Umweltbundesamt 2019).

Virgin materials are generally used to manufacture single-use cups. Owing to the possible presence of contaminants, such as the ingress of printing inks, recycled materials are only suitable for foodstuffs to a limited extent. Approval for their use as food contact materials would therefore also be needed. Even after use, recycling is difficult, because paper cups are usually

[79] However, care would need to be taken when drawing up an agreement to reduce the consumption of very lightweight bags that this would neither increase the consumption of disposable paper bags, for which the life-cycle assessment is worse, nor result in more products being sold pre-packed.

coated with plastic, which means that only a small proportion of the paper fibres are separated in the recycling process and the majority end up being incinerated. When cups are disposed of in public waste bins where there is no separation, they are sent straight for incineration. Other forms of single-use cups include variants containing bioplastics, for which the life-cycle assessment is no better, and cups made entirely from plastic (polystyrene). The latter can be recycled when disposed of via Germany's yellow bin system, although there is a loss of quality (DUH 2015, p. 8).

An additional problem, particularly in towns and cities, involves cups littering public spaces instead of being disposed of in waste bins. Furthermore, the volume of cups disposed of in public waste bins can cause them to be overloaded. These overfilled bins need to be emptied more often, which increases costs, and, where they are unusable, this in itself causes littering. As consumption outside the home continues to rise, it can be assumed that these problems will increase in the future if no sustainable concepts are established for drinking hot beverages on the go (SK:KK et al. 2018).

There are several alternatives to the use of disposable cups (DUH 2015, pp. 12–13):

Providing reusable drinking vessels

Reusable drinking vessels can be provided where drinks are consumed in situ. After washing, they can be used again and, in the case of porcelain cups, used an almost unlimited number of times.

Refilling customers' own reusable cups

Alternatively, customers can bring their own reusable cups with them and have them filled in the shop. If this option is used, it is important that the cups are clean – this can be checked visually by staff. The coffee machines used in shops usually have an adjustable spout, preventing any contact with the cup.

Pooling system featuring returnable cups

Another option is to serve drinks in returnable cups against a deposit, which customers can return rinsed or unrinsed after use, making them available for the next user after cleaning. When several cafes work together, or where the system is introduced to several branches of one chain, customers are able to return their cups locally. Returnable cups have the advantage that, being used multiple times, they are more environmentally friendly than single-use cups, and cups made of polypropylene are easily recycled. The limitations of this system are that the lids are still made of single-use plastic in many cases and the cups, if they are not returned as intended and the corresponding utilisation cycles are therefore not achieved, can have a worse life-cycle assessment than the single-use variants. Having an attractive yet simple design may be advantageous when it comes to the acceptance of returnable cups – ensuring that customers are happy to use them, but do not see them as souvenirs, which would cause them to be lost from the returns system.

The way staff communicate with customers is a key factor in the success of returnable and reusable cups. However, this is not always easy to implement in the course of normal business.

Successful examples of return systems for takeaway food and drink

In 2015, Environmental Action Germany launched the Becherheld (cup hero) campaign (DUH 2018) with two objectives. First, to formulate recommended actions for policymakers, retail and consumers with the aim of cutting back on single-use cups, and second, to raise awareness amongst the target groups of the environmental impacts of these cups.

In Freiburg, Germany, a reusable FreiburgCup (Freiburgcup 2018) was introduced in 2016 with the participation of 14 coffee businesses and can now be bought for a deposit of €1 in over 100 cafes, bakeries and cafeterias in Freiburg and returned later. The cup has been designed for a useful life of at least 400 washes. It is made of recyclable polypropylene, although the lid is still a single-use item made of polystyrene for hygiene reasons. The city's waste management and sanitation company, Abfallwirtschaft und Stadtreinigung Freiburg, which is responsible for the service, advises against using the lid on environmental grounds. Examples of similar return systems exist elsewhere in Germany, such as the Hannoccino cup system in Hanover (Hannoccino 2017) – which was introduced by the city's waste management organisation aha Zweckverband Abfallwirtschaft Region Hannover, the FairCup (Fair Cup n.d.) in Göttingen – which originated as a school project – and the provider CUPFORCUP (Cup for Cup 2018), which is active in several towns and cities in North Rhine-Westphalia and in Hamburg.

Founded in 2016, start-up company reCup (reCup 2018) aims to develop a deposit system that operates in multiple towns and cities. The company's cups are currently available in various German cities including Berlin, Dresden, Hamburg, Heidelberg, Cologne and Munich. reCup is another service that provides cups on loan for a €1 deposit from cafes and bakeries, which can then be returned to any participating business. A lid to fit the cups is not yet available against a deposit for hygiene reasons, but is offered for sale and can then be reused by the individual customer.

Another attempt to reduce the consumption of single-use cups is to discount the drink when a customer brings their own reusable cup. For example, Starbucks charges €0.30 less per drink (Starbucks 2018), and participating branches of McCafé give customers a €0.10 discount (McDonald's 2018). Customers using cups from reCup also benefit from a price reduction. Some providers leave the decision up to the participating shops, because they argue that many have tight margins. Bund für Lebensmittelrecht und Lebensmittelkunde e.V., the German Federation for Food Law and Food Science, has published a leaflet giving guidance on filling cups brought in by customers (BLL 2018).

Another possibility could be a levy on single-use cups based on the model of plastic carrier bags in order to create an incentive for consumers to give up disposable cups and switch to a reusable variant.

In addition to reusable cups for drinks, there are also return systems for food containers. Das Tiffin Projekt based in Berlin supplies lunch boxes and also cooperates with partner restaurants, where customers borrow a box, have it filled with a takeaway meal and can return it to any of the participating restaurants (Das Tiffin Projekt n.d.). reCIRCLE (reCIRCLE n.d.) in Switzerland takes a similar approach. Thanks to so-called reCIRCLE BOXes – washable containers with lids – participating partners are able to sell takeaway dishes in these reusable containers rather than disposable ones. The boxes can be returned after use or washed at home and reused. As well as being suitable for drinks, the reusable FairCup (Meyer n.d.) from Lower Saxony can also be used for foodstuffs, such as fruit, vegetables, fish, meat, cheese, sausages and salad. What's special about this system is that the containers can be returned via certified deposit machines.

Introduction into packaging legislation of financial incentives to prevent packaging waste

A stronger regulatory strategy to prevent packaging waste would involve mandatory requirements under the German Packaging Act (VerpackG) to take greater account of the issue of prevention in addition to recyclability and the use of secondary raw materials. In Germany, packaging is subject to a system of extended producer responsibility (product responsibility in accordance with waste management legislation), which means that the initial distributors of packaged products should also assume organisational and financial responsibility for their

packaging after it has been used. The theory is that this process of internalising costs will create incentives to take a resource-efficient approach to preventing packaging waste. The way these participation fees for packaging are currently configured, however, still focuses heavily on recyclability and the use of secondary raw materials, not on prevention.

The often inadequate inducements to create environmentally friendly packaging designs are generally seen as one of the principal weaknesses so far encountered in terms of implementing the concept of producer responsibility (see Watkins et al. 2017). A situation has arisen in Germany in particular where the participation fees have more than halved as a result of the intensified competition between the various dual systems (RWI 2017, p. 83), which has in turn also reduced the incentive to cut the volume of packaging.

Practical measures aimed at helping to increase resource efficiency by means of market-based instruments are currently being developed at European level, for example, through the European Commission's plastics strategy, which is heavily focused on systems of extended producer responsibility for the avoidance of plastic waste (European Commission 2018a). At national level, Germany's Packaging Act replaced the country's previously applicable Packaging Ordinance on 1 January 2019. Section 21 of the act explicitly regulates the eco-friendly structure of the participation fees. The dual systems are accordingly "required, within the framework of the assessment of the participation fees, to create incentives for manufacturers of packaging subject to participation in the system to 1. promote the use of materials and material combinations where the highest possible percentage can be recycled, taking into account the practicalities of sorting and recovery, and 2. promote the use of recycled materials and renewable raw materials."

Section 21 of the German Packaging Act thus refers to product design as a key prerequisite when it comes to recycling packaging material. However, it does not address the issue of actually preventing packaging waste. In the current participation fees, this aspect is taken into account via the weight of the packaging, but only the costs of collection and recovery are covered – excluding both the externalised costs of resource consumption on the input side and the consequential costs, such as the accumulation of waste in the environment and in the oceans specifically. Against this background, the explicit recognition of waste prevention aspects in the level of participation fees for packaging could represent a market-based approach to increasing resource efficiency. Discussions would have to be held with the central agency in charge of the Packaging Register (Zentrale Stelle or ZSVR), the dual systems and the distributors placing packaging on the market as to how this could be implemented in practice in the context of the competition between the systems and also how its misuse could be prevented through appropriate monitoring.

In Italy and France there are two systems, CONAI and Citeo, which explicitly aim to provide incentives for environmentally beneficial design by means of these cost-based approaches. France in particular can be regarded as a best practice example for the so-called "eco-modulation" of licence fees, although it would certainly not be possible to transfer all the experience from that country's monopoly system to Germany. As well as collecting and recycling packaging waste using a bonus/penalty system, the approach, which was founded in 1992 (when it was known as Eco-Emballages), explicitly focuses, amongst other things, on reducing the amount of packaging waste (Didier & Sittler 2014).

Table 30: Citeo's bonus/penalty system of extended producer responsibility

BONUS		
Awareness-raising bonus	**Bonus for information on packaging[80]**	
	8%	Sorting instructions on the packaging
	5%	Triman logo on the packaging
	4%	QR code with a link to an approved separation guide
	Bonus for action[81]	
	4%	Awareness-raising campaigns (e.g. TV and radio, advertising, press)
Reduction bonus	**Bonus for reduction and recyclability[82]**	
	8%	One or more actions taken to reduce packaging or improve recyclability
	+4%	Additional bonus if the action is documented and published in Citeo's best practice catalogue
	Bonus for separable plastic packaging	
	12%	Bottles made of PET, HDPE or PP
	Bonus for rigid plastic packaging that can be fed into existing recycling channels	
	8%	Rigid packaging materials made of PET, HDPE or PP (excluding bottles)
Total bonus = awareness-raising bonus + reduction bonus = min. 0% to max. 24%		
PENALTY[83]		
Penalty for packaging with sorting instructions but no recycling channel		100%
Penalty for packaging containing mineral opacifiers		100%
Penalty for disruptive packaging (which impairs recyclability)		50%
Penalty for paper and cardboard printed with mineral oil-based inks		10%

Source: Own illustration by the Wuppertal Institute based on data from Citeo 2017.

[80] The bonus for information on the packaging is not cumulative.

[81] The bonus for action can be added to the bonus for information on the packaging; the maximum awareness-raising bonus is therefore 12 per cent.

[82] This bonus can only be claimed in the first year that the packaging is placed on the market.

[83] Packaging assigned a penalty is not eligible for any bonuses.

In this system, the licence fee can be reduced by up to 24 per cent if information relating to prevention opportunities is provided on the packaging itself or publicised by the company placing it on the market (e.g. in the form of TV advertising) or if specific individual points from design guidelines for the EPR system are taken into account. The latter includes, for example, a documented weight reduction compared with the original packaging solution.

In addition, it is suggested that waste prevention should also be more explicitly defined in Section 4 of the German Packaging Act under the general requirements for packaging. Paragraph 1 of this section states that "packaging volume and dimensions must be restricted to the minimum appropriate to ensure the necessary security and hygiene of the goods to be packaged and to ensure their acceptance by consumers". It would be helpful to specify here how said minimum volumes and dimensions can actually be determined. Similarly, the prevention of packaging waste could be added as a separate subject area under Section 22(9) of the Packaging Act, which concerns the obligations of system operators to finance the provision of waste advice by local authorities. To this end, it would be necessary to examine to what extent these aspects could be addressed on a mandatory basis at European level or even at national level.

Supporting pooling systems for outer packaging

In addition to product packaging made from plastics, transport packaging in particular has been a significant driver of the total waste volume in recent years, with waste from paper, cardboard and boxes in particular being generated alongside plastics (see Schüler 2017, p. 83). Discount goods are very commonly presented in open, half-size cartons, which are designed to fit on shelves (grouped packaging or secondary packaging). The typical feature of these cartons is that the goods only need to be rearranged on opening the full- or half-size carton within the outer box. The shelf-ready nature of the carton system necessitates smaller packaging units. The "discounterisation" of full-line retailers means that they too are generally moving in the same direction.

In addition to this grouped/secondary packaging, transport pallets are another possible focal point for the WPP, with the increasing diversity of product variants and logistical processes resulting in an increase in the proportion of disposable wooden pallets over the long term. Reusable pallets – perhaps made of recycled plastic – may be a possible alternative. These pallets are in circulation for much longer than wooden pallets and may therefore have a significant impact in terms of waste prevention. Various suppliers have established themselves on the market for this purpose, either offering pallets like these under leasing or rental models or providing web-based tracking for purchased pallets. The WPP could initiate a process in this area to persuade retailers and logistics companies to agree on a limited number of standard styles in order to make pooling solutions of this kind more attractive.

Supporting reuse and return systems

In a similar way to the retail sector, consumers must be made aware of the need to give preference to return systems and returnable packaging. From the perspective of waste prevention in particular, returnable packaging generally outperforms disposable packaging. Limitations are primarily associated with long transport distances as well as, for example, inefficient washing processes. In the case of beverages, for example, preference should be given to locally produced drinks in returnable bottles in order to reduce the environmental impact of transport (UBA 2018c).

One trend in recent years has been for some shops, including supermarkets, not to use retail packaging. Where this is the case, largely dry food supplied in bulk packaging is offered loose for measuring out. In these packaging-free supermarkets, many of the products are stored in large wall-mounted dispensers known as "bulk bins", so that customers can serve themselves. The

containers required for the dispensed products, such as reusable jars, canisters, bottles, boxes or storage tins, can be brought in by the consumers themselves or borrowed from the supermarket against a deposit. This way, customers can decide for themselves how much to dispense based on how much they need. The weight of the containers brought in by shoppers is deducted before filling (Flatley 2018).

On the one hand, the WPP could play a role in raising awareness of such waste prevention practices; and, on the other hand, it could also highlight the importance of the rate of reuse for beverage packaging as set out in the legislation from the perspective of waste prevention.

4.2.2 Food waste

4.2.2.1 Justification for relevance

According to the findings of a study carried out on behalf of the German Federal Ministry of Food and Agriculture (BMEL) and published in 2012, Germany produces approximately 11 million tonnes of food waste each year (Kranert et al 2012). However, these figures do not include losses attributable to agriculture. In the home, approximately 6.7 million tonnes or 82 kilos of food waste are generated per person per year, of which 4.35 million tonnes or 53 kilos are regarded as avoidable (47 per cent) or partially avoidable (18 per cent). Approximately 1.9 million tonnes per year arise as a result of consumption outside the home. At 1.9 million tonnes per year, this "out-of-home" consumption generates less food waste; however, Jepsen et al. observe that "the proportion of food losses per product used is considerably higher than in the case of in-home consumption" (Jepsen et al. 2016, p. 26) and that "the environmental impact per kilogram of food consumed [...] is significantly higher in the OOH sector" (Jepsen et al. 2016, p. 92). Moreover, it is easier to implement measures to reduce food losses here, which is why it is recommended that appropriate waste reduction action is taken in this area first and foremost. According to the calculations, approximately 550,000 tonnes are generated in the retail sector and approximately 1.85 million tonnes by industry. In the case of these statistics, it should be noted that a shortage of available data means that the calculated figures are often based on estimates and projections. A report commissioned by the WWF, which brings together data from various studies, puts the food losses along the entire value chain – including food losses in agricultural production – at over 18 million tonnes, of which almost 10 million tonnes are avoidable (WWF 2015, p. 9).
Food waste occurs for a variety of reasons. For example, the EU "FUSIONS" project identified a total of 105 causes, some of which feed into one another. Technological drivers (e.g. production techniques), institutional drivers (e.g. aspects of the taxation of food donations) and social drivers (e.g. purchasing behaviour) were identified at all levels of the value chain – from farms to private households (Canali et al. 2014).

In addition to the ethical and social dimensions, food losses have significant environmental impacts: "Per person per year, food losses – both avoidable and unavoidable – are the cause of almost half a tonne of greenhouse gas emissions in Germany, account for a good 500 square metres of agricultural land and consume around 2,700 litres of water. Extrapolated to Germany as a whole, this corresponds to an annual total of 38,340 kilotonnes of greenhouse gases, over 43,000 square metres of agricultural land and 216 million cubic metres of water" (Jepsen et al. 2016, p. 110). Reducing food waste also offers the potential of economic savings. For instance, the commodity value of avoidable and partially avoidable household food waste is around €234 per capita and year (Kranert et al. 2012, p. 125).

At international level, with the adoption of the Sustainable Development Goals (SDGs) in September 2015, the United Nations resolved to halve global per capita food waste at retail and

consumer level by 2030 and to reduce food losses along production and supply chains, including post-harvest losses (SDG 12.3) (United Nations n.d.). Directive 2018/851 of the European Parliament and of the Council amending the Waste Framework Directive (European Parliament and Council of the European Union 2018) requires member states to adopt waste prevention measures in order to achieve the United Nations goal. In addition, food donations and other forms of distributing food for human consumption are to be encouraged in preference to other forms of exploitation. The directive must be transposed into national law by the member states by July 2020. Germany's Federal Government is likewise committed to the United Nations' goal and has stressed the need for all stakeholders in the value chain to make a contribution (Deutscher Bundestag 2017, p. 2). The WPP also addresses the reduction of food waste and sets companies the following target:

> "With regard to preventing food waste, concerted actions and agreements between public institutions and industry/trade should be encouraged in order to reduce food waste generated along the production and supply chain. The aim is to reduce food waste by looking at the entire value chain – not just consumer behaviour – in order to reduce waste." (BMU 2013, p. 29)

With regard to the application of waste prevention measures to consumers, the WPP proposes the following approach:

> "Public education campaigns will be launched or continued as a key element of sensitising consumers to aspects of waste prevention. Campaigns focusing on low-waste purchasing habits (quantities, size of packaging, best-before/use-by dates, reusable packaging) will play an important role here." (BMU 2013, p. 30)

The Zu gut für die Tonne (Too good for the bin) programme run by the German Federal Ministry of Food and Agriculture (BMEL) is cited as a good example of this in relation to food waste.

More specifically, the WPP indicates the following measures for the reduction of food waste:

- Voluntary agreement with retail and gastronomy regarding training measures aimed at a more targeted supply of foodstuffs to shops and restaurants
- Waste prevention agreements between industry/commerce and government agencies
- Concerted action to prevent food waste.

In addition, the German Federal Government is providing parallel support for the implementation of the WPP by reinforcing public education and consultation activities aimed at preventing food waste (BMU 2013, p. 34). Furthermore, plans are outlined for the German Federal Ministry of Food and Agriculture (BMEL) to comprehensively communicate and advertise existing and planned public education and consultation activities concerning the prevention of food waste (BMU 2013, p. 35).

4.2.2.2 Practical courses of action

The importance of decreasing food waste has already been recognised as a relevant issue by many stakeholders and is evident in numerous strategies. However, further efforts are needed if these concepts are to be put into practice on a large scale and if real success with the prevention initiatives is to be achieved.

Collect data on food waste and losses according to EU methodology

A reliable data set concerning the volumes of food waste and food losses is needed in order to assess the successful outcomes of prevention measures and identify the points where

prevention measures are most effective. In Germany, food waste data has not been collected comprehensively to date and has instead only been recorded sporadically on a project-by-project basis. Even in these cases, the available data set is often unreliable, since calculations frequently have to be based on estimates due to a lack of data. A methodology for collecting food waste data is currently being developed by the European Commission in cooperation with the members of the EU Platform on Food Losses and Food Waste. This would allow for consistent and comparable quantification of figures at EU level. According to the current timetable, January 2020 is the start of the first reporting period (Zambrzycki 2017, European Parliament and Council of the European Union 2018).

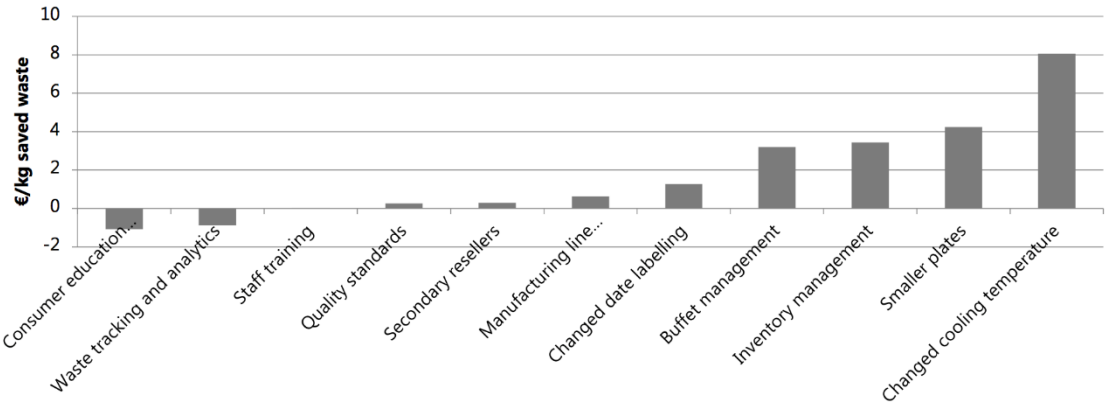
Set up a coordination unit and sectorial working groups responsible for monitoring

For comprehensive data collection to take place, it is important that a corresponding coordination unit be set up to oversee monitoring. In Flanders, where extensive monitoring (Flemish Food Supply Chain Platform for Food Loss 2017) has already been carried out, an action plan (Government of Flanders 2014) has been agreed between public and private stakeholders that also includes measures by the individual stakeholders to collect data on the volume of food waste. The action plan contains measures to be undertaken by various ministries. In Flanders, implementation of the measures is coordinated by the Ministry of the Environment and monitoring is carried out by the Ministry of Agriculture. The various working groups, which include representatives from the various stakeholder groups, meet four times a year to discuss the results of the measures, the monitoring processes and any further coordination steps.

Communicate the economic added value of reducing food waste to stakeholders

One approach to reducing food waste is to communicate to stakeholders in practical terms how taking action will benefit them. Various studies have calculated impressive aggregated cost-saving opportunities, but individual stakeholders often do not see food waste prevention as a worthwhile investment. Identifying and communicating the economic added value of measures to reduce food waste in a way that is tailored to specific stakeholders can help to motivate them to take action. One promising approach to this was presented, for example, within the framework of the EU Platform on Food Losses and Food Waste. Preliminary findings with regard to the costs saved per kilogram of food waste (fruit and vegetables) avoided through a range of measures have been reported (Figure 26).

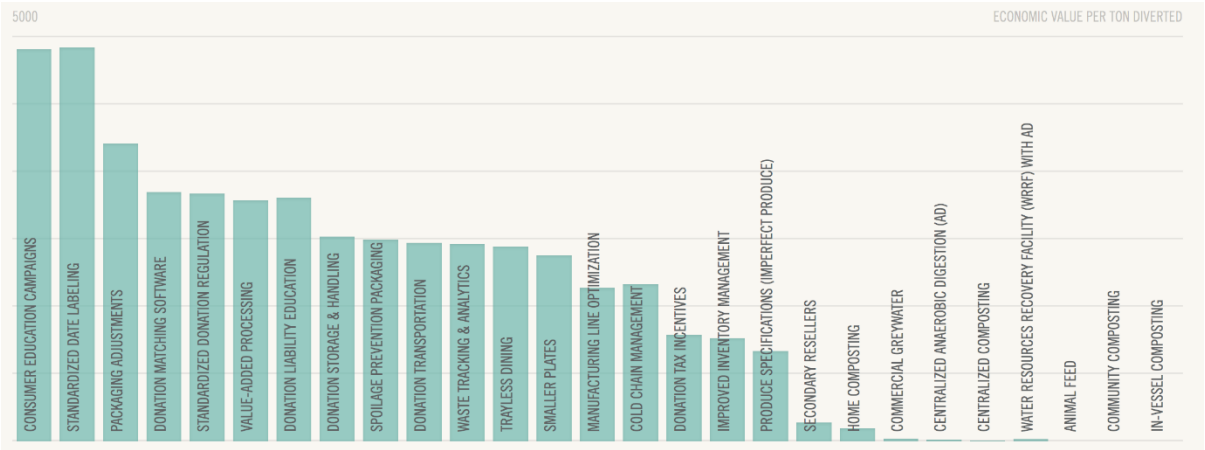
Figure 26: Cost-savings from preventing fruit and vegetable waste by measure (preliminary results)



Source: Jensen & Teube (2017), slide 14.

A similar approach is taken by ReFED, an association of companies, non-profit organisations, foundations and government officials working to reduce food waste in the United States. ReFED has produced the following data set, outlining the financial benefits to society (consumers, businesses, governments and other stakeholders) of solutions aimed at reducing food waste, less all investment and costs per ton of food waste (Figure 27).

Figure 27: Financial benefits of waste prevention measures



Source: ReFED (2018).

Improve consumer education and incorporate it into existing structures; integrate psychological research into research on food waste prevention

At consumer level, improving education is considered a relevant task in order to provide consumers with knowledge about the shelf life, appearance and use of food, amongst other aspects, thereby enabling them to make informed decisions. In this context, a move away from campaigns and towards incorporating education on food and food waste into existing structures is advised (Wilts et al. 2018, p. 20). A greater incorporation of psychological research has also been recommended in order to better understand the motives and behavioural patterns of consumers and stakeholders. Although existing efforts to promote the prevention of food waste have often not led to the expected outcomes, surveys indicate a high level of awareness of the issue's relevance (BMUB & UBA 2017, pp. 58–59). However, this clearly only results in actual changes in behaviour in some areas and thus does not lead to the envisaged reduction. Above all,

a better understanding is needed of the specific areas where consumers are able and willing to accept information – and in which form.

Statutory provisions and voluntary agreements for food retailers and the food industry

Another way of influencing the disposal of foodstuffs that are fit for human consumption is to lay down specific rules. Legislation with respect to the retail trade already exists in France, Italy and Finland, for example. These regulations require retailers as well as out-of-home caterers and large-scale consumers such as restaurants, hospitals and cafes to draw up contracts with organisations in the social sector to take delivery of residual stocks of food. For such an approach to be successful, one of the important considerations is that it be closely coordinated with the social enterprises for which the donations are intended, as such measures can entail considerable additional logistical and personnel costs for them. An alternative concept has been adopted in the United Kingdom, where stakeholders in the food industry have made a voluntary commitment aimed at reducing the quantities of food packaging and household waste. A collective commitment of this kind, which is shouldered by significant elements of the retail trade, allows for the introduction of more far-reaching measures that would otherwise scarcely be possible in a competitive environment – such as refraining from putting out new fresh produce in the last half hour of trading, the majority of which would then be wasted.

Digitalisation (e.g. dynamic shelf life) and improved transparency in the value chain by optimising the collection, exchange and processing of data

Digital solutions that can contribute to the avoidance of food waste represent another area where action can be taken, with one example being sensor-based concepts that support a dynamic shelf life and could thus replace static shelf-life information. Various research projects have investigated the possibilities of technology including RFID chips and temperature sensors (see, for example, Malmö University n.d.). However, little research has been done in the field of digital solutions that test and evaluate the collection, exchange and processing of data with the participation of multiple stakeholders in the upstream and downstream stages of a value chain. Up to now, such projects have only focused on individual stages of the value chain, meaning that the transferability of the data has not been tested, which leads to the failure of corresponding approaches at the various interfaces. Since the value chain for food products is frequently long and often involves partners from various countries, a European dimension must also be taken into account here.

Successful examples

A range of strategies, measures and instruments seeking to contribute towards the prevention of food waste have already been identified, developed and – in some cases – implemented both inside and outside Germany. In France, for example, a law was passed in February 2016 that has made it mandatory for supermarkets with a retail space of 400 square metres and above to donate unsaleable, but still edible, foodstuffs to social enterprises or, alternatively, to use it as animal feed or compost.[84] They are thus required to enter into agreements with charitable institutions and can be fined for non-compliance with the legislation. In Italy, a law was adopted in August 2016 to regulate how surplus products, including food, are given and distributed to charities.[85] There is no threat of sanctions in the Italian legislation – companies obtain tax breaks for making donations and the process has also been simplified.

One example of a voluntary agreement in the food sector is the United Kingdom's Courtauld Commitment (WRAP 2018). Launched in 2005, the Courtauld Commitment is now in its fourth

[84] Law no. 2016-138 of 11 February 2016 relating to the fight against food waste.

[85] National law no. 166 dated 19 August 2016.

phase. The objective of this voluntary agreement is to support the UK's political goals with regard to waste prevention, climate protection and lowering greenhouse gas emissions by improving resource efficiency and cutting waste levels in the British grocery sector. It is financed by the British, Scottish, Welsh and Northern Irish governments, and the Waste and Resources Action Programme (WRAP) is responsible for its implementation. WRAP works in partnership with leading grocery retailers, brand owners, manufacturers and suppliers who sign up to the agreement's targets and support their delivery. In order to achieve the agreed objectives, WRAP provides the signatories with evidence-based research, guidelines, tools, case studies and expert guidance and support. It also organises forums, workshops and meetings to encourage the take-up of best practice throughout the food sector.

To raise consumer awareness of the fact that products can often still be safely consumed beyond their best-before dates, the Norwegian Q dairy business has chosen to label its products with the words "Best before, but not bad after". Other companies, including TINE, Norway's largest producer, distributor and exporter of dairy products, have also embraced the idea (Aftenposten 2018).

In Germany, the information campaign Zu gut für die Tonne (Too good for the bin) (BMEL 2018) informs consumers as well as businesses, local authorities, influencers and teachers about food waste. The campaign brings together various pieces of information and activities, such as the Restlos genießen (Enjoying every little bit) initiative, which aims to use Beste-Reste (Best of the leftovers) boxes to encourage restaurateurs and diners to take uneaten food home. Each year since 2016, the BMEL has celebrated new initiatives and companies that are taking action to reduce food waste by awarding the Bundespreis für Engagement gegen Lebensmittelverschwendung. Germany's governing coalition intends to further develop the Zu gut für die Tonne initiative into a national strategy with the cooperation of the individual federal states (CDU/CSU/SPD 2018). An Internet platform (BMEL 2017) operated by the BMEL pools together information about tools, activities and best practice examples for the purpose of cutting down on food waste. With the implementation of the WPP in mind, the German Federal Environment Agency (UBA) and German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) spoke to experts and representatives of various interest groups about four areas of action in the field of waste prevention between 2014 and 2017. The discussions relating to the prevention of food waste (UBA n.d. b) focused on avoidance measures for out-of-home consumption and the links between food hygiene and waste prevention. In September 2017, the UBA's expert forum, Effectively Reducing Food Waste – Achieving more together, brought together stakeholders from the agricultural sector, retail, initiatives, start-ups and the world of politics to debate potential shared solutions in five core topic areas (Wilts et al. 2018). Practical guidelines for the catering sector, published by the UBA in collaboration with Germany's hotel and restaurant association, DEHOGA, show how food and catering waste can be reduced by planning carefully and taking all the process steps into consideration when it comes to catering an event (UBA 2016a). At the level of Germany's individual federal states, a discussion group consisting of stakeholders from the food sector and initiated in North Rhine-Westphalia by the NRW Ministry of Consumer Protection has, for example, been in existence since 2010 to promote networking and projects focused on the subject of food waste (MULNV NRW n.d.). Similar groups have been established in Hamburg and Saarland since 2015 and 2017 respectively. In 2015, an alliance of stakeholders from the food value chain by the name of Wir retten Lebensmittel! (We're saving food!) was launched in Bavaria (StMELF Bayern n.d.).

With the goal of networking and promoting potential solutions for out-of-home consumption, stakeholders from the food industry have joined forces to form an association called United

Against Waste (United Against Waste n.d.). Action taken by retailers includes the Naturgut Bio-Helden (Naturally good organic heroes) campaign by the PENNY supermarket group, which saw it begin offering fruit and vegetables with external blemishes as part of its own-brand organic range Naturgut across Germany in April 2016 (PENNY 2016). Similar initiatives have been introduced by the supermarket Aldi Süd (Krumme Dinger (Wonky items)) (Aldi Süd n.d.) and by smaller food businesses like Etepetete (Etepetete n.d.) and Querfeld (Querfeld 2018), which sell or process fruit and vegetables that have been separated from the main harvest because they do not conform to the aesthetic expectations of the retail trade. Charitable organisations like Tafel food banks collect food items that are perfect in terms of quality but would otherwise be binned and distribute them to socially and economically disadvantaged people (Tafel Deutschland e. V. n.d.). Apps like Too Good To Go (Too Good To Go n.d.) and ResQ (Resq Club 2018) seek to save leftover dishes from restaurants from being thrown away. Food can also be made available via the online Foodsharing portal (Food Sharing n.d.) instead of being disposed of.

4.2.3 Waste electrical and electronic equipment

4.2.3.1 Justification for relevance

The amount of waste electrical and electronic equipment (WEEE) collected in Germany in 2016 amounted to 782,214 tonnes, of which 711,005 tonnes came from private households (UBA 2018a). Waste electrical and electronic equipment is a challenge, especially from the point of view of qualitative waste prevention and in view of the resources used in its production:

> "WEEE is a complex mixture of materials and components that because of their hazardous content, and if not properly managed, can cause major environmental and health problems. Moreover, the production of modern electronics requires the use of scarce and expensive resources (e.g. around 10% of total gold worldwide is used for their production). To improve the environmental management of WEEE and to contribute to a circular economy and enhance resource efficiency the improvement of collection, treatment and recycling of electronics at the end of their life is essential." (European Commission 2018b)

Electrical and electronic equipment is a highly diverse and very dynamic product group characterised by ever shorter useful lives. Investigations carried out on behalf of the German Federal Environment Agency (UBA) (Prakash et al. 2016, p. 24) showed that the average first useful service life (i.e. the period in which the item is used by the first user only) of large household appliances in Germany declined slightly between 2004 and 2012/2013, from 14.1 to 13.0 years. The average first useful service life of appliances that were replaced due to a defect fell by one year between 2004 and 2012/2013 to 12.5 years. A particularly critical view was taken of the fact that the proportion of large household appliances that were replaced within less than five years due to a defect rose from 3.5 per cent to 8.3 per cent of total replacements between 2004 and 2012. Further analyses of lifetime and service life trends for a total of 13 product groups in the field of electrical and electronic equipment have confirmed that the first useful service life of a number of the product groups examined has decreased in recent years (in addition to large household appliances, e.g. televisions or washing machines, dishwashers, refrigerators) (see UBA 2017d, p. 7).

Against this background, particular focal points for waste prevention with regard to waste electrical and electronic equipment are aspects of functional and psychological obsolescence – on the one hand, the extension of the technical lifetime and, on the other hand, the apparent tendency of consumers to make new purchases even though existing products are still functional, thus triggering high levels of resource consumption (Prakash et al. 2016, p. 22).

4.2.3.2 Practical courses of action

Proof/guarantee from the manufacturer of technical lifetime and availability of spare parts

In its strategy for a European circular economy, the European Commission drew attention to the importance of informed consumer decisions when it comes to waste prevention: "The choices made by millions of consumers can support or hamper the circular economy. These choices are shaped by the information to which consumers have access [...]. This phase is also crucial for preventing and reducing the generation of household waste." (European Commission 2015, p. 7). A key initial step could be to require that the manufacturer provide proof of a product's technical lifetime.

The UBA itself has pointed to the fact that consumers are not generally aware of this information: "the lack of transparency results in consumers not being able to make the best purchasing decisions to suit their own needs (asymmetric information). Therefore, measures to improve consumer information are important instruments that allow consumers to make purchasing decisions in favour of long-lived products." (UBA 2017d, p. 12)

The WPP should therefore assess for which product groups or product components verifiable data on the technical service life can be collected and communicated without requiring unreasonable effort. The Ecodesign Directive could be a suitable place to start. The European Commission has been called upon to consider extending the energy efficiency labelling scheme for household appliances and other energy-related products to include providing consumer information about the environmental performance of energy-related products on the products themselves, including their durability (European Parliament and Council of the European Union 2017).

A much stronger regulatory approach would be to introduce a "manufacturer's duty to issue a guarantee statement" (*Herstellergarantieaussagepflicht*) in order to counter a possibly artificially induced, premature end to the lifetime of a product (Schlacke et al. 2015, UBA 2017d, p. 13). This measure would involve making it mandatory for manufacturers to make statements about the guaranteed lifetime of their products (when applied or used correctly). Although there would be an option to indicate a "zero" time period and therefore to offer no guarantee, the manufacturer would still be under obligation to provide this information and this may be associated with a negative public perception. In the case of a period of time that is longer than the legal warranty period, the manufacturer would be liable to provide a material guarantee. If a product should fail to reach its stated lifetime, the buyer would be entitled to make a claim under the guarantee, such as a refund of the purchase price, a replacement or a repair. The minimum standards for the nature or design would need to be set out in law, but the instrument itself has been conceived to be flexible. As such, manufacturers would be free to decide on the exact details of the guarantee rather than following an obligatory format. The instrument has thus been designed to provide consumers with a better basis on which to make decisions and would enable them to make claims directly against the manufacturer, thereby holding it directly liable as the organisation responsible for the product's characteristics and reducing the information asymmetry between producer and consumer with regard to the product lifetime. Of course, it should be noted that consumers are also expected to use the product for its intended purpose.

In recent years, France in particular has emerged as a pioneer in the fight against planned obsolescence and, in addition to other actions, has passed a law stipulating that cases of fraud where a "product is deliberately built in such a way that its lifetime is artificially shortened with the aim of generating new sales" are punishable by a sentence of up to two years in prison and a €300,000 fine. France is thus the first country to have developed a law explicitly relating to

obsolescence: “Planned obsolescence is defined as the set of techniques by which the party responsible for placing a product on the market deliberately aims to shorten the lifetime of said product in order to increase its rate of replacement” (Article L. 213-4-1 of the French Consumer Code, own translation). In summary, the following obligations have been laid down for sellers:

1. Those placing products on the market must provide consumers with information about spare parts if they have received this information from the manufacturer or importer of a product.
2. The information should cover the period during which the spare parts will be available.
3. This information must be brought to consumers’ attention in a visible and legible form before the sale is concluded.
4. Only those spare parts that are essential to the functioning of the product are affected.

French companies must also tell consumers how long spare parts will be available for the product, otherwise they risk a fine of up to €15,000. On top of that, it has been the law since 2016 that defective products must be repaired or replaced free of charge within two years of being purchased (Khaleeli 2015).

French environmental protection organisation France Nature Environnement sees the new law as a “strong political signal to manufacturers, retailers and citizens” (N-TV 2015). However, the organisation concedes that successfully taking a manufacturer to court for built-in wear and tear is likely to be difficult, because the complainant must first show that the service life of the product has been deliberately shortened – standardised definitions of service life would be an important tool in this respect.

Supporting free software and hardware solutions

The speed at which software on electronic devices becomes outdated is increasingly seen as a relevant cause of electronic devices having limited useful lives, which leads to functional obsolescence. Open-source operating systems could close this (software) gap, since a multitude of derivatives are available that can also be run on less powerful and older devices and offer all the usual functions. However, the effort involved is often prohibitive, since in most cases manufacturers are unwilling to release the hardware specifications, even for older devices. Furthermore, software solutions of this kind, which extend the useful life of a device, cannot generally be marketed by commercial businesses, as they are in a legal grey area with respect to existing copyright law (Prakash et al. 2016, p. 274).

One approach to waste prevention could therefore be to promote open-source concepts that facilitate the creation of software solutions tailored to devices or the open-source development of entire products (open-source hardware). One particularly promising application of the open-source concept from a resource perspective lies in combining it with the technical possibilities of three-dimensional printing. 3D printers build three-dimensional components layer by layer. Construction, which is controlled by a computer, makes use of one or more liquid or solid materials, depending on predefined dimensions and shapes (CAD: computer-aided design). Physical or chemical hardening or melting processes take place during fabrication. Typical materials used in 3D printing are plastics, synthetic resins, ceramics and metals. 3D printers are used in the industrial sector and by researchers. There are also home, entertainment and artistic applications. Although the recent hype about 3D printing has been particularly focused on applications in private and non-professional contexts, much greater relevance from a resource perspective is potentially associated with those professional devices that are used in industrial settings, for example in the context of rapid prototyping or rapid manufacturing processes, where optical technologies are harnessed to melt costly pre-produced raw materials using

techniques including selective laser sintering, stereolithography or electronic beam melting (Petschow 2014).

This process could be helpful when used in combination with open-source concepts, especially with regard to the production of replacement parts, contributing towards extending the useful life of products. These self-produced replacement parts can be particularly important when original spares are no longer available on the market or only at prohibitively high prices. Where this has been the case in the past, products have had to be disposed of, but in future, a replacement part could be produced with the help of a 3D printer, allowing the whole product to remain in use. In order for the production of spare parts using 3D printers to actually play a role in protecting the environment, however, there are a number of questions and factors that must be considered and clarified. These include issues concerning liability and copyright as well as questions relating to the disposal phase, such as the regulation of producer responsibility in terms of waste management with regard to the individually manufactured components and their proper disposal (Keppner et al, pp. 32, 42–43, 50). Appropriate pilot projects could be initiated within the WPP that should also take into account the demand for 3D-printing materials.

Obligation for public bodies responsible for waste management to provide evidence of cooperation with their own or external reuse facilities

A core waste prevention strategy in the field of electrical devices is to support the prolongation of their useful life by facilitating their preparation for reuse. However, accessing suitable waste equipment has proven to be a key challenge for many stakeholders. On this point, Article 6 paragraph 2 of the Directive 2012/19/EU on WEEE (European Parliament and Council of the European Union 2012) states: "In order to maximise preparing for reuse, Member States shall promote that, prior to any further transfer, collection schemes or facilities provide, where appropriate, for the separation at the collection points of WEEE that is to be prepared for re-use from other separately collected WEEE, in particular by granting access for personnel from re-use centres." In practice, however, it has been shown that the vast majority of reuse organisations have no access to waste equipment of this kind that has been disposed of by members of the public. To gain access to high-quality waste equipment to prepare it for reuse, these organisations must sign contracts with local authorities or other competent collection points. This step in itself can be rather a challenge, especially for small organisations, as it requires them to approach and persuade local decision makers to change their processes at the collection points and generally make additional space available for this purpose. On the other hand, it is also important to ensure that only reputable organisations obtain access to materials in order to prepare them for reuse, as a strong informal market is also active in this area throughout Europe. From a legal point of view, all operators of primary treatment facilities, including participating public bodies responsible for waste management, are obliged to check all waste equipment for its potential suitability to be prepared for reuse. However, this would first of all require collection to be carried out appropriately at recycling centres and the installation of containers specifically intended for equipment that members of the public believe is still functional.

In view of the fact that many of these public bodies responsible for waste management in particular have neither the staff capacity nor the technical expertise to assess the potential suitability of an item to be prepared for reuse, the WPP could call for an investigation into whether each public body responsible for waste management could, in future, be required – within the framework of its self-governing local administration – to provide evidence that it has an agreement in place with a suitable stakeholder that is active in preparing WEEE for reuse. The content of such an agreement can be left to the local stakeholders and adapted to the particular circumstances; nevertheless, making these arrangements would put the issue on the

agenda for all stakeholders involved. At national level, however, the regulations that require certification as a primary treatment facility in order to treat WEEE in terms of preparing it for reuse must remain standardised or be designed in a standard format (Fabian 2015) – and there is still a considerable need for further training here in the case of numerous stakeholders operating in the field of (preparing equipment for) reuse.

Flanders may be cited as a best practice example when it comes to regulating access to WEEE that is potentially suitable to be prepared for reuse. Here, a cooperative arrangement between reuse centres and take-back systems for waste equipment has been successfully agreed, with both sides emphasising the benefits of working together. In Flanders, members of the regional reuse network Komosie now have better access to high-quality waste products, which, having achieved end-of-waste status, can be resold in their shops, while the take-back system reduces treatment costs.

4.2.4 Construction and demolition waste

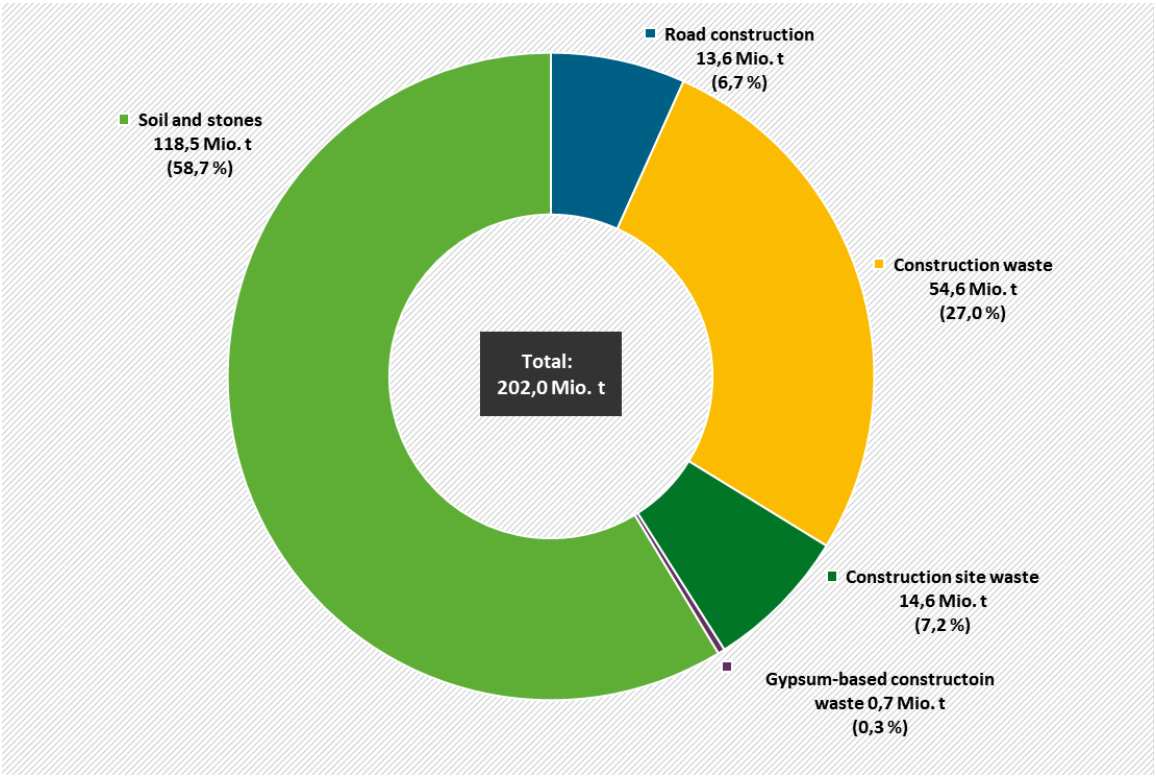
4.2.4.1 Justification for relevance

By reason of the sheer quantities involved, reducing construction and demolition waste is an important factor when it comes to reducing the consumption of resources and achieving European and national waste reduction targets. However, the measures taken in this area are clearly focused on recycling. The EU Waste Framework Directive and the German Circular Economy Act (KrWG), for example, stipulate that at least 70 per cent by weight of non-hazardous construction and demolition waste must be prepared for reuse, recycled or exploited in other forms of material recovery by 2020. The purpose of the so-called Umbrella Ordinance (MantelV), which is currently being drafted, is to introduce uniform regulation of the way mineral substitute building materials are used throughout Germany. The amended Commercial Waste Ordinance (GewAbfV), which came into force on 1 August 2017, makes it obligatory for waste producers to step up their separation of waste and to improve their recording. In addition to commercial municipal waste, the ordinance also covers certain types of construction and demolition waste. It requires producers and owners of construction and demolition waste to collect glass, plastics, metals, wood, insulation material, bitumen mixtures, gypsum-based construction materials, concrete, bricks, and tiles and ceramics separately and, in accordance with the provisions of the Circular Economy Act (KrWG), to prioritise their preparation for reuse or recycling. Exceptions may be made for various reasons, including when it is not technically possible or not economically reasonable to separate the collection of an individual waste type. In any case, fulfilment or non-fulfilment must be documented.

Construction and demolition waste is generated in particular in the course of refurbishment, renovation, new construction and conversion projects, the demolition of buildings and roadworks. In Germany, this waste amounted to an overall volume of 209 million tonnes in 2015 (Statistisches Bundesamt 2017). This means that construction and demolition waste accounts for about half (52 per cent) of the total volume of waste and thus offers considerable potential for waste prevention as well as for recycling and reuse. On the one hand, making use of this waste can conserve natural resources and provide opportunities to halt further cost increases in the construction sector or to reduce costs, which is essential when it comes to the supply of affordable housing. On the other hand, preventing this waste from being disposed of means averting a further shortage of landfill capacity. In quantitative terms, the main waste streams in this sector are soil and stones followed by demolition waste. Of the 202 million tonnes of mineral construction waste generated in 2014, 118.5 million tonnes (58.7 per cent) comprised soil and stones, 54.6 million tonnes (27 per cent) demolition waste, 13.6 million tonnes (6.8 per

cent) waste from road construction, 14.6 million tonnes (7.2 per cent) building-site waste and 0.7 million tonnes (0.3 per cent) gypsum-based construction waste (see Figure 28 below).

Figure 28: Statistics on quantities of mineral construction waste in 2014



Source: UBA 2017c.

In the soil and stones category, 75.5 per cent of the waste was used in surface-mining operations and recovered through other measures, mainly landfill construction. Recycled building materials were produced from 10.2 per cent of this waste and 4.3 per cent was disposed of in landfill sites. In the demolition waste category, 77.8 per cent was recycled, 16.0 per cent was reused to backfill excavations and at landfill sites and 6.2 per cent was sent to landfill. In the road construction waste category, 93.7 per cent was recycled, 4.1 per cent was recovered for use in landfill construction and to backfill excavation sites and 2.2 per cent was landfilled. In the gypsum-based construction waste category, 5.4 per cent was recycled, 35.6 per cent was reused in landfill construction and in mining contexts and 59.0 per cent was sent to landfill. The approximate breakdown of building-site waste was 50 per cent iron and steel, 20 per cent waste wood and 5 per cent glass, plastic, metal and insulation material. Mineral elements are particularly found in the mixed construction and demolition waste category, which accounts for about 25 per cent of building-site waste. In the building-site waste category, 1.4 per cent was recycled, 96.9 per cent was recovered through other means and 1.7 per cent was disposed of in landfill sites (Kreislaufwirtschaft Bau 2017, p. 6–11).

In 2014, the recovery rate for mineral construction waste was 89.5 per cent (Bundesverband Baustoffe 2017). Although this rate is high, the waste often does not undergo high-quality recovery, where the further use is in keeping with the original function of the material and the recycled materials serve as a substitute for primary raw materials. For example, mineral construction and demolition waste is used in road construction, but often not in the base courses of roads and pavements, but rather in areas close to the ground where lower-quality materials

are required (UBA 2016c). Using it to backfill mines and quarries does not constitute high-quality recovery either (Klöckner & Heuser 2018, p. 485).

As in other areas, prevention is clearly identified as the top priority for all planning measures when it comes to construction and demolition waste:

- "The generation of such waste should be avoided as far as possible, for example by preserving existing building stock and designing structures for a long service life.
- Unavoidable waste should be retained in the economic cycle, such as by constructing buildings, operating building sites and demolishing structures with a view to recycling.
- The disposal of construction and demolition waste should be limited to what is unavoidably necessary and should be carried out in an environmentally responsible manner." (UBA 2017a)

4.2.4.2 Practical courses of action

Establishment of material passports for buildings

One approach that may help to prevent waste in the construction sector would be to require the provision of material passports for buildings according to uniform standards. The recovery of raw materials is becoming increasingly important in terms of conserving resources and meeting the growing demand for building materials. However, it is often difficult to determine what materials have been used in construction at a later date. A material passport that documents the materials used as well as changes to a building's structure can therefore provide valuable information when it comes to its dismantling and subsequent recycling. Furthermore, knowledge about material usage can help to determine the material footprint, which can be used to carry out the ecological assessment of buildings (see UBA 2017f, pp. 56–57).

The primary objective of the material passports concept is to recover the greatest possible volume of the raw materials held within buildings. However, it has been shown that the system can be used to optimise the way buildings are maintained, thus also helping to make significant contributions towards waste prevention. Various ongoing research projects also aim to extend the use of material passports from the level of individual buildings to district level in order to generate further synergy potential.

Promotion of building components exchanges

In order to ensure that usable building components recovered as part of a demolition or conversion project can be reused, warehouses and exchanges are needed that will store these materials and market them to subsequent users. At present, there are not enough of these sites in Germany, nor are they available nationwide. It is therefore recommended that the level of need be determined and that the exchanges be given financial and institutional support (UBA 2015b, p. 183). The bauteilnetz Deutschland (building component network for Germany) is a nationwide collaborative project, which – alongside other activities – provides advice on setting up building components exchanges (bauteilnetz Deutschland n.d.). So that the building components can be obtained as needed and, as far as possible, without long storage times and circuitous transport routes, it makes sense for the objects to be listed on an Internet platform when the deconstruction of the building is in an early stage (UBA 2015b, p. 183). Used concrete elements, such as structural slabs, load-bearing interior wall elements and exterior wall panels that have been insulated with mineral wool products can also find a new use, although this form of repurposing has so far not been very common in Germany (DBU & VDI ZRE 2013, pp. 22–23). Because of the logistical challenges involved, it is particularly important that the availability of

these kinds of components is announced as soon as possible if the reuse of the materials is to be financially worthwhile.

Awards highlighting leading examples of the preservation of old building stock

Competitions and awards recognising leading examples of the preservation of old building stock can raise awareness of the importance of preventing the construction and demolition waste that results from the demolition of buildings. Presenting prizes to successful construction projects can thus also support the dissemination of good practice examples. In this context, it is sensible that there should be cooperation with the regional Chambers of Architects.

Successful examples

One example of a system that serves, amongst other things, to identify waste and separate it at source is the Dutch certification programme for demolition processes (BRL SVMS-007) (Stichting Veilig en Milieukundig Slopen 2012). The programme is a voluntary instrument designed to ensure high-quality, safe and environmentally responsible demolition practices. The procedure includes a preliminary inspection, during which the demolition contractor draws up an inventory of materials, including their quantity, nature and any impurities. A waste management plan then sets out the demolition, processing and disposal methods that will be used. Experts in environmentally friendly demolition methods are involved in the execution of the demolition. Lastly, the demolition company produces a final report on the demolition materials that have been released. (European Commission 2016, p. 41).
Carrying out an audit prior to a conversion or demolition project can support the reuse or recycling of suitable materials and increase the quality and quantity of recycled products. Local markets for construction and demolition waste and for recycled materials, including the available capacity of recycling facilities, should be considered. It is recommended that the process be overseen by a local authority or an independent third party (European Commission 2016, pp. 10–12).

The German city of Bremen's building components exchange, Bauteilbörse Bremen (Bauteilbörse Bremen n.d.), established in 2002, is one platform that facilitates the reuse of building components. It aims to act as a broker for used – and still usable – building components obtained through the demolition or conversion of buildings. The exchange is targeted at private individuals, craft businesses, demolition companies, construction firms, planning offices and public authorities. With its concept, the Bauteilbörse wants to play a role in preventing waste, protecting resources and saving energy. One of the advantages for users of the exchange is that they are able to save on disposal costs or, alternatively, purchase inexpensive materials and, in some cases, components that are scarce and difficult to obtain.

Several of Germany's federal states – including Bavaria (StMUV 2017), North Rhine-Westphalia (Vero et al. 2015) and Baden-Württemberg (UM 2013) – have published guidance documents to promote the use of reclaimed building materials, which are intended to serve as a reference for builders in the private and public sector. Although recycled building materials are already used in many cases, and are often comparable to primary raw materials in terms of quality, some reservations and uncertainties regarding their usability and legal constraints remain, with primary raw materials often still being used instead as a result. In this regard, it would be an important step for the public sector to play a pioneering role here in order to raise the level of acceptance and generate the sales volume that is required for recycled building materials to be made available on a profitable basis. The guidance documents provide technical background knowledge, legal information, recommendations for public procurement procedures and real-world examples where recycled construction materials are already in use. In 2012, the Kreislaufwirtschaft auf dem Bau (Circular economy in construction) alliance was formed in

Rhineland-Palatinate, having been initiated by the federal state's then Ministry of Economic Affairs, Climate Protection, Energy and Regional Planning (Landesamt für Umwelt Rheinland-Pfalz n.d.). In addition to several state ministries, the alliance includes the state associations of municipal umbrella organisations, the Chamber of Architects, the Chamber of Engineers and various associations representing the construction industry in Rhineland-Palatinate (Landesverband Bauindustrie, Baugewerbeverband, Industrieverband Steine und Erden, Baustoffüberwachungsverein). They have jointly signed an agreement in which they have pledged to promote or campaign in favour of the following:

- To carry out demolition and dismantling measures as selectively as possible in order to ensure that the resulting materials can be recycled in high-quality processes.
- To invite tenders for construction measures in a product-neutral way so that suitable, quality-assured recycled building materials are not excluded.
- To consider the use of quality-assured recycled building materials from the planning phase of any construction measures.

4.3 Priority concepts for waste prevention

As well as focusing on priority waste streams, the authors of this report recommend that, when the WPP is revised, further waste prevention concepts should be specifically supported, which, as cross-sectoral issues, could contribute to the prevention of various waste streams.

Using the analysis of the current level of implementation in Chapter 2 and the research into the format of the waste prevention programmes in other EU member states as a basis, the following topics have been identified where the public sector could have particularly effective leverage at its disposal with regard to waste prevention:

- Public procurement
- Repair and preparation for reuse
- Supporting product-service systems

This chapter outlines practical measures for these areas that could be addressed within the framework of the WPP. In view of the general applicability of these actions, connections to existing or planned initiatives, programmes and so on are highlighted where these could offer synergies for the purpose of waste prevention. In a similar fashion to the waste-specific measures, successful examples from European and international contexts are also presented, which may provide pointers with regard to implementation in Germany.

4.3.1 Public procurement as a driver of waste prevention

A market-based approach to supporting waste prevention, which has been repeatedly mentioned both at national and international level, is public procurement. The aim of this is to integrate waste prevention criteria into public procurement guidelines and thereby both support low-waste alternatives that are already available on the market – such as in the form of more durable products – and, in view of the financial dimensions of public procurement, create dynamic incentives for the development of such products.

Often, eco-friendly procurement has other positive (side) effects:

> "If the life-cycle costs of the service put out to tender are taken into account in procurement, not only does environmental friendliness improve but the cost

> effectiveness of procurement decisions improves as well. [...] And last but not least, by adopting green procurement practices, the public sector also sets a good example for private companies and members of the public." (Hermann 2017)

The public sector across Germany alone buys products and services worth around €300 billion (BMU 2018).

As part of its strategy for a circular economy (European Commission 2015), the European Commission was keen to stress the role of public procurement in supporting the development of a circular economy, making explicit mention of waste prevention aspects. At national level, too, Germany's Resource Efficiency Programme, for example, emphasises the part to be played by public procurement as an important source of leverage when it comes to supporting resource-efficient product alternatives, which often also help to prevent waste: "Because of the large quantities purchased, the public sector can deliberately support the market launch and diffusion of environment-friendly products, most of all when it comes to standard products such as office equipment (furniture, monitors, computers, etc.)." (BMUB 2016a, p. 55).

Since Germany's procurement legislation was reformed in 2016, sustainability considerations can now be taken into account to a greater degree when awarding public contracts. The German Federal Government has already set its own procurement targets in a number of selected product groups as part of its Sustainability Action Programme and through its General Administrative Rules on the Procurement of Energy-Efficient Products and Services (AVV-EnEff) alongside other measures. In Section 45 paragraph 1, the German Circular Economy Act (KrWG) itself also lays down waste prevention requirements for all departments acting at national level; similar regulations can be found in most federal states.

Nevertheless, analysis of the current level of implementation of the WPP shows that public procurement is still far from exploiting all of the areas of potential for waste prevention. In view of the diverse requirements that public procurement professionals are expected to satisfy (ranging from climate protection considerations, which are already more firmly established, to questions of minimum social standards along the value chain), waste prevention is proving to be an issue that is often only looked at briefly, if at all. Some of the specific obstacles identified here include:

- Additional effort in connection with procurement activities
- Lack of detailed guidance with regard to waste prevention for many award categories and product areas
- Legal uncertainty over the admissibility of such requirements.

With these points in mind, the following four measures under the WPP could provide the extra impetus needed to incorporate waste prevention more deeply into public procurement practices.

4.3.1.1 Measure 1: Development of binding tendering requirements in the form of regulations or other acts of law ensuring waste prevention in the procurement of goods and services

Although, as described above, a clear legal basis for waste-saving procurement already exists in the form of Section 45(1) of the German Circular Economy Act (KrWG) and the designation of waste prevention, the development of binding requirements for the award of contracts would open up a much more concrete possibility of actually expressly incorporating specific waste prevention considerations in invitations to tender and also of weighting them accordingly in the final selection from the bids received. According to the statements of many stakeholders

engaged with the issue in practice, there are still considerable legal uncertainties (see work package 1), with the result that, while waste prevention considerations are formally examined in the analysis, this does not ultimately lead to different outcomes.

Wherever possible, such regulations or other appropriate acts of law should be developed in close cooperation with the Competence Centre for Sustainable Procurement (KNB) in order to establish the topic of waste prevention as consistently as possible as a requirement for sustainable procurement. The competence centre, which is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi), provides those working in public procurement with advice on how to increase their investment in innovative products and optimise their purchasing processes. It also supports procurement bodies when they initiate research and development contracts for products and processes intended for public sector procurement (BMWi n.d.).

Germany's General Administrative Rules on the Procurement of Energy-Efficient Products and Services (AVV-EnEff) could serve as a possible model for such tendering requirements (BMWi 2017). Since 2008, these regulations have made it mandatory for the country's federal authorities to specify special energy-efficiency criteria when awarding public contracts – thereby supplementing and concretising legal obligations under the Ordinance on the Award of Public Contracts (VgV) for the award of contracts above the EU thresholds. In addition, the AVV-EnEff obligates the federal authorities to take a high level of energy efficiency into account when it comes to procurement, even below the EU thresholds. The guidelines appended to the administrative rules contain information explaining how the criteria are to be applied in detail in the tendering process. The structure is based on the typical outline of a tendering process (analysis of needs, preparation of tendering documents and performance specifications, terms of execution, suitability criteria, award criteria). It is thus intended that the ordering parties within the Federal Government generally only purchase goods and products that have been assigned the highest energy-efficiency rating.

The objective behind developing an analogous ordinance for the issue of waste prevention would therefore be to explicitly define the existing requirements for public procurement – which are often formulated in very general terms, as is the case in the KrWG – and, as a consequence, to increase the willingness of public procurement bodies to genuinely engage with the substance of the issue and to empower those stakeholders who have wanted to lend greater weight to the topic for some time.

4.3.1.2 Measure 2: Development of specific guidelines for waste prevention in public procurement

In the course of the project, one of the main obstacles to the implementation of a waste prevention approach in public procurement was revealed as being the considerable time needed to identify and evaluate actual waste prevention outcomes. As a rule, there is still a lack of specific guidelines that clarify the requirements/criteria for various areas of procurement. The overwhelming majority of the existing guidelines and practical recommendations refer to the subject of energy consumption, whereas corresponding support for waste prevention – such as that relating to the topic of saving life-cycle costs – only exists in individual cases, often as a result of research projects, which are, however, not kept up to date.

An expert report commissioned by the German Federal Environment Agency (UBA) on the current legal situation with regard to public procurement has stressed that, when evaluating bids

> "The contract shall be awarded to the most economically advantageous tender (Section 127(1)1 of the German Competition Act (GWB) 2016). [However,] the award criteria cover various aspects, which may also include environmental characteristics and life-cycle costs. All the award criteria must be specified and weighted in the invitation to tender. When evaluating the bids, no criteria may be taken into consideration that were not previously specified. Environmental aspects are permissible if they relate to the subject matter of the contract, do not allow the public procurement body to make an arbitrary choice, have been made known to the companies and do not violate European primary legislation (in particular the principle of non-discrimination)." (Hermann 2017, p. 93)

An evaluation of the Federal State of Berlin's Administrative Regulation on Procurement and the Environment (VwVBU) has shown that, against this background, performance data sheets and calculation tools that put the specifications into concrete terms are generally regarded by those working in procurement as the most helpful resources:

> "For products or services for which no performance data sheet is available, the procurement bodies must draw up their own environmental protection criteria in accordance with the specifications of the VwVBU. This process involves several steps and thus takes a certain amount of time. In addition, a very high level of product-specific knowledge is required. [...] On the one hand, developing further performance data sheets and calculation tools would be advisable for products and services with a high environmental impact. In the case of such products and services, establishing environmental protection requirements primarily serves to conserve resources and reduce environmental consequences. On the other hand, it would be wise to develop additional performance data sheets for products and services that are procured frequently. This would ensure that the performance data sheets are used regularly and would thereby provide a high level of support to the procurement bodies." (Senatsverwaltung für Stadtentwicklung und Umwelt Berlin 2015, p. 15)

The findings of work package 3.2 could be used as the basis for sensible prioritisation. At the same time, an evaluation of the dissemination of criteria for sustainable procurement in the field of waste prevention in Sweden, for example, has shown that:

> "Just over two in five organisations (43 percent) have imposed a requirement for waste volumes to be reduced as regards construction and demolition contracts. Fewer have imposed requirements for reductions in waste volumes as regards food (25 percent) and electronics (24 percent). A few (six percent) have imposed requirements concerning a reduction in waste volumes as regards textiles." (Swedish Environmental Protection Agency 2016, p. 21)

4.3.1.3 Measure 3: Support for the training or further education of public procurement staff on the subject of waste prevention

In view of the complexity of the cross-sectoral issue of waste prevention in public procurement, it makes sense that specific training and further education on the subject of waste prevention should be developed and delivered within the framework of the WPP.

For instance, the evaluation of the procurement guidelines in Berlin recommended that more extensive and regular training should be given to overcome the lack of understanding amongst procurement staff of how to implement the Administrative Regulation (VwVBU) (Senatsverwaltung für Stadtentwicklung und Umwelt Berlin 2015, p. 15). The training undertaken by procurement staff as part of the study to evaluate the VwVBU revealed two

points. First, that there is strong interest in training measures of this kind and, second, that there is still a considerable need for training.

Corresponding programmes should be run in cooperation with the Competence Centre for Sustainable Procurement (KNB) within the German Federal Ministry of the Interior's Procurement Office. This body already has extensive experience and networks in this field and is in a position to explain relevant laws and regulations to training participants as part of various foundation and specialisation modules. Selected guidelines, handouts, best practice examples and calculation modules are presented alongside certificates, labels and quality marks – also in relation to product groups. The "module D" offered by the Centre relates directly to the topic of "climate-friendly procurement," for example (BeschA 2016); similarly, there is also scope to develop a module on waste prevention in procurement.

4.3.1.4 Measure 4: Organisation of buyer conferences to support environmentally responsible procurement

The German Federal Environment Agency (UBA) has identified so-called buyer conferences, at which individual procurement clients communicate their needs and draw attention to possible examples of good practice and new developments, as a useful instrument for boosting environmentally responsible procurement in specific areas (Robert & Schmidt 2015). Buyer conferences like these can help to increase the acceptance of centralised procurement.

It is also conceivable that procurement staff may initiate information events – so-called "conferences of interested parties" – with the subject of waste prevention particularly in mind, at which potential suppliers would present environmentally friendly products. The knowledge gained from these events could in turn be incorporated into requirements planning. Suppliers can also benefit from the opportunity to raise any comments relating to contract terms, batch sizes and lots or individual product characteristics. This contributes to a higher level of market acceptance for upcoming tenders. The awarding body will have no reason to fear any violation of public procurement law, as long as it involves as many interested parties as possible in any such conference, writes detailed minutes and publishes them together with the tender documents. The planning and implementation of an appropriate conference could therefore be initiated within the context of the WPP.

4.3.2 Repair/reuse

The extension of the useful life of products through repair and remanufacturing is referred to in both the German WPP and the EU Waste Framework Directive as being key to waste prevention:

> "Encouraging the reuse of products is a pivotal aspect of waste prevention." (BMU 2013, p. 28; original text in bold)
>
> "Member States shall take measures to prevent waste generation. Those measures shall, at least [...] encourage the reuse of products and the setting up of systems promoting repair and reuse activities, including in particular for electrical and electronic equipment, textiles and furniture, as well as packaging and construction materials and products." (Directive 2018/851 amending the Waste Framework Directive, Article 9(1), European Parliament and Council of the European Union 2018)

Despite prominent mentions in key policy documents and programmes, the true relevance of the subject of repair is difficult to assess or, where data is actually available, has so far tended to be considered a niche phenomenon: "The size of the repair sector – particularly of computer and personal and household goods – differs markedly from country to country, with diverging trends. Recent Eurostat data [for 2015] show that, even in countries with a comparably large

number of enterprises operating in the repair of computers and personal and household goods sector, the value added remains rather low [...]" (EEA 2018b, p. 28). In its 2017 waste prevention status report, which focused on reuse and preparation for reuse, the European Environment Agency concludes that significant waste prevention potential still remains untapped in many sectors: "while reuse is an established market model for cars, it is still in its infancy for many other product groups" (EEA 2018b, p. 32).

It is the view of various experts that the repair and reuse of products has actually declined in recent decades (Poppe 2014). The reason for this is the increasing complexity of products combined with shorter innovation cycles, both of which have led to a rapid loss of product value, which in turn favours the purchase of new products. Reusing products is also made more difficult by an often deliberate deterioration of their characteristics. The limited evidence available indicates that the effective service life of a number of consumer products is decreasing despite improved technical possibilities with regard to recycling (EEA 2017). "Planned obsolescence" has been recognised as an area requiring priority action in the Circular Economy Action Plan, in the findings of a recent study by the European Parliament (European Parliament 2016) and in many waste prevention strategies. The analysis of the actual implementation of the WPP as well as various projects researching the subject of repair/remanufacturing (see, for example, Fischer et al. 2017) refer, amongst other things, to the following specific obstacles, which affect both the supply of and demand for repaired products:

- Lack of opportunity for suppliers of quality-assured used goods to benefit from recognition value
- Insufficient professionalisation (especially with respect to marketing)
- Uncertainty as regards issues relating to product legislation (e.g. compliance with new legal standards on pollution control, energy efficiency, product safety)
- Uncertainty with regard to product liability in the event of damage.

Against this background, the WPP could adopt the following five measures, the content of which overlaps to some extent with the issue of waste electronic devices as a priority waste stream, where the subject of repair should, by its very nature, also play an important role.

4.3.2.1 Support for the WirD project to develop an umbrella brand and quality standards for second-hand products, including support for the development of insurance packages for repair shops

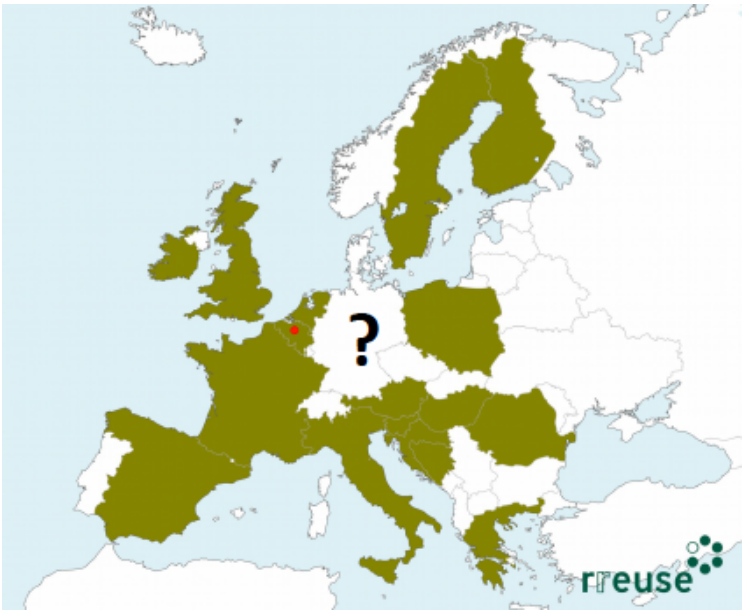
On the one hand, the diversity of those operating in the repair business – as can be seen in the context of the Runder Tisch Reparatur (Repair round table) association (Runder Tisch Reparatur n.d.) – and their different specialisations is a strength, but, on the other, results in the quality of repair services or of the repaired products themselves being difficult for consumers to predict and often differing widely.

In view of this, umbrella brands for the reuse market have been developed and successfully put into action in some EU member states. The cooperative quality labels De Kringwinkel, ReVital and Ressourcerie have been set up, predominantly by social enterprises, in Belgium, Austria and France, where they are becoming increasingly well known and widespread.

In all three cases, the joint approaches are succeeding in significantly building the sales and the business performance of the companies involved in the reuse market in addition to creating more jobs with greater stability (WIR e.V. n.d.). The following overview, prepared by European association RREUSE, shows that there is still a lack of appropriate standards in Germany,

meaning that customers face considerable uncertainty in terms of what criteria a product repair actually meets.

Figure 29: Quality standards for reuse in Europe



Source: RREUSE, cited in Vendramin & Koch 2017.

Against this background, the WPP could trigger the establishment of an umbrella brand that would build on the findings of similar funded projects by associations in the field (WIR e. V. 2018). This umbrella brand would need to include precise standards governing the quality of the processes on the one hand and the quality of the repaired products on the other. At the same time, the organisations awarded the umbrella brand's quality label would be under obligation to collect data – over and above the legal requirements – relating to the volume of repaired products, the products actually resold and the revenue generated as a result, and to publish this information in accordance with consistent standards. The data obtained in this way could be used in the future to provide the repair sector with even more precisely targeted support and to better assess the actual trends in terms of repairs in Germany.

4.3.2.2 Introduction of a reduced VAT rate for repair services performed by SMEs

In many cases, the useful life of products is not fully exploited because repairing them is regarded as not being cost-effective compared with purchasing new products, especially as a result of Germany's high labour costs. However, on the one hand, this assessment does not take adequate account of the significantly lower environmental costs of repair compared with the production of new items and, on the other hand, it is possible that supporting repair infrastructures successfully could also be associated with economies of scale that could justify short-term subsidies for the repair sector.

With this in mind, the German Federal Environment Agency (UBA) has been one of various bodies to call for the introduction of a reduced value added tax rate for repair services (UBA 2017d, p. 3). The EU Directive on the System of Value Added Tax already permits this to a limited extent for labour-intensive repair services performed locally (e.g. minor repairs to bicycles, shoes, clothing and household linen). In an initial step, Germany could make use of the existing latitude available under European law. An extension of this to include other repair services is also worth examining and feeding into the European discussion process.

At the same time, improvements to the tax deductibility of repairs have been proposed. The recommendation is for labour costs associated with the repair of household items to be made tax-deductible under income tax in the same way as household-related services, even if the repair is carried out outside the home.

A good practice example of this kind of support for the repair sector through the tax system can be found in Sweden, where such measures have already been implemented successfully (see RREUSE 2017):

- Discounted VAT for relatively minor repairs (including mending and alteration) to bicycles, shoes and leather goods
- 50 per cent of the labour costs for repairs to large household appliances are tax deductible up to a maximum of SEK 25,000/year [approx. €2,400] or SEK 50,000 [approx. €4,800] for persons over the age of 65. This applies to repairs performed by professionals at the owner's home.

As well as bolstering the demand side by means of improved financial conditions, the subject of repair will only have the opportunity to become a true driver of waste prevention in the long term through the promotion of repair-friendly products. With this in mind, the WPP should support processes at both national and European level that aim to standardise reparability.

Various methods are currently used in practice and by the scientific community to assess the repairability of products. They formulate criteria in relation to specific product groups – such as the Austrian standard ONR 192102:2014 and the iFixit repairability scorecard. The particular challenge will be to establish an objective and impartial perception of repairability, which may indeed be completely different even for identical products from the point of view of a repair expert or an amateur keen to carry out repairs.

Corresponding specifications are currently being developed both as part of an ongoing project by the German Federal Environment Agency (UBA)[86] and with the coordination of the EU Joint Research Centre. The WPP should pick up on these developments and provide a platform for the dissemination of these criteria and, for example, with regard to public procurement.

4.3.3 Supporting product-service systems

One of the core challenges of waste prevention is the obvious interest of the industrial sector and of the retail trade in selling as many products as possible, in turn stimulating economic growth and hence tending to increase the volume of waste. The quantity and complexity of the products purchased each year are steadily increasing in industrialised nations – so too are the associated levels of material consumption and waste volumes. In most cases, however, this is driven by the benefits offered by the products rather than the desire for product ownership (Umweltbundesamt Österreich 2008, p. 7).

As such, product-service systems (PSS) represent a key waste prevention strategy in line with the fundamental idea of "paying to use rather than buy products". The concept is increasingly described as sharing or collaborative consumption (Schmitt et al. 2017a, p. 6). Behind all these terms lie everyday actions with the purpose of making collective use of various things. In some cases, the need can only be met by owning a material product (with examples including food and clothing). In other cases, however, a need can also be satisfied through an "immaterial" service – a typical example being the washing of clothes. This need for clean clothing can be fulfilled either

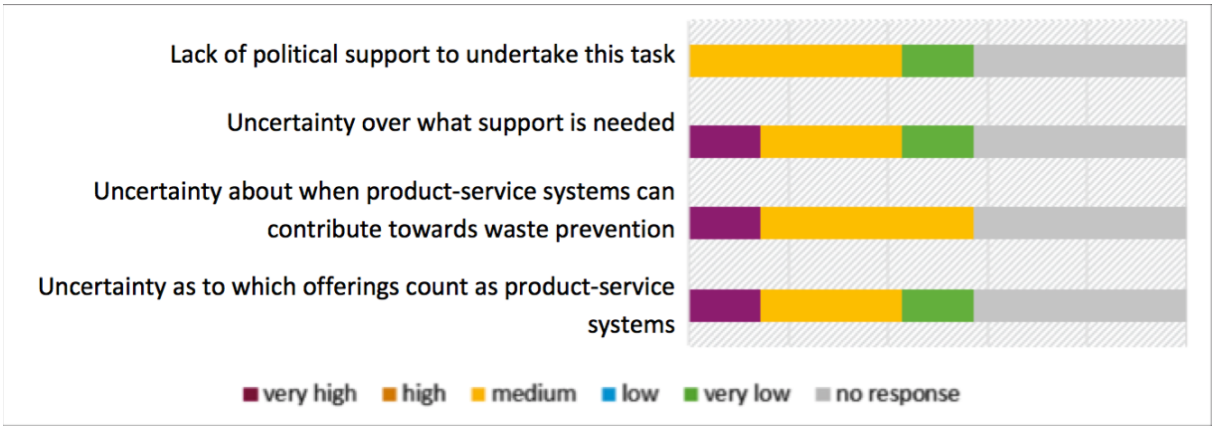
[86] Methoden und Normen zur Stärkung der Materialeffizienz unter der Ökodesign-Richtlinie [Methodologies and standards to raise material efficiency under the Ecodesign Directive] (FKZ 3717 37 318 0)

by individuals buying a washing machine, a tumble dryer and an iron, and cleaning their clothes themselves (variant A) or by a service company collecting the dirty laundry and delivering the clean clothes (variant B) (see Umweltbundesamt Österreich 2008, p. 7).

From a producer's perspective, there are some significant differences between variant A and variant B. In variant A, the producer has an interest in selling as many products as possible in as short a time as possible. It is therefore fundamentally contrary to the producer's interest to make durable, low-maintenance or maintenance-friendly products. In variant B, on the other hand, it is in the interest of the producer to manufacture a product that is as durable, low-maintenance or maintenance-friendly as possible, since it is with this product that it stands to generate the highest revenues (largest number of services sold) at minimal cost (with respect to product manufacture and maintenance).

Thanks in particular to the opportunities offered by digital business models, "using instead of owning" has become much more significant in recent years: "Online platforms offering rental, exchange and sharing options are multiplying rapidly; their users are growing in number (e.g. kleiderkreisel.de, mamikreisel.de, Airbnb and many more). The Internet and flexible technologies are providing a framework for reconfiguring even familiar and proven practices (e.g. the move from second-hand shops to clothes swaps). The sharing industry's global market volume is estimated at more than $100 billion" (see Schmitt et al. 2017b). Nevertheless, assessments of the subject have been relatively critical as regards implementing the WPP; Figure 30 below illustrates the obstacles that have been identified as being central to this.

Figure 30: Obstacles to the implementation of PSS concepts in the context of waste prevention



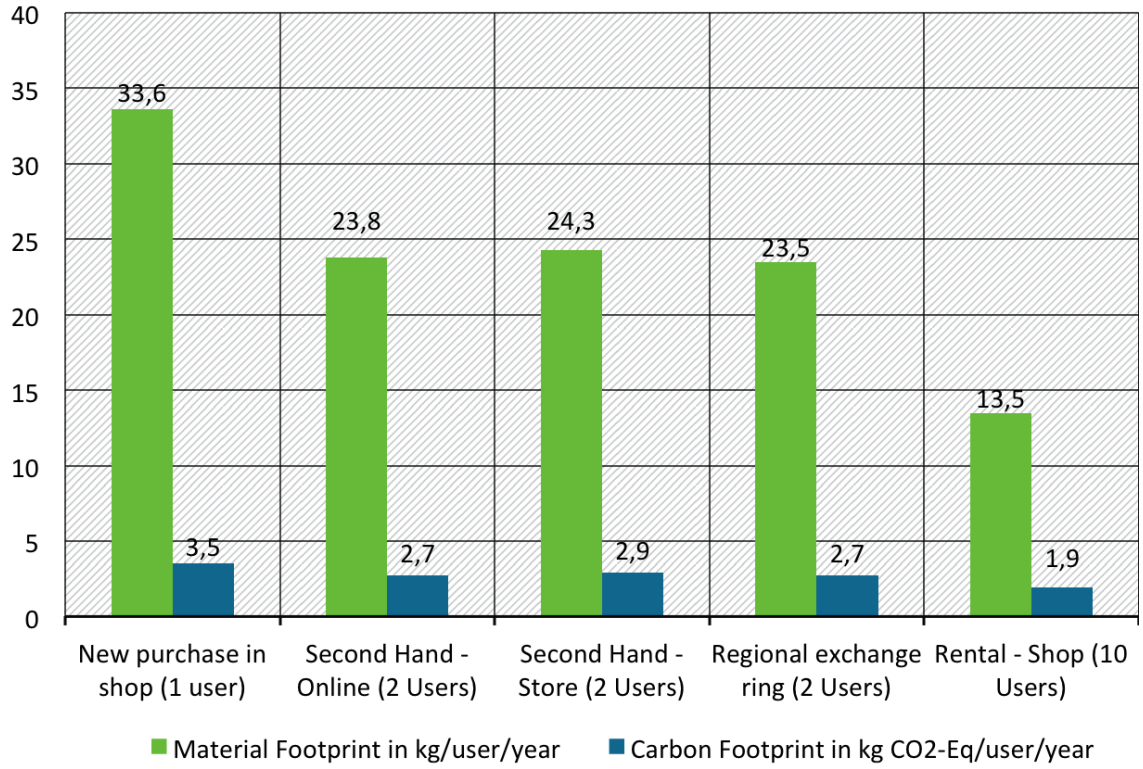
Source: Own illustration by Ökopol.

Against this background, it is recommended that the new WPP should refine the thematic focus of the approach and also take the limits of the concept into greater consideration (key term: rebound effects).

4.3.3.1 Measure 1: Identification of applications with i) high waste-prevention potential and ii) real need for support by the public sector

Numerous examples demonstrate the potential contribution to be made by PSS models to waste prevention and increased resource efficiency, see Chapter 2 as well as Figure 31 below, which illustrates the material and carbon footprint involved when DIY stores and the like hire out tools compared with the traditional option of buying a new product.

Figure 31: Material and carbon footprint – tool (e.g. drill) incl. use

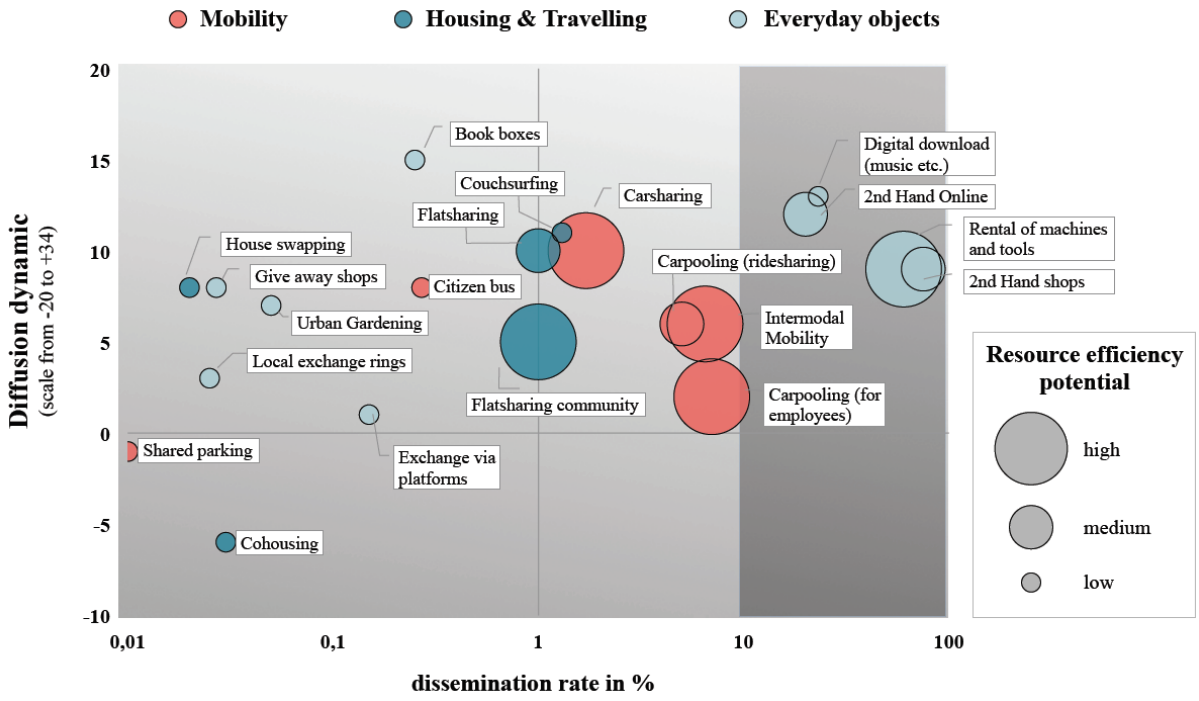


Source: Own illustration Wuppertal Intsitute based on Bienge 2017, p. 41.

At the same time, however, it has been shown that the effects in terms of resource savings and waste prevention can vary greatly depending on the area of application and the specific form they take. PSS models can also trigger the additional outlay of resources, such as when additional individual transport is stimulated through the offer of car-sharing solutions, for example.

With this in mind, it is advisable that the WPP should encourage studies looking at where PSS systems actually contribute towards waste prevention and where such approaches actually require the support of the public sector. The investigations carried out within the framework of the NsBRess – Collaborative Consumption. Resource Efficiency and Diffusion Potentials project may be an example of a good place to start. The following figure ranks existing approaches in terms of their potential for resource efficiency and their diffusion dynamics. It is evident from this illustration that some approaches are already clearly successfully established on the market and therefore do not necessarily require further support from a WPP.

Figure 32: An overview of the potential for resource efficiency and diffusion dynamics of the CC offers under investigation



Source: Bienge et al. 2019.

4.3.3.2 Measure 2: Supporting the demand for PSS

By using this kind of methodology to establish which courses of action should be prioritised, the WPP in particular could be a suitable platform through which to support the demand for these kinds of services.

It would appear to make sense not only to incorporate the relevant knowledge into the formulation of future political strategy, but also to adapt it for use by different target groups (e.g. providers, users and intermediaries as well as those involved in policy making and public administration). Information and communication campaigns and easy-access advisory services may also help to increase the supply of and demand for resource-light PSS services.

In particular, findings from the analysis of so-called nudging techniques should be taken into account here (see Thorun et al. 2017). Nudging is a tool originating in behavioural economics that refers to influencing people in order to stimulate desired behavioural changes without imposing bans or creating economic incentives. It works on the assumption that human decision making only follows rational principles to a limited extent and that decisions are influenced by context. This is where nudging comes in, by changing the context in order to steer decision making in a direction that is perceived to be a "better" option, because it benefits such areas as the common good, the environment or health. Examples include arranging fruit and sweet pastries on a buffet in a way that makes selecting the healthier option easier, or adjusting a computer's settings to default to double-sided printing. In doing so, however, the technique does not aim to restrict freedom of choice.

The importance of nudging is currently growing with respect to encouraging sustainable consumption patterns in order to support environmentally friendly behaviour amongst consumers, while simultaneously avoiding manipulating or patronising them and interfering

with individuals' freedom of choice. It is therefore vital to make nudges transparent, to offer positive choices, to make alternative options easily accessible and, in particular, to empower consumers to make informed choices. It should be noted that nudges do not generally bring about wholescale changes, but they can make a valuable contribution to reinforcing environmentally beneficial behaviour when used as a complement to existing tools.

A study by the OECD (2017) presents behavioural insights gathered from various case studies, including findings on nudging approaches aimed at reducing waste. A case study for the Nordic Council that looked at reducing electronic waste through measures intended to encourage sustainable consumption decisions tested the effects of nudges on the 19–28 age group with regard to mobile phone purchases. 87 per cent of consumers said they would prefer to have their defective mobile phone repaired rather than buy a new one, if this option were available in-store. That is 20 per cent more than in the scenario where only new mobile phones were offered in the shop. In another scenario, 28.9 per cent of consumers stated that they would choose a used mobile phone if it were available in-store, a figure seven times higher than in the baseline scenario. In the area of food waste, a study was carried out on behalf of the Consumers, Health, Agriculture and Food Executive Agency (Chafea) to test whether consumer acceptance of non-standard fruit and vegetables can be improved by means of messaging. One result of the case study was that 41 per cent of participants would buy imperfect products when confronted with an anti-food-waste message ("Embrace imperfection: join the fight against food waste") and 42 per cent would buy them when shown an authenticity message ("Naturally imperfect: Apples the way they actually look"). When presented with no message, 26 per cent chose the imperfect and 74 per cent the flawless product. These results suggest that nudging techniques can play a key role in reducing waste. However, it must first be determined which strategies actually have a positive effect on waste-reducing consumption decisions, as not all measures deliver the hoped-for effect.

4.4 Review of the structure of the current WPP and proposals for updating WPP

Besides examining the content of the current WPP, it also fell within the scope of this research project to review its structure in order to identify any need for adjustment and modification. The methodology and the findings of this review are presented below in addition to the resulting recommendations.

4.4.1 Methodology

In order to identify those areas of the current WPP where there may be a need for structural adjustments and changes and how this need could be addressed, the following steps were taken on a chapter-by-chapter basis:

1. Examination of the weaknesses, deficiencies or requirements for changes that were noted by the various stakeholders involved as part of the analysis of the current status, in the corresponding surveys and in the expert interviews that were conducted.[87]
2. Collation of concept ideas and proposals for further development of the structure, which resulted from the work and discussions relating to stocktaking (work package 1) and potential analysis (work package 2).

[87] A detailed presentation of the key findings of the expert interviews can be found in Jepsen and Rödig (2018): Bewertung der Umsetzung des Abfallvermeidungsprogramms und Entwicklung geeigneter Kommunikationsstrategien und Handlungsansätze [Evaluation of the implementation of the waste prevention programme and development of appropriate communication strategies and courses of action].

3. Identification of the activities that would be essential if the desired or proposed changes and additions were to be implemented.

The results of this three-step approach are presented below. It should be noted that assignment of the weaknesses, deficiencies and desired changes to the individual chapters of the WPP is not entirely clear-cut, as both content and structural overlaps and cross references must be taken into account.

4.4.2 Findings with regard to the current chapters 1 & 2 of the WPP

4.4.2.1 Noted weaknesses and deficiencies

With respect to Chapter 2 of the report, representatives from all levels (representatives of the Federal Government departments as well as representatives of the individual federal states and municipal authorities) described the surveys as unsatisfactory and, in some cases, irritating, especially the lack of clarity surrounding basic terminology. In particular, this relates to the following:

- The lack of clarity concerning the WPP's "responsible bodies", i.e. the question of who exactly are the "initiators of the WPP's waste prevention measures"?
  The principle question here is whether, in the context of the WPP, these initiators are actually always government agencies, as the WPP's character as a government programme leads many to expect. On the other hand, the view is commonly held that "the others" – that is, the non-government (market) actors – "could do a lot more".[88] Furthermore, the municipal authority representatives specifically do not feel that they are actually responsible for the implementation of the WPP, partly because of the programme's title "... of the German Government with the Involvement of the Federal States".
- A further area of imprecision here relates to whether waste prevention is actually "only" an issue for the environment ministries. The stakeholders involved in the implementation of the WPP to date have unanimously agreed that, as far as they understand it, waste prevention must always be an activity that cuts across all policy areas (departments). The introduction to the WPP also touches on the interdisciplinary character of waste prevention and mentions the fact that the WPP was adopted in coordination with the other departments of government. However, there is no differentiation of the "government agencies" or any explicit reference to the need for other departments to be involved. The way the WPP has actually been implemented so far at federal and state level shows that the understanding of waste prevention as an interdepartmental mission with extensive relevance has evidently not yet become well established at higher levels of government.
- Uncertainties with regard to the type/degree of (voluntary) obligation on the part of the government agencies that stems from the WPP.
  What is lacking here is clarification as to whether the WPP merely has the status of a request or suggestion for the government agencies as well, or whether the Federal Government and the individual states have taken it upon themselves to commit to implementing the waste prevention measures.

[88] The feedback received suggests that the nuanced remarks relating to the limitations of action by national government in terms of waste prevention, particularly with regard to changing consumption patterns and conditions in Chapter 1 of the WPP, tend to intensify this irritation rather than successfully assign responsibility, as intended.

The following formulation, which was cited by respondents as an example of a "vague" remark as regards the "voluntary obligation status" of the WPP, can be found in Chapter 2.3: *"However, [...] this Programme do[es] not address [...], but instead focus[es] on public sector measures and instruments with general significance as waste prevention tools, and which could be applied to a variety of waste streams following appropriate analysis."*

- The question as to why aspects of chemicals regulation under REACH legislation are explicitly excluded from the WPP. This point is made in the current WPP with the remark that the controls "indirectly" contribute to qualitative waste avoidance although i) the restriction instrument in the context of the implementation of REACH is a measure that is specifically aimed at *"reducing the content of harmful substances in materials and products",* thus directly corresponding to the definition of waste prevention in Section 3 paragraph 20 of the German Circular Economy Act (KrWG) and ii) precisely this removal of harmful substances from materials and products is expressed as a key requirement within the framework of the discussions relating to the EU Circular Economy Action Plan, not only with regard to waste recovery and recycling but also in terms of activities involving the direct reuse of products (without being classified as waste in the meantime).

4.4.2.2 Ideas and proposals for potential solutions

To overcome the ambiguities outlined above, the following proposals have been identified or developed in the course of this study:

- Explicit naming of the (government) agencies responsible for implementing the WPP. Such as, for example "all administrative bodies at federal and state government level ...". This goes further than the current, somewhat generic remarks like *"[...] we would stress that the Waste Prevention Programme is solely concerned with waste prevention measures in the public sector [...]"*[89] and would thereby establish certainty as to the expected behaviour of the named parties.
- Emphasis of the cross-sectoral nature of waste prevention and the relevance of the areas of policy-making and public administration unrelated to waste and the environment when it comes to successfully overcoming this challenge, which affects the whole of society.
- Explicit definition of the nature of the (voluntary) obligations incumbent on the government agencies responsible for implementing the WPP.
  For this purpose, in the context of the various waste prevention strategies and measures, qualitative hints at least should be deliberately inserted, such as in the form of expressions like "are committed to implementing" or "endeavour to implement", "aim to ...".
- Inclusion of wording that clarifies what action will be taken to invite/prompt/stimulate additional non-governmental actors to participate in the efforts to prevent waste.
- Provision of support also for stakeholders involved in the discussions over chemicals legislation and its practical implementation in their efforts to apply key waste prevention objectives.

[89] See WPP 2013, page 10, second paragraph.

4.4.2.3 Prerequisites

In the view of the authors of this report, the above-described potential clarifications of the text of the WPP nevertheless first require corresponding lucidity in the context of the decision to adopt a revised WPP. The authors see a need for more clarity with regard to the following:

1. Greater precision in the Federal Government's resolution insofar as it may be necessary to make the wording more explicit than before as regards which further departments of government, in addition to the Ministry for the Environment, are under obligation to implement the WPP – or whether this applies to all areas.
2. The question of the extent to which explicit "formal" resolutions by the individual federal states (i.e. their governments), analogous to the Federal Government's own resolution, are necessary in order to establish the basis for interdepartmental activities aimed at implementing the WPP at state level as well.
3. The question of whether, and how, to facilitate the participation of municipal authorities as additional state bodies responsible for implementing the WPP.
4. A way of encouraging proactive cooperation between the administrative units responsible for preventing waste and those in charge of issues relating to chemicals policy within federal and state government, which would make it possible, on the one hand, to clarify necessary interfaces and, on the other hand, to develop targeted synergies.

At the latest, these points would need to be clarified prior to the editorial revision of the text of the WPP (the focus here being on Chapter 2, but in actual fact, this also applies to all other parts of the text), as this is the only way in which unambiguous wording that is not open to interpretation can be used. Many of those responsible for the WPP at the federal state level in particular regard these clarifications of the WPP as important prerequisites that will support their implementation efforts.

4.4.3 Findings with regard to the current Chapter 3 of the WPP (Waste prevention objectives)

4.4.3.1 Noted weaknesses and deficiencies

The lack of (quantified) objectives or defined milestones is considered problematic, particularly by committed supporters of waste prevention at the level of the federal states, but also by some municipal authorities. From the perspective of these stakeholders, this deficiency with regard to specifics complicates targeting implementation efforts and accessing the necessary resources at the relevant action points.

4.4.3.2 Ideas and proposals for potential solutions

Consideration should be given as to whether the indicators developed as part of a recently completed departmental research project[90] (Wilts et al. 2019), such as the waste intensity of the entire national economy, ought to be included in the WPP. It is recommended that quantified targets be formulated for those indicators deemed suitable for measuring waste prevention success in specific action areas – those that form the focus of the updated WPP following implementation of the proposals made by the authors of this report, for example. These may be corresponding objectives at appropriately defined milestones in the course of the implementation of measures (see the proposals for Chapter 4), which can be differentiated by time (short, medium and long term).

[90] Project number 3715343020

In consideration of the existing uncertainties, these objectives may by all means be formulated as target margins with a suitable range of tolerance to provide "orientation".

4.4.3.3 Prerequisite

Since the departmental research project on waste prevention indicators was completed before the report intended to support the revision of the WPP, there will need to be a further review of whether any modifications/additions to the set of success indicators proposed so far are also required in order to reflect any amended/additional priorities or measures in the new WPP.

4.4.4 Findings with regard to the current Chapter 4 of the WPP (Specific waste prevention measures)

4.4.4.1 Noted weaknesses and deficiencies

Existing uncertainties with regard to the level of detail of the "Recommended measures" described in Chapter 4 of the WPP, "Specific waste prevention measures", became apparent here. On the one hand, the waste prevention concepts listed in Chapter 4.1 of the WPP are described in such a cursory manner that they appear to be more concerned with indicating areas requiring action than they are with giving specific guidelines for taking action – i.e. for the most part, they are not (yet) ready for direct implementation. The introduction to Chapter 4 of the WPP thus also explains that more detail can be found in the selection of measures listed in the Appendix. In some cases, however, the descriptions of measures in the Appendix contain almost identical wording (e.g. in the case of measures 30 or 31). On the other hand, measures are also listed here that have no equivalent in Chapter 4 of the WPP (such as measure 12). This is due to the fact that the descriptions in Chapter 4 of the WPP are so precise that they actually make measures that are formulated a little differently appear as if they "do not fit".

4.4.4.2 Ideas and proposals for potential solutions

In order to avoid the uncertainties mentioned by some stakeholders in terms of the level of precision or detail in Chapter 4 and the Appendix of the WPP, a clearer division would be advisable here. We suggest that Chapter 4 should (only) expressly discuss courses of action and areas requiring action, and in each case describe them in such broad terms that all pertinent descriptions of measures in the Appendix "fit" here. The measures in the Appendix should in turn be very clearly identified as "illustrative" examples of measures in order to leave room for other developments and implementations of measures that fit the recommended action area in Chapter 4.

4.4.5 Findings with regard to the current Chapter 6 of the WPP (Appendix: Measures and their assessment)

4.4.5.1 Noted weaknesses and deficiencies

Representatives from all of the WPP's target groups repeatedly questioned the status of the list of measures in the Appendix of the WPP. In Chapter 2.3 of the report, it is interpreted as a more or less complete *"collection of existing and potential waste prevention measures at Federal Government, Länder and local government level";* and the introduction to Chapter 4 of the WPP speaks of a list and assessment *"of the identified measures"*. The detailed presentation in Chapter 6 of the WPP may then be difficult to understand, as there it says *"[...] the measures [described were grouped] into clusters to be applied and evaluated as general instruments for a wide range of waste streams."* The difference between a "measure" (a term that, as described above, is also used for the rather broad descriptions in Chapter 4) and a general "instrument" is not apparent

to many readers, and so the debate repeatedly returns to the question as to whether "measures" that are not described are not part of the WPP's proposed "measures" to be taken into account in the context of specific implementation activities. With regard to practical implementation to date, particularly in the political debate over whether waste prevention measures can and should be implemented, the Appendix of the WPP has repeatedly been used as a sort of "complete list of proposals". Furthermore, it has often been noted in those discussions (and the analysis here) that the descriptions are far too vague to allow for direct implementation.

- In connection with the overall character of the WPP, the fact that "non-governmental actors" are sometimes named as (co-)initiators of measures also raises questions, both on the part of the named non-governmental organisations – whose "reflex" it has often been to question the legal basis for the supposed obligation – and on the part of representatives of the government agencies, who argue that much more could be done by the private sector and stakeholders within civil society to prevent waste and that the contribution of government agencies should therefore be put into sharp perspective.

4.4.5.2 Proposals and ideas for potential solutions

- As already explained in the context of Chapter 4 of the WPP, the authors believe it would be useful to introduce much greater differentiation in terms of both content and language between waste prevention strategies and action areas, waste prevention instruments and waste prevention measures, deletion or more specific description as explicitly identified "possible illustrative measures".
- With this clear structure as a foundation, it will then be possible to decide whether, in addition to the recommended priorities in terms of waste prevention strategies and action areas, recommendations for "instrumentation" should also be put forward in Chapter 4 of the WPP, or whether the showcase of possible instruments with regard to the implementation of activities in the prioritised action areas should be moved to the Appendix of the WPP.
- In the case of truly illustrative, model examples of "implementation measures", perhaps reference should be made to ideas presented outside the WPP itself – for example, in relation to municipal implementation measures on the list of measures for the European Week for Waste Reduction.
- In the interest of clarity with respect to the nature of the WPP as a framework intended to guide the voluntary commitment of government agencies, descriptions of action areas, instruments and measures should be consistently formulated in such a way that, in each case, it is left to the government agencies to take the initiative. It would not be a contradiction to point out at appropriate junctures – with suitable emphasis – that, as a challenge for the whole of society, "waste prevention" can only be tackled successfully if other stakeholder groups also carry out similarly specific planning and implementation activities.

4.4.5.3 Prerequisite

It is a prerequisite for the proposed organisation of waste prevention strategies, action areas, instruments and examples of measures into distinct groups that there should be a corresponding

clarification process at the level of those involved in drawing up the WPP and that corresponding clarifying definitions/limits be incorporated within the text of the WPP.

5 Further research needs

The analyses performed during this project have generated extensive information on the current situation of the WPP implementation, on obstacles, on the environmental effects of individual measures and on possible key topics derived from these measures for the continuation of the programme. Nevertheless, considerable research is still needed in the field of waste prevention if waste volumes and the associated environmental burdens are not only to be separated from economic development, but also significantly reduced, as required by the Sustainable Development Goals for example.

With this in mind, below are individual aspects with an identified special need for research. The structure is based on the chronological approach in the project and does not imply priority of individual issues.

Further research need 1: Involving local stakeholders in the Waste Prevention Programme

The analyses of the actual implementation of the WPP have once again demonstrated the important role that municipalities play in waste prevention. Due to its much greater proximity to relevant stakeholders such as households and regional industry, the municipal level appears to be best suitable for broaching the issue of waste prevention, for taking on a pioneering role and for initiating applicable collaborations between stakeholders in many action areas. Accordingly, the municipalities were also addressed at various points in the current WPP, e.g. in Measure 1, the development of municipal waste prevention concepts.

At the same time, however, it is unclear how municipal stakeholders can indeed be successfully integrated through a federal and state programme. This raises the question as to whether such a national programme is legally binding for the municipalities, as well as the operational question of how such collaboration could be structured as effectively as possible, especially since the evaluations also show that contact persons and responsibilities for the cross-sectoral issue of waste prevention are organised very differently in the municipalities. Often the public waste management authorities are the first point of contact due to their activities in areas such as repair; however, key aspects such as public procurement are only marginally addressed. Individual federal states have established successful platforms for information exchange on this issue, which are sometimes supported by formulations in the state waste laws. However, it should be examined whether or not mandatory municipal waste prevention concepts could be a suitable instrument and which financial responsibilities it would create for the municipalities.

Further research need 2: Horizontal crossover of waste prevention

In addition to the vertical crossover regarding collaboration between the federal, state and municipal governments, the question also arises as to how the cross-sectoral issue of waste prevention could be coordinated more effectively with other programmes with overlapping content, such as the National Programme for Sustainable Consumption, the Federal Government's Resource Efficiency Programme or the planned Strategy for Food Waste Prevention. There is a clear potential to combine efforts between the programmes, especially with regard to the individual measures. While parallel structures should be avoided, the EU Waste Framework Directive also obliges Member States to tackle these issues within the framework of their WPP. It must therefore be examined how best to exploit such synergies during the development and implementation of the programme and how to deal simultaneously with sometimes varying topic priorities or assessments.

Further research need 3: Environmental impacts of individual waste streams

A key challenge in the design of national waste prevention programmes continues to be the assessment and prevention of environmental impacts through specific waste prevention measures. The material and carbon footprint estimates made during this project once again illustrate how the effects of preventing a tonne of waste can vary greatly from case to case. In the process, established indicators were chosen that largely abstract from the specific spatial context of waste generation. Looking at the currently intensively discussed topic of plastic waste, however, it becomes clear that the focus here is less on the absolute expenditure of resources or greenhouse gas emissions caused, but rather on topics such as possible impacts on biodiversity in marine ecosystems. There is still a considerable need for research on uniform assessment standards that also take into account such matters as the actual collection and recycling rates for specific waste streams to allow for a more precise identification of which waste streams should be given priority.

Further research need 4: Efficiency and comparability of individual waste prevention measures

A clear need for research is also evident in the economic evaluation of concrete waste prevention measures. Waste prevention is still perceived by many stakeholders as an additional cost, without this actually being quantifiable in monetary terms. Even with the measures presented here to prioritise the WPP, it is hardly possible to estimate the costs associated with the individual measures given the current level of knowledge. There are however even greater knowledge gaps when it comes to estimating the potential cost savings that could materialise by reducing the volume of waste. However, reliable statements on the efficiency of waste prevention measures, i.e. costs/benefits per unit of waste or regarding the further research need 3 mentioned above per environmental effect achieved, would be highly relevant information to design waste prevention programmes. These would significantly improve comparisons between individual prevention measures and thus show the actual need for action by the public authorities (measures with relevant cost savings would presumably have to be supported by other instruments than those that have clearly positive environmental effects but are currently not profitable). Analyses from the OECD have shown that hardly any such analyses exist to date or if they do, they just address individual waste streams.

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Interviews with the following individuals:

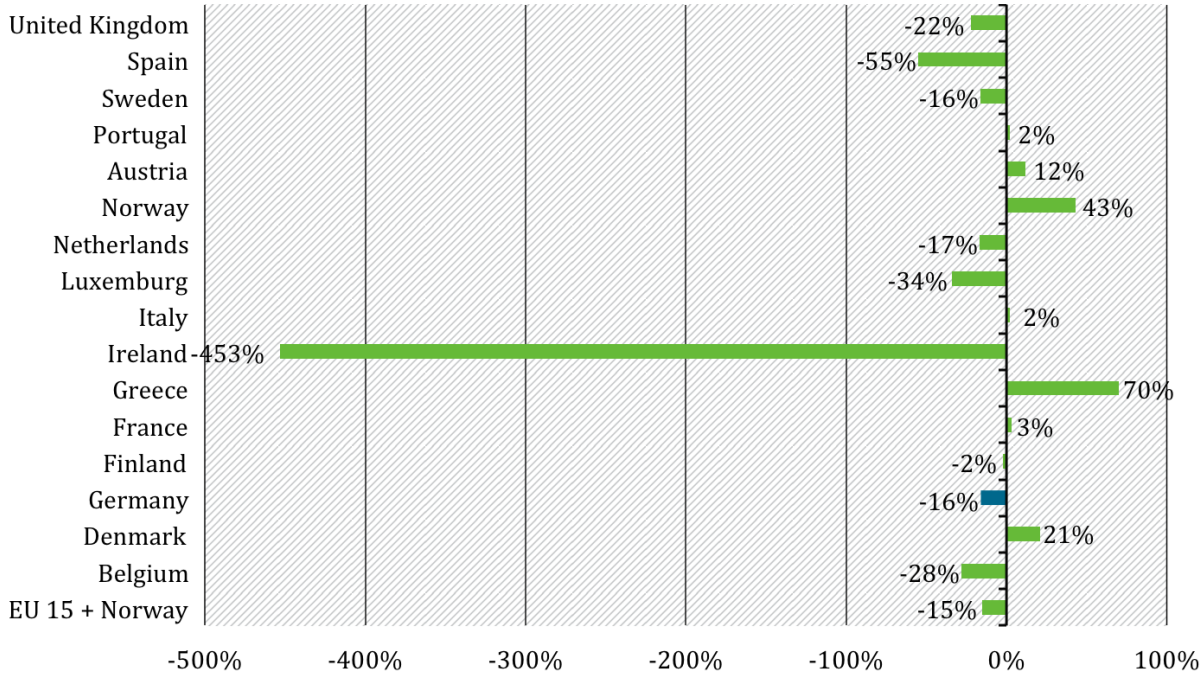
Ivo Dierbach, Spokesperson of Stadtwerke Erfurt, the public utilities companies of Erfurt, one of the first major cities to have introduced the organic waste bin as early as 1998

Dietmar Lübcke, Managing Director of Abfallwirtschaftszweckverbandes Ostthüringen

A Appendix: Analysis of the development of aggregated waste streams compared to other EU member states

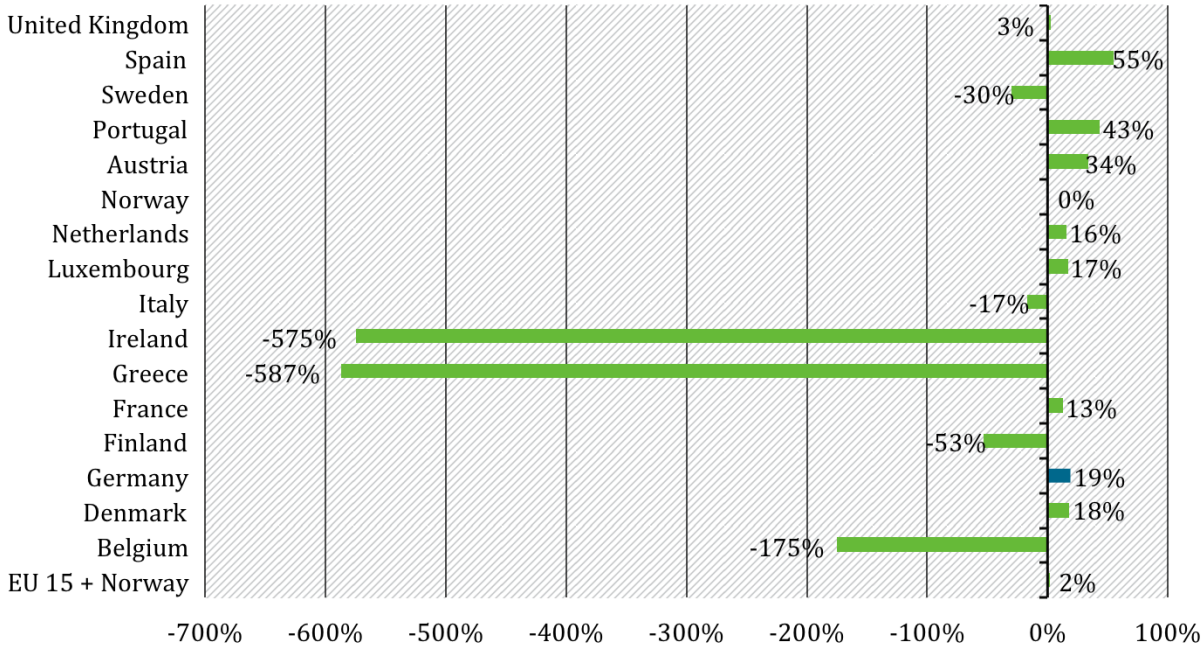
Analysis of the development of aggregated waste streams compared to other EU member states (15 EU member states + Norway).

Figure 33: Chemical wastes 2010-2014, total volume of waste in tonnes – percentage change



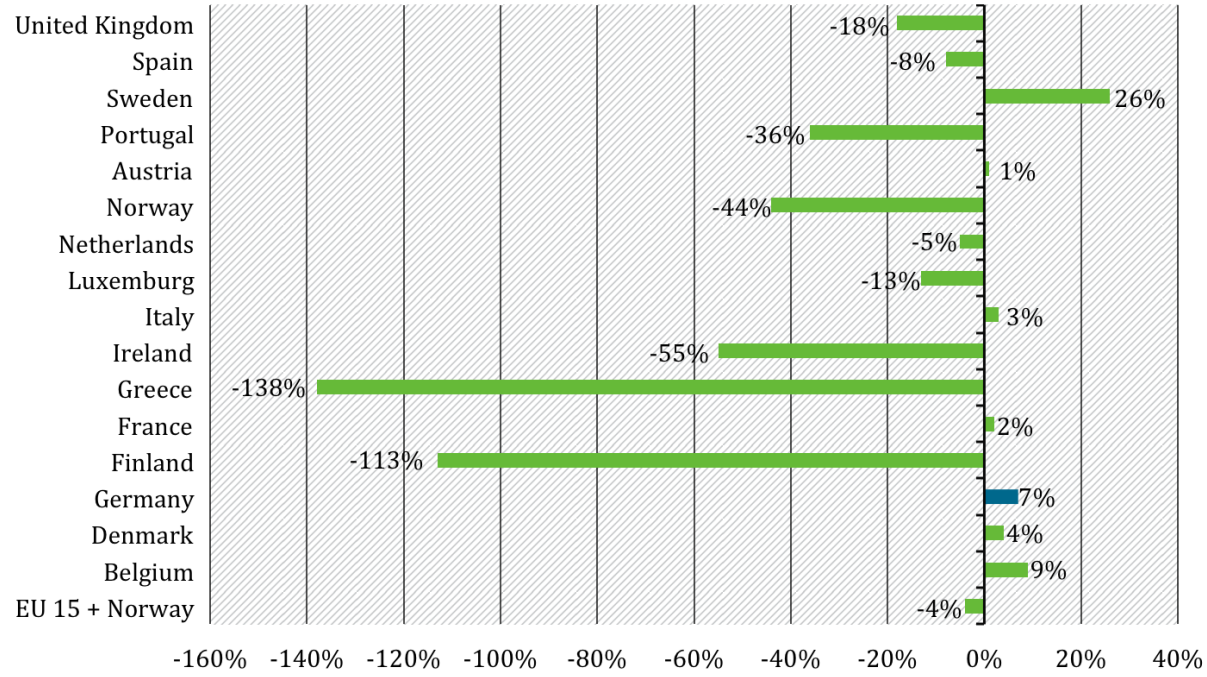
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous)

Figure 34: Metallic wastes, ferrous 2010-2014, total volume of waste in tonnes – percentage change



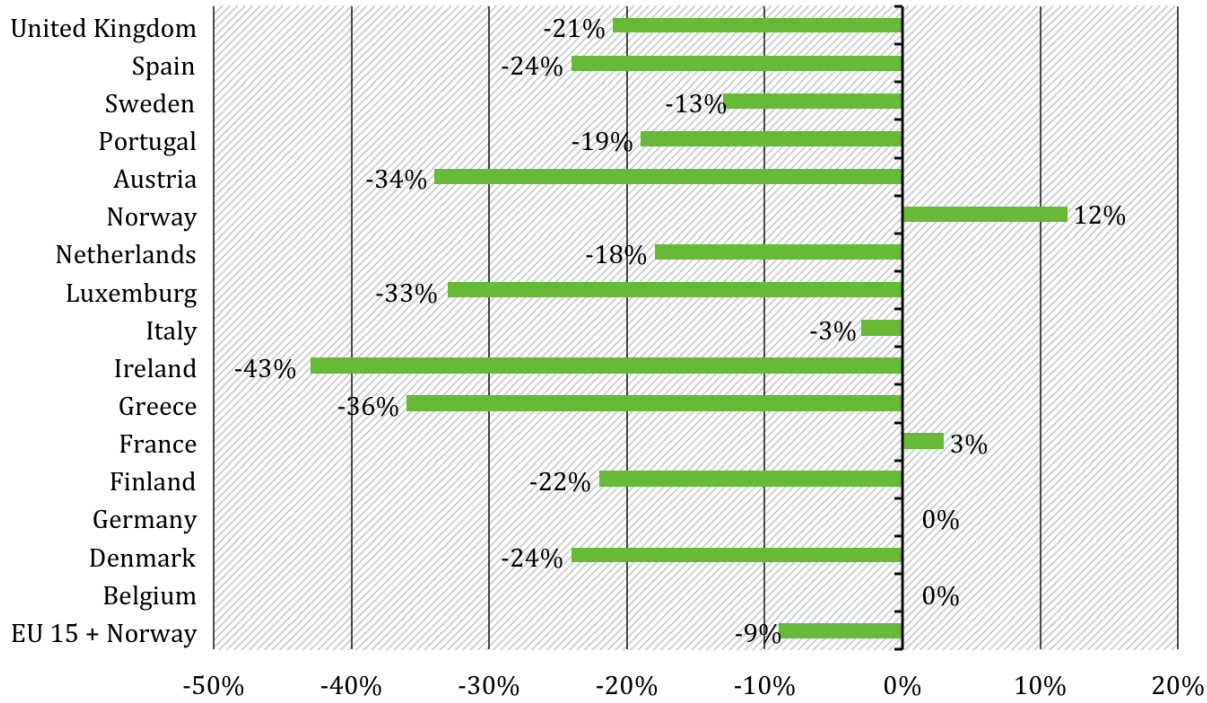
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 35: Glass waste 2010-2014, total volume of waste in tonnes – percentage change



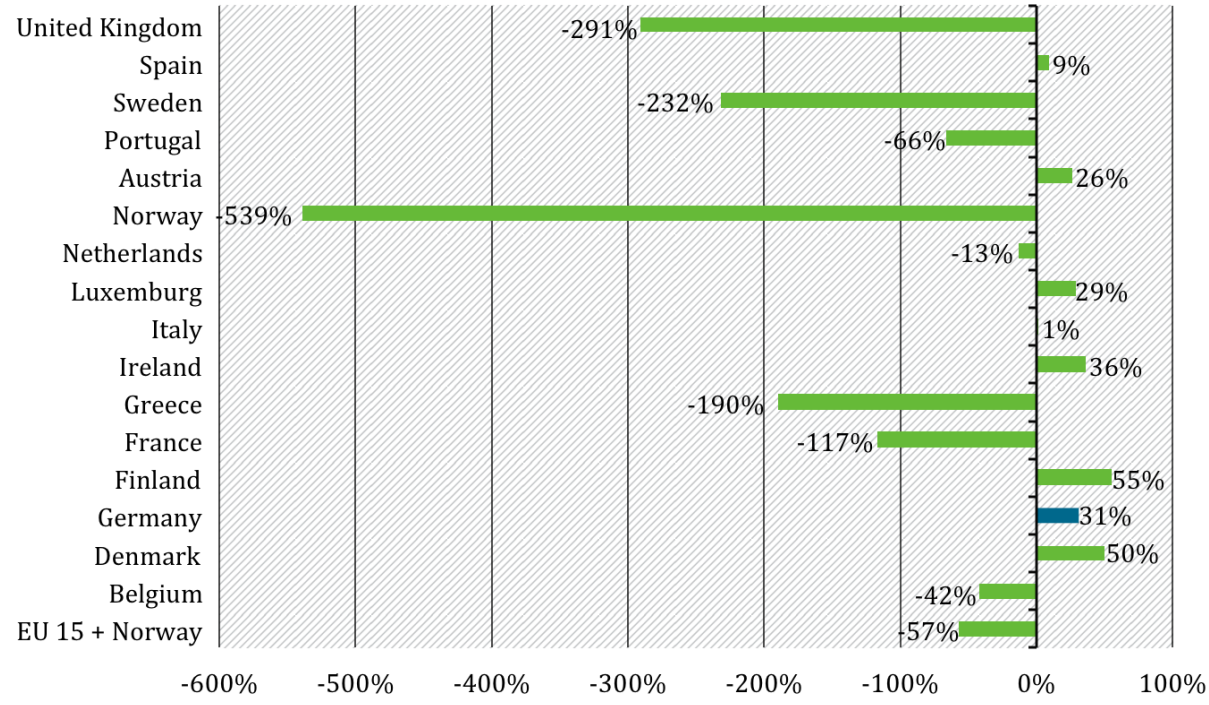
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 36: Paper and cardboard waste 2010-2014, total volume of waste in tonnes – percentage change



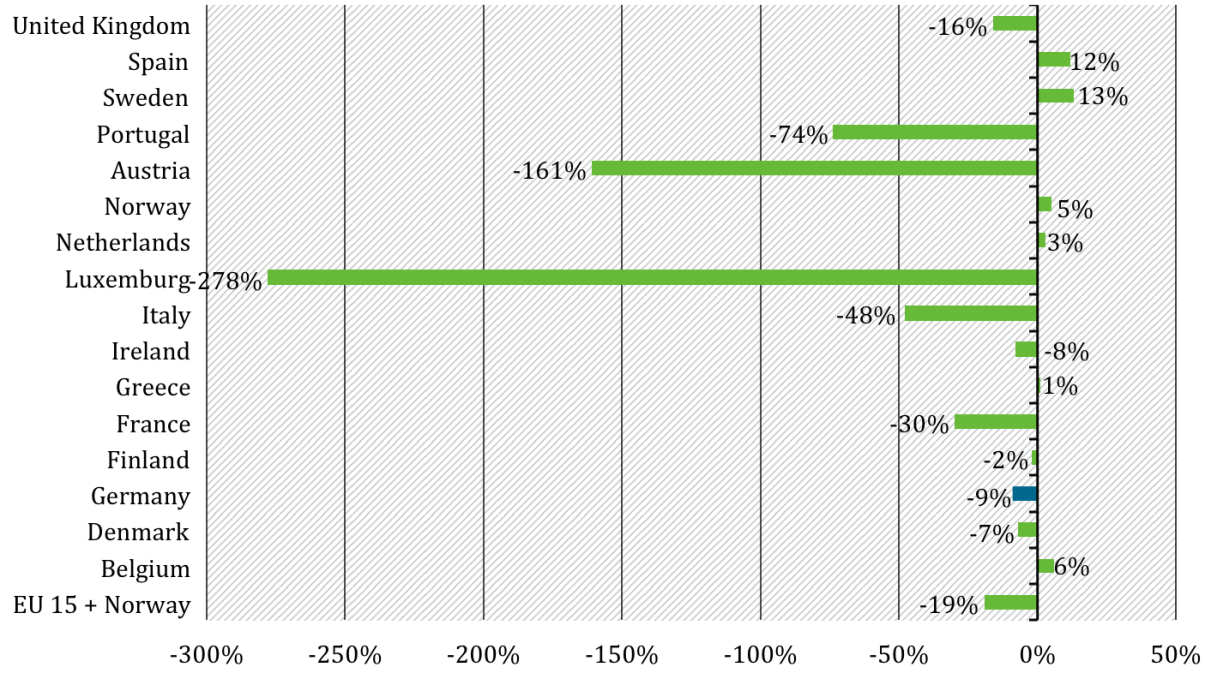
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous)

Figure 37: Textile wastes 2010-2014, total volume of waste in tonnes – percentage change



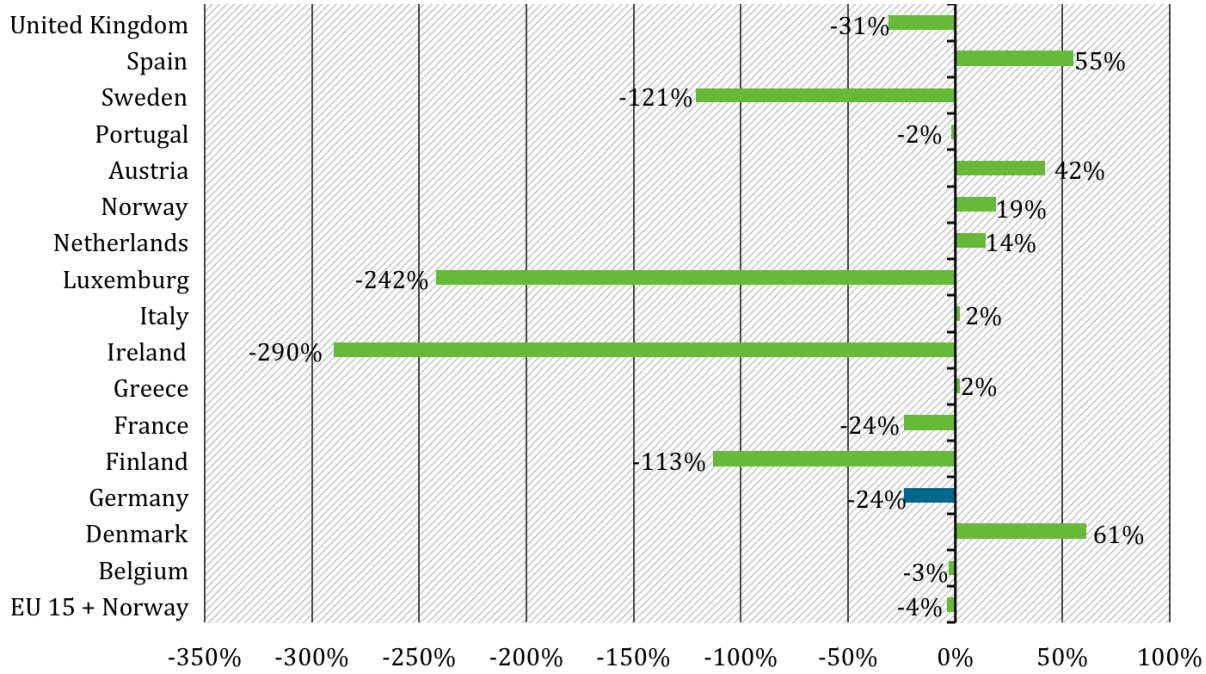
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 38: Discarded vehicles 2010-2014, total volume of waste in tonnes – percentage change



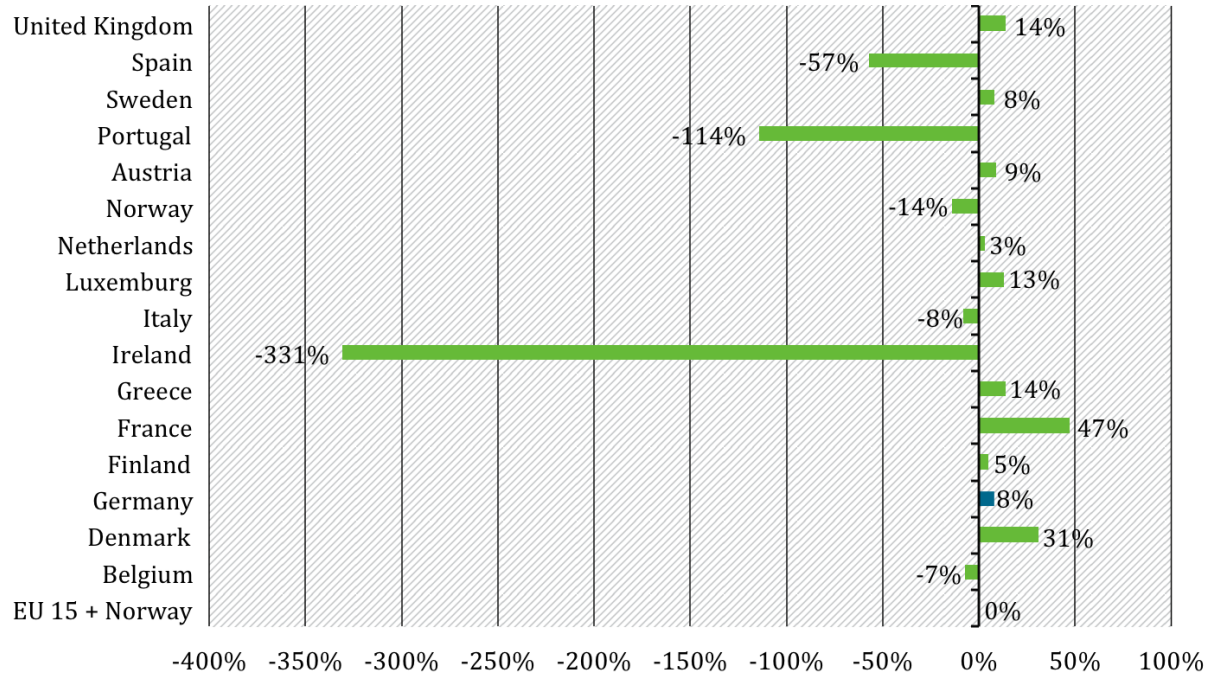
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 39: Batteries and accumulators wastes 2010-2014, total volume of waste in tonnes – percentage change



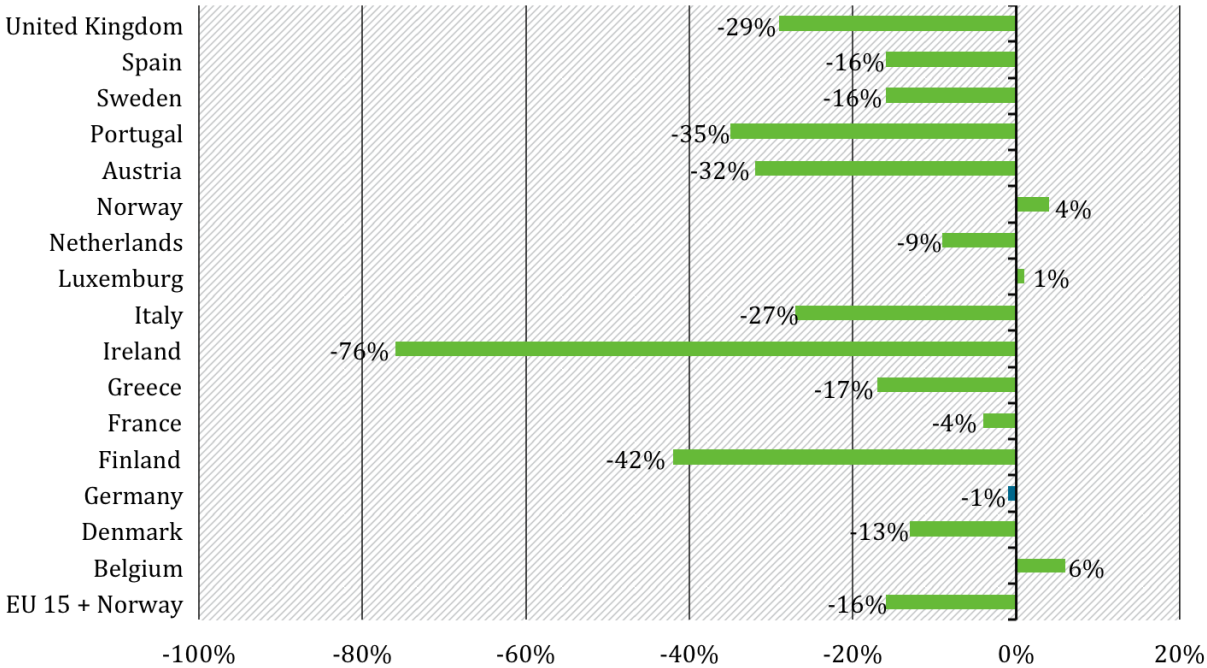
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 40: Animal and mixed food waste 2010-2014, total volume of waste in tonnes – percentage change



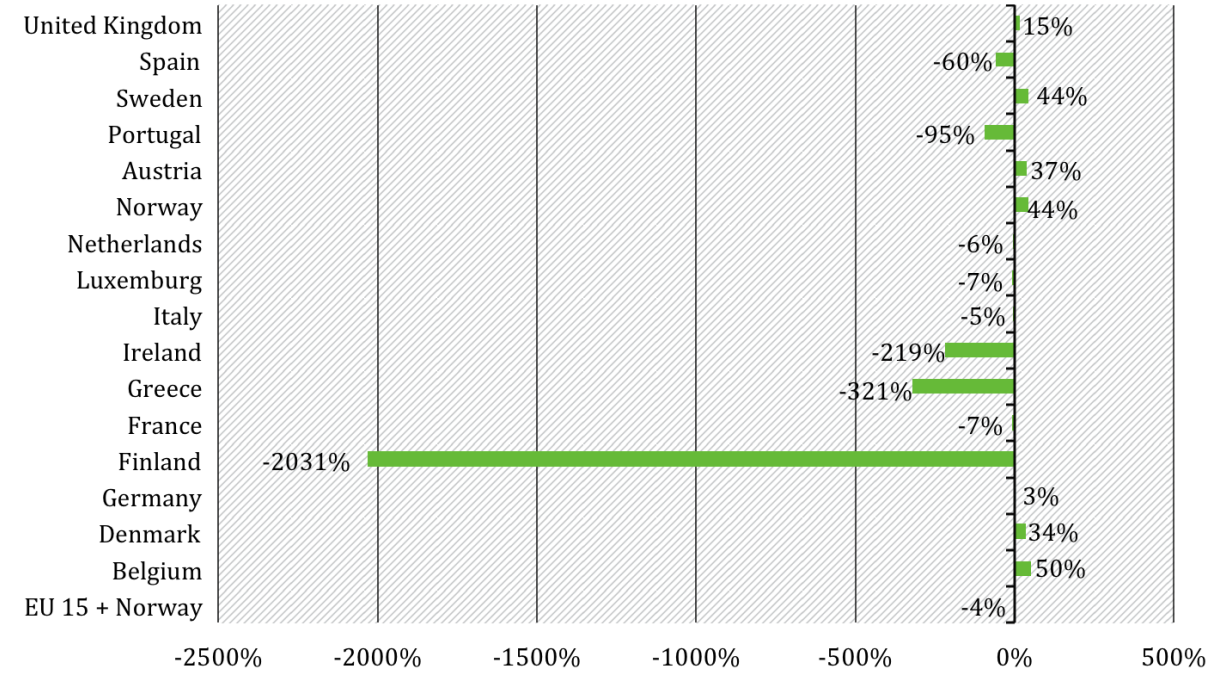
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 41: Household and similar wastes 2010-2014, total volume of waste in tonnes – percentage change



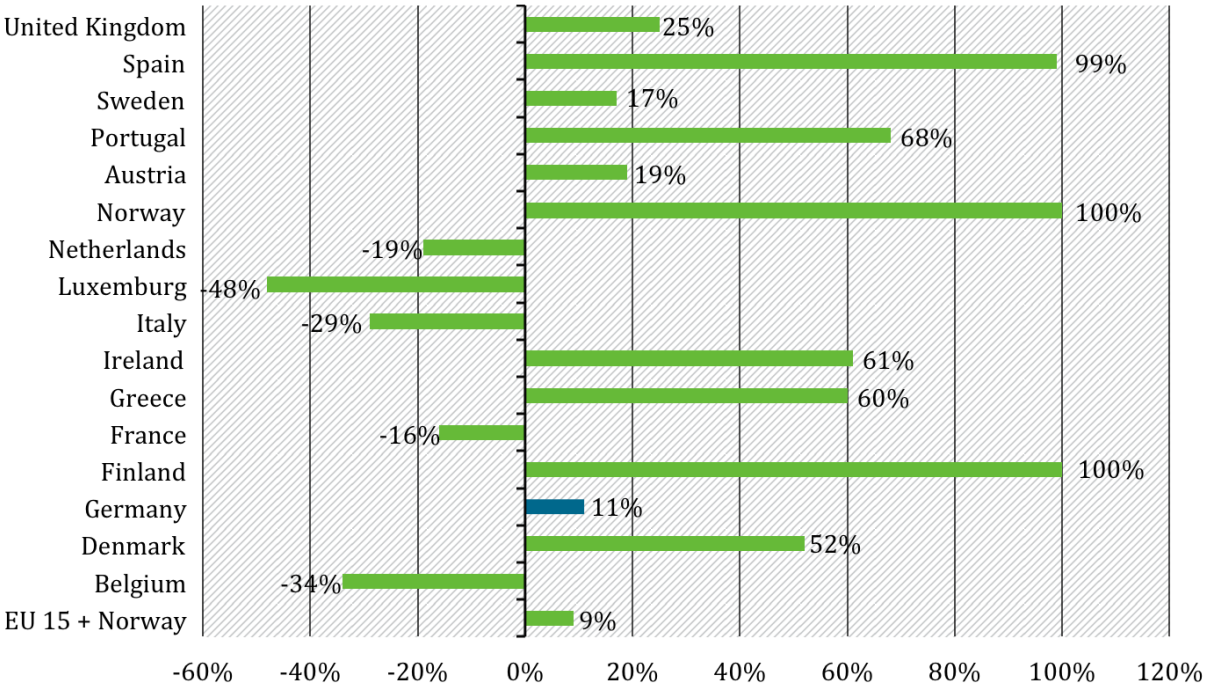
Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 42: Mineral waste from construction and demolition 2010-2014, total volume of waste in tonnes – percentage change



Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).

Figure 43: Soils 2010-2014, total volume of waste in tonnes – percentage change



Source: Own calculation and Wuppertal Institute presentation based on Eurostat (status of data as of 26.10.2017, env_wasgen, unit: tonnes, total hazardous and non-hazardous).