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Prevention of hazardous waste in Europe — the status in 2015

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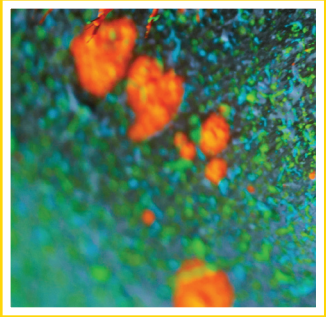

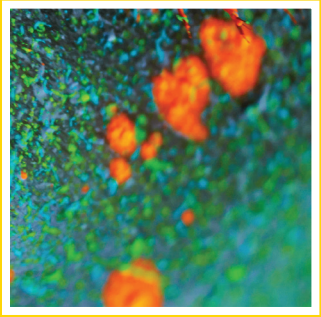

European Environment Agency

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Abbreviations

ADEME	French Environment and Energy Management Agency
APA	Portuguese Environment Agency
BAT	Best available techniques
BCNecologia	Urban Ecology Agency of Barcelona
BMLFUW	Ministerium für ein Lebenswertes Österreich
BREF	Best available techniques reference document
Cefic	European Chemical Industry Council
CLP	Classification, Labelling and Packaging
Defra	Department for Environment, Food and Rural Affairs
EAA	Environment Agency Austria
EAP	Environment Action Programme
EC	European Commission
EEA	European Environment Agency
EEC	European Economic Community
EFTA	European Free Trade Association
Eionet	European Environment Information and Observation Network
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
EPA	Environmental Protection Agency, Ireland
EPR	Extended producer responsibility
E-PRTR	European Pollutant Release and Transfer Register
ESAP	Electrical and Electronic Equipment Sustainability Action Plan
ETC/SCP	European Topic Centre on Sustainable Consumption and Production
ETC/WMGE	European Topic Centre on Waste and Materials in a Green Economy

EU	European Union
EWC	European Waste Catalogue
GDP	Gross domestic product
GHS	Global Harmonised System
GPP	Green public procurement
HP	Hazardous property
IMO	International Maritime Organisation
IMPEL	Implementation and Enforcement of Environmental Law
INEDIC	Innovation and Eco-design in the Ceramic Industry
INETI	Institute for Energy, Portugal
ISO	International Organization for Standardization
LCC	Lifecycle costing
LED	Light emitting diode
MAGRAMA	Ministry of Agriculture, Food and Environment, Spain
MEPRD	Ministry of Environmental Protection and Regional Development, Latvia
NACE	Statistical classification of economic activities
NGO	Non-governmental organisation
NHWMP	National Hazardous Waste Management Plan of Ireland
NRT	Natural resources tax
NWMP	National Waste Management Plan of Bulgaria
NWPP	National Waste Prevention Programme of Ireland
OECD	Organisation for Economic Co-operation and Development
PCB	Polychlorinated biphenyl
PESGRI	Strategic Plan for Industrial Waste Management
PIUS	Production-integrated environmental protection
PNAPRI	National Plan for Industrial Waste Prevention
PNGR	Portuguese National Waste Plan
POPs	Persistent organic pollutants
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals

RLAB	Reuse Laboratory
RoHS	Restriction of Hazardous Substances
SCAP	Sustainable Clothing Action Plan
SDS	Sustainable Development Strategy
SEPA	Swedish Environmental Protection Agency
SIM-Flanders	Strategic Initiative Materials in Flanders
SME	Small and medium-sized enterprise
TaBaChem	Take Back Chemicals
TGAP	La taxe générale sur les activités polluantes
UBA	German Federal Environment Agency
UFI	Umweltförderung im Inland
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WEEE	Waste electrical and electronic equipment
WFD	Waste Framework Directive
WRAP	Waste and Resources Action Plan

Authors and acknowledgements

This report was prepared by the European Environment Agency (EEA) and the European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE) in cooperation with the 33 EEA Eionet member countries and national/regional experts.

The third review covers 30 national and regional waste prevention programmes in Europe that had been adopted by the end of 2015.

2016 review process

Setting the concept and shaping the analysis took several steps and was based on intensive interaction with Eionet and national and international waste prevention experts, through different communication mechanisms.

Discussions about prevention of hazardous waste started during the 2016 experts' workshop on prevention of hazardous waste, which was held on 24 and 25 February 2016 in Berlin. The workshop was organised as a joint venture between the German Federal Environment Agency (UBA) and the EEA. The discussions helped set the concept for review assessment.

The work continued by organising a series of bilateral interviews with Eionet experts from the selected countries and regions. The outputs allowed chunks of information to be integrated in the report. The work was extended to updating country/region fact sheets as a basis for the EEA waste prevention webpage.

Finally, as a formal requirement, Eionet consultations took place over a period of 2 months and additional discussions were organised based on the Eionet comments.

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The idea for bilateral interviews with individual countries came from the Belgian National Reference Centre (NRC) on waste during the Eionet workshop on waste in 2015.

The authors gratefully acknowledge the contributions of a number of additional experts in the Eionet and other networks who were involved in the waste prevention process over the last few years.

About this review

This is the third EEA report in a series of annual reviews of waste prevention programmes in Europe. The review is stipulated in the European Union (EU) Waste Framework Directive (EU, 2008). This year's review covers 30 out of the 36 national and regional waste prevention programmes that had been adopted by the end of 2015.

In comparison with the previous reports, this edition reflects on the progress towards the implementation of prevention of a selected waste type: hazardous waste. Over the last 10 years or so, the better regulation of the identification, handling and management of hazardous waste has been one of the priorities of environmental policies in Europe and worldwide. Hazardous waste is a large, complex area of work, in particular for industrial processes in which economic factors represent an important incentive for both prevention and recycling. Distinguishing between these two areas is not always straightforward.

There are two recurrent subjects that might have implications for this analysis: the ongoing changes in the classification of waste, and separate discussions about hazardous (ecotoxic) property ([1]).

Changes in the classification of hazardous waste are expected to affect waste generation and management statistics. Hence, they have implications for establishing the baseline necessary for the quantitative monitoring and evaluation of prevention measures. For that reason, this analysis focuses mainly on qualitative aspects. Although the report looks at the generation figures at European and country levels, the statistics are used to determine the latest trends, rather than to provide an accurate account of the success of prevention.

([1]) Given the lack of guidelines or recommendations at EU level for a specific methodology to assess ecotoxic hazardous property (HP) of waste HP 14 in Annex III of the Waste Framework Directive, EU Member States performed HP 14 assessment in different ways. The revised waste legislation related to the waste classification did not include amendments about this property, as 'no satisfactory methodology could be developed and assessed in time' (Deloitte and INERIS, 2015).

Executive summary

This publication is part of a series of annual reviews by the European Environment Agency (EEA) of national waste prevention programmes in Europe. The review process covers programmes in the 28 European Union (EU) Member States and three European Free Trade Association (EFTA) Member States, Iceland, Liechtenstein and Norway. This third review, which covers the 30 national and regional programmes ([2]) that had been adopted by the end of 2015 (Table 4.1), focuses on the prevention of hazardous waste.

The Waste Framework Directive (EU, 1975, revised 2008) set a legal obligation for EU Member States to adopt waste prevention programmes by 12 December 2013. The EEA has been invited to review progress towards the 'completion and implementation of the programmes' annually (EU, 2008). The Directive, including its article related to waste prevention, is currently under revision and discussion.

Since the early 1970s, several multilateral environmental agreements have emerged that aim to improve the prevention and management of chemicals and hazardous waste, including its shipment. Almost in parallel, the then European Economic Community (EEC) took the first steps to introduce environmental policy and legislation, starting with waste in 1975, and specifically dangerous waste 3 years later. Prevention and recycling were mentioned, but 'only as an aspiration' (Haigh, 2016), and without considering waste movements, let alone transboundary ones.

Hazardous waste shipments were first covered by the EEC's Transfrontier Shipment of Hazardous Waste Directive (84/631), but this neither considered the quality of disposal facilities at the final location nor required the seeking of consent from the receiving country. Those two concepts were subsequently introduced by the United Nations Environment Programme (UNEP) and the Organisation for Economic Co-operation and Development (OECD) (Haigh, 2016).

In 1989, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention, 2016) was adopted, and the EU produced its first Community Strategy for Waste Management (EC, 1989). The strategy was an introduction to the Single Market (the free movement of goods, persons, services and capital) that progressively established the internal market in 1992 and anticipated a rise in waste exports. It encouraged the introduction of high waste disposal standards and a reduction in movement of waste (the 'proximity principle).

Several years later, in 1997, the second Community Strategy marked a shift in the main focus of EU waste policy away from pure waste management to the recovery of resources, including energy from waste. The Strategy reaffirmed the three-step waste hierarchy — prevention, recovery and safe disposal — the proximity principle and the self-sufficiency concept for waste disposal facilities. For the first time, producer responsibility was mentioned and the predominant role of the product manufacturer recognised. The current five-step waste hierarchy gives the highest priority to waste prevention, followed by preparing for reuse, recycling, other recovery and disposal. This is reflected in the objectives of the Waste Framework Directive (EU, 2008) and the Thematic Strategy on the prevention and recycling of waste (EC, 2005). The EU has also strengthened regulation on waste shipments (EU, 2006b) and introduced stricter regulation of their inspections (EU, 2014a).

EU policies such as the Roadmap to a Resource Efficient Europe (EC, 2011) and the EU's 7th Environment Action Programme (EU, 2013) also recognised the need to prevent waste, to reduce waste generation by 2020 and to work towards eradicating the illegal shipments of, in particular, hazardous waste.

A new overarching framework for waste policy and resource efficiency has emerged in the ambitious Circular Economy Package, which introduces

([2]) As some countries have regional rather than national coverage in terms of waste prevention programmes, the number of programmes is higher than the number of countries (36 programmes, 31 countries), as explained in Chapter 4.

measures 'to cover the entire cycle: from production and consumption to waste management and the market for secondary raw materials' (EC, 2015). This package, which aims to transform Europe into a more competitive, sustainable, resource-efficient economy, addresses a range of economic sectors, including waste.

Third waste prevention review

This year's review has a thematic focus on the prevention of hazardous waste. The information presented is a combination of material collected and published during the EEA reviews (2014, 2015), discussions organised during the experts' workshop on the prevention of hazardous waste (Berlin, 24–25 February 2016), interviews conducted with 12 selected countries and region, and research into other relevant material and publicly available sources.

The review is organised in six thematic chapters.

Chapter 1 provides information on hazardous waste definitions and changes in waste classifications. It also provides an overview of qualitative and quantitative waste prevention policies and their meaning in practice, and introduces the potential use of the value chain as a long-term model in waste prevention monitoring and evaluation. The chapter concludes with an analysis of the probable relationships between the socio-economic, health and environmental aspects of (hazardous) waste prevention.

Chapter 2 describes current trends in the amounts of hazardous waste generated, including economic and population parameters. The chapter reflects on hazardous waste and waste shipments data sources (Eurostat database), and potential alternative sources (European Pollutant Release and Transfer Register (E-PRTR) database). It also highlights important challenges and the limits of the available data on hazardous waste when assessing prevention of hazardous waste.

Chapter 3 gives a brief summary of institutional set-ups and responsibilities for prevention of hazardous waste, which are often different from those for its management. In addition, it provides a historical overview of the development of global and European legal mechanisms to regulate waste shipments since the 1970s, in particular of hazardous waste, and to prevent its generation.

Chapter 4 provides an overview of hazardous waste prevention objectives, scope, quantitative targets, indicators, and policy instruments and measures set in waste prevention programmes and beyond. The chapter also explores monitoring and evaluation systems for waste prevention and highlights several interesting examples and practices currently in place in Europe.

Chapter 5 provides a brief overview of 12 national and regional contexts for preventing hazardous waste, in Austria, Bulgaria, Estonia, France, Germany, Ireland, Latvia, the Netherlands, Portugal, Spain, Sweden and England (United Kingdom).

Chapter 6 highlights key findings and outlines future prospects of the review process, describing ways to further improve the quality, coverage and depth of the analyses by focusing on selected themes and data quality issues.

Key findings

- The **general** findings about prevention of hazardous waste are as follows.
  - In 2012, hazardous waste represented close to 4 % of the 2.5 billion tonnes of waste generated in the EU-28. The figure has risen slightly since 2008. The largest volumes of hazardous waste are generated by the waste management, construction, and mining and quarrying sectors, as well as households.
  - Data quality issues and changes in waste classification are expected to create, in some countries, discontinuity in time series of long-term trends, including on the generation of hazardous waste. This is likely to affect (at present) the setting of waste prevention targets and indicators, and it limits assessments of the effectiveness of implemented measures to qualitative terms at both European and national/regional levels.
  - Bulgaria and Estonia generated the highest amounts of hazardous waste in Europe, due to their intensive mining and quarrying, and shale oil sectors, respectively.
  - The prevention of hazardous waste at national or regional level lags behind its management in terms of political priority or support. Prioritisation of waste prevention at the EU level is, however, a powerful driver for change.
  - A lack of institutions dedicated to hazardous waste prevention or a fragmentation of the institutional set-up often delays the implementation of hazardous waste prevention measures.
  - The prevention of hazardous waste is, in many cases, covered by the waste prevention programmes, although some countries, including Germany, prefer to deal with it separately.
- **Waste prevention scope:** out of 30 programmes analysed, 25 explicitly covered hazardous waste. The sectors mentioned that were relevant to hazardous waste were households, 30; construction, 27; and mining, 11.
- **Waste prevention objectives:** 17 programmes include reducing quantities of hazardous substances or hazardous waste generation as an objective. Programmes without explicit hazardous waste objectives may include it as a part of specific waste types, in broader objectives or directly in waste prevention measures.
- **Quantitative waste prevention targets:** only four programmes set targets for hazardous waste prevention, in Bulgaria, Italy, Latvia and Sweden.
- **Waste prevention indicators:** 7 programmes included a list of indicators for hazardous waste, in Austria, Bulgaria, Cyprus, France, Germany, Latvia and Spain.
- **Monitoring system:** 10 programmes include a description of monitoring systems, although none of them have a specific monitoring scheme for the prevention of hazardous waste.
- **Waste prevention measures:** most of the measures in programmes are linked to production regulations, including bans on toxic materials. Other measures do not address particular waste streams but may, for example, include hazardous waste in green public procurement guidelines.
- **Policy instruments:** regulatory instruments, such as bans on specific hazardous substances, are frequently used to prevent hazardous waste. Voluntary and information instruments also play an important role. Market-based instruments aimed at hazardous waste prevention were, however, not found.

1 Tracing hazardous waste

The prevention of waste is firmly grounded in the Waste Framework Directive (WFD) (EU, 1975, revised 2008), which set a legal obligation for EU Member States to adopt waste prevention programmes by the end of 2013. The EEA was invited to review the progress towards the 'completion and implementation of the programmes' annually (EU, 2008). This report is the third in a series of waste prevention reviews.

Waste prevention has the highest priority in the waste hierarchy, followed by preparing for reuse, recycling and other recovery, with disposal being the least desirable option. The waste hierarchy is the overarching principle behind EU and national waste policies (EEA, 2015).

In an economically challenged and rapidly changing world, in which socio-economic aspects and health and environmental issues are increasingly linked, focusing on the prevention of hazardous waste this year seemed logical. Although the report provides insights into current developments, including through selected country/region profiles, it is not intended to provide a full picture of implementation efforts across Europe.

Twenty-eight EU Member States plus three European Free Trade Association (EFTA) countries, Iceland, Liechtenstein and Norway, are legally obliged to adopt a waste prevention programme under the WFD.

This chapter provides an overview of the classification of hazardous waste, explains terms such as qualitative and quantitative waste prevention, considers value chains as a monitoring method and provides an overview of links between pressures arising from waste generation and environmental, health and socio-economic aspects.

1.1 Definition of hazardous waste

The classification of hazardous and non-hazardous waste is based on the system for **classification** and **labelling** of dangerous substances ([3]) and preparations (Figure 1.1). This approach ensures the application of similar principles over a product's entire lifecycle (EC, 2016f).

By Decision 2000/532/EC, the European Commission (EC) established a **List of Wastes** on the basis of a classification system, including a distinction between hazardous and non-hazardous wastes. The list should be closely linked to **Annex III** of the WFD (although currently it is not), which laid down the properties that render waste hazardous (EU, 2000a; EU, 2008).

To simplify and modernise European waste legislation, the EC reviewed both documents, making changes that were applicable as of 1 June 2015. Decision 2000/532/EC (EU, 2000a) was amended by Decision 2014/955/EU ([4]), while Annex III to Directive 2008/98/EC was replaced with Regulation 1357/2014 (EU, 2014b) (Box 1.1) (EC, 2016c).

Hazardous waste poses a greater risk to human health and the environment than non-hazardous wastes, and thus requires a **stricter control regime**. Articles 17–20 of the WFD set obligations for hazardous waste labelling, record keeping, monitoring and control, from the waste producer to final disposal or recovery. Mixing of hazardous substances is banned to prevent further risks (EC, 2016f).

([3]) The classification of dangerous substances places a substance into one or several defined classes of danger and characterises the type and severity of the adverse effects that the substance can cause (EC, 2016b). Annex I to Directive 67/548/EEC contains a list of dangerous substances, together with provisions on classification, packaging and labelling of each (EC, 2016e; EU, 2001). The EU has comprehensive chemical legislation, spearheaded by the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and Classification, Labelling and Packaging (CLP) regulations, which aim to ensure a high level of protection of human health and the environment. Specific groups of chemicals, such as biocides, pesticides, pharmaceuticals and cosmetics, are covered by separate legislation (EC, 2016a).

([4]) Commission Decision of 18 December 2014 amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European Parliament and of the Council (OJ L 370/44) (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2014.370.01.0044.01.ENG) accessed 24 November 2016.

Box 1.1 Hazardous properties

In the **Waste Framework Directive, Article 3(2)**, hazardous waste means waste that displays one or more of the hazardous properties (HPs) listed in Annex III (EU, 2008).

The Annex to **Regulation 1357/2014** includes a list of properties of waste that render it hazardous (EU, 2014b).

Annex		
HP 1 Explosive	HP 2 Oxidising	HP 3 Flammable
HP 4 Irritant — skin irritation and eye damage	HP 5 Specific Target Organ Toxicity (STOT)/Aspiration Toxicity	HP 6 Acute Toxicity
HP 7 Carcinogenic	HP 8 Corrosive	HP 9 Infectious
HP 10 Toxic for reproduction	HP 11 Mutagenic	HP 12 Release of an acute toxic gas
HP 13 Sensitising	HP 14 Ecotoxic (but it is still not defined at European level, although discussions are under way)	HP 15 Waste capable of exhibiting a hazardous property listed above not directly displayed by the original waste

Figure 1.1 The Global Harmonised System of Classification and Labelling of Chemicals (GHS)

Note: The GHS is an internationally agreed system created by the United Nations to replace various classification and labelling standards used in different countries. The GHS has been embedded in the EU legislative system as a part of the CLP Regulation.

Source: UNECE, 2016a.

1.2 Qualitative and quantitative waste prevention

Waste prevention as defined by the WFD (Box 1.2) can be implemented in different ways. Targeting the source of waste generation reduces its amount and toxicity before recycling, composting, energy recovery or landfill becomes an option. Waste prevention, however, also covers measures to reduce the adverse impacts of waste on human health and the environment (EEA, 2015).

Box 1.2 Waste prevention as defined in Article 3(12) of the Waste Framework Directive

'Prevention' means measures taken before a substance, material or product has become waste that reduce:

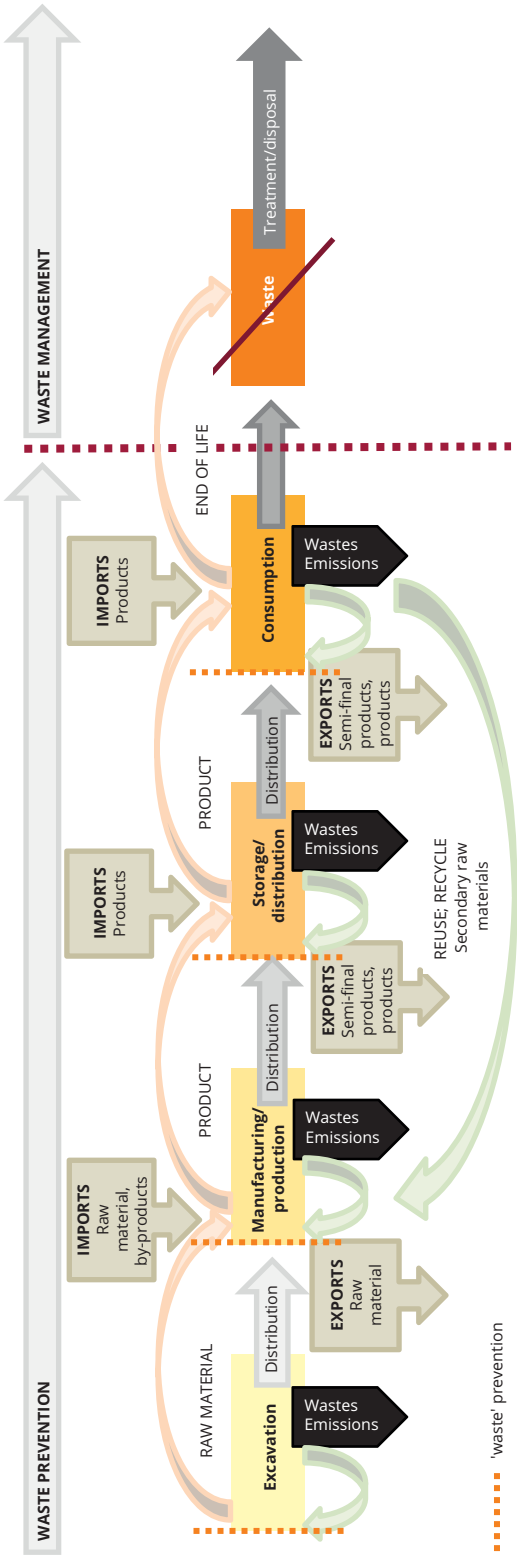
(a) the quantity of waste, including through the reuse of products or the extension of the lifespan of products;

(b) the adverse impacts of the generated waste on the environment and human health; or

(c) the content of harmful substances in materials and products.'

Source: EU, 2008.

Figure 1.2 **Waste flows and prevention potential in value chain**



Source: EEA.

Waste prevention has both quantitative and qualitative aspects that should be taken into account when setting targets, selecting indicators and designing measures.

Quantitative waste prevention is achieved by decreasing the quantity of materials used in products and by increasing the efficiency with which they are used. Waste can also be avoided by limiting unnecessary consumption and by designing and consuming products that generate less waste. Quantitative waste prevention also covers action that can be taken before a product reaches the end of its life through repair, refurbishment or reuse (EC, 2012).

Qualitative waste prevention is defined as reducing the hazardous content of waste, as defined in Article 3(12) of the WFD. This helps to reduce human and environmental exposure to hazardous materials. Reducing or restricting the use of hazardous substances is also a prerequisite for establishing a circular economy, as it enables material loops, simplifies the process of establishing industrial symbiosis ([5]) (Box 1.4) and can also lower the cost of collecting and recycling post-consumer waste (EEA, 2015).

1.3 Waste in the value chain

Designing and implementing waste prevention measures, and ultimately assessing their benefits, can be a challenging task that has a high priority in the waste hierarchy (EEA, 2014; EEA, 2015). By examining different stages of the **value chain**, waste prevention measures can be assessed for their performance (Figure 1.2).

Waste can be prevented by improving material efficiency, by using processes that generate less waste and by innovation in the **production phase** (EC, 2012). Examples of waste prevention and resource efficiency in chemical production processes that were provided by the European Chemical Industry Council (Cefic) are presented in Box 1.3. Product design enabling low waste generation in the use phase is an efficient form of strict avoidance of waste. This includes reduction of the content of harmful substances in materials and products as a means of qualitative waste prevention.

In the **distribution phase**, waste can be prevented by, among other things, good planning of supply and stocks, waste-reducing marketing and choosing less waste-intensive packaging (EEA, 2015).

([5]) Industrial symbiosis occurs when one company or sector uses the by-product(s) of another company or sector. In this context, 'by-products' refers to energy, water and materials.

Waste can also be prevented during the consumption phase, by, for example, choosing products that are less waste-intensive over their lifecycles, keeping products in use for longer, repairing, sharing or renting products or reducing levels of consumption (EC, 2012).

When a product's lifespan expires and it is classified as waste, it enters the **waste management phase**.

One way of **monitoring** and **evaluating** particular waste prevention measures could be by tracking waste generation patterns along the value chain. Although a number of specific waste prevention measures have already been implemented at different stages of the value chain, overall progress may not be visible at aggregated levels; for example waste generation at a country or particular industry level, let alone the European level.

Even though some countries in Europe do have a system for monitoring and evaluation of waste prevention measures, information about hazardous waste streams is very scarce.

To add to the complexity, prevention and recycling, in particular for hazardous waste, often overlap or are misunderstood. As can be observed from examples of industrial symbiosis (Box 1.4), the reuse and recycling of certain materials could reduce the waste generated. However, particular measures that provide secondary materials and reduce the need for virgin material might not fall into the prevention category.

Box 1.3 Waste prevention and resource efficiency in chemical production processes

The chemical industry is characterised by a wide range of different subsectors and activities. As a result, many different residues and by-products, such as unintended chemicals, spent process aids, unreacted (raw and intermediate) materials, residues stemming from environmental abatement techniques etc. are generated in chemical production plants (Cefic, 2016).

Avoiding and minimising waste is a continual priority of the chemical industry, along with increasing the resource efficiency of its processes by substantially reducing the consumption of primary raw materials and energy.

In general, these are obtained by (Cefic, 2016):

- optimising process conditions in order to minimise the generation of residues and by-products;
- internal loops of valuable materials where residues and by products are (directly or after treatment) fed back into the process;
- applying industrial symbiosis practices: residues and by-products of one chemical process are used as raw materials for others (interconnected or integrated chemical production plants); residues and by-products of chemical processes are used as raw materials for other industrial sectors and applications.

Box 1.4 Examples of industrial symbiosis for waste prevention

Poland
As part of the EU project Chemical Regions for Resource Efficiency, the idea of recovering phosphorus from sludge was introduced to Polish regional companies. The scheme, implemented as a collaboration between a fertiliser company, a coagulant producer and a wastewater treatment plant in Szczecin, resulted in the annual reuse of approximately 1 500 tonnes of incinerated sludge (Jones, 2016).

United Kingdom
The National Industrial Symbiosis Programme is a good example of the impact of industrial collaboration on waste prevention. During its first year of operation, in 2005/2006, 430 000 tonnes of hazardous waste were eliminated (Lombardi and Laybourn, 2007). Case studies include a collaboration between an air conditioning unit manufacturer and an aluminium ingot producer in which hazardous potassium aluminium fluoride from the manufacturing process was used as raw material in aluminium production. The scheme eliminated 15 tonnes of hazardous waste and saved GBP 30 000 (or around EUR 38 000).

An example of qualitative prevention is a collaboration between a recycling company that was generating a hazardous residue consisting of waste labels removed from bottles using a corrosive agent. A composting management company was able to offer neutralisation and composting of the hazardous labels. The resulting product from this process is a non-hazardous compost that has commercial value (Laybourn and Morrissey, 2009).

1.4 Technological and behavioural changes

The analysis can be extended to include links between economic, social, health and environmental issues. How, for example, do changes in technology and consumption patterns affect waste prevention and associated pressures on health and the environment?

Changes in technology can lead to improved production processes with less waste generation as a final outcome. They can be triggered by many factors, including investment in corporate research and development, changing consumer preferences, economic drivers and changes or tightening of legislation. An example of technological innovation is provided in Box 1.5.

If **consumer demand** for specific goods/products falls for any reason, it alters, with a time lag, production operations or volumes. The result might be seen as beneficial from a health and environmental point of view. On the negative side, however, revenues are likely to drop, as will employment figures.

Rebound effects need to be taken into account too. These occur where decreasing demand for a certain product, for example caused by taxation or regulation, is compensated for by alternative consumption that may have even higher associated environmental pressures. Therefore, far-reaching effects and risks have to be analysed before any action is taken or measures proposed.

Box 1.5 Nanomaterials in construction (Flanders, Belgium)

Technological innovation such as nanotechnology may have significant impacts on waste sectors in the future. On the one hand, it may offer ways of enhancing material efficiency as it reduces the use of raw materials; on the other hand, it can open up new issues in waste treatment. Nevertheless, research is still needed on how exactly nanomaterials will affect recycling or energy recovery (Meinander and Mroueh, 2012).

The Strategic Initiative Materials in Flanders (SIM-Flanders) has developed research on the use of durable and sustainable structural materials in various sectors, including construction. It emphasises the use of nanotechnology in hybrid structural materials to ensure better durability, recyclability and therefore sustainability in the future. The trends towards light-weight components and construction, and towards the use of multifunctional and hybrid materials, as well as the legislation-driven obligation for environmentally-friendly production processes, emphasise the need to develop new innovative bonding and welding technologies. Within the construction sector, improved lifecycle efficiency is crucial. Nanotechnology can contribute to that through controlled downsizing and degradation techniques for the recycling of these new materials (SIM Flanders, 2011).

2 Trends and sources of hazardous waste

Hazardous waste is of high concern because of the potential risks it poses to humans and the environment if it accumulates throughout different stages of the value chain and if it is not managed properly. For that reason, hazardous waste is subject to restrictive and extensive regulation, both in Europe and around the world. Over the last 10 years or so, better regulation for identification, handling and management of hazardous waste has been one of the top priorities of environmental policies (ETC/SCP and ETC/WMGE, 2015; EC, 2016f). However, measures to prevent the generation of hazardous waste are still required.

Although statistics exist at the European level, it is very difficult to interpret such aggregated data. As a result, and because hazardous waste generation is largely driven by production patterns, data are presented here as waste intensity per unit of gross domestic product (GDP). This can be used as a first approximation of potential environmental pressures, although much more information is needed to describe the actual pressures (OECD, 2001). This report also presents data on hazardous waste generation per person, by country (ETC/SCP and ETC/WMGE, 2015).

This chapter shows overall trends in hazardous waste generation and highlights the sectors responsible. It also underlines key challenges related to new EU waste classifications and interpretations of existing data. Different geographical and time coverages should be noted throughout.

2.1 Hazardous waste in Europe

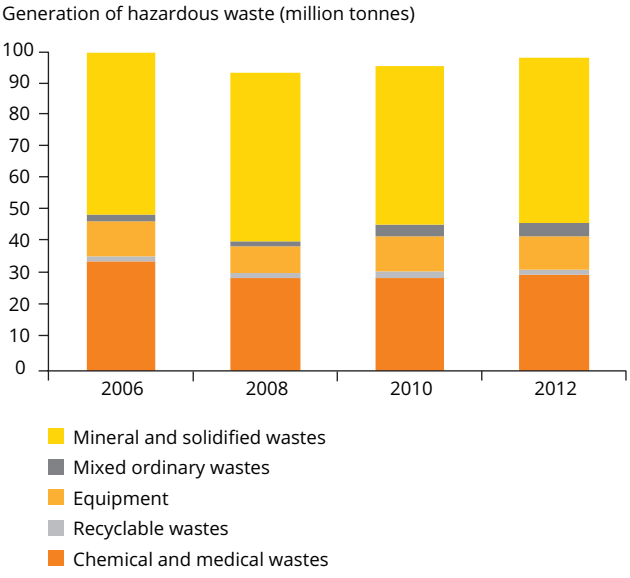
In 2012, EU-28 Member States discarded 2.5 billion tonnes of waste, of which close to 4 % was classified as hazardous. Although rates of overall waste generation in Europe declined between 2006 and 2012 by more than 3 % in absolute terms, the proportion of hazardous waste in total waste is slowly increasing (Eurostat, 2016a).

2.1.1 Hazardous waste streams

The amount of hazardous waste generated in the EU-28 increased slightly from previous years to around 100 million tonnes in 2012 (Figure 2.1). The predominant waste types, accounting for more than half the generated amount, **were mineral and solidified wastes**, whereas one third were **chemical and medical wastes** (Eurostat, 2016a).

It is likely that the increase in recycling activities, which has involved better sorting as well as the collection of treated wood and some chemical waste, has led to the identification of increased amounts of hazardous waste. Most likely, the hazardous waste existed previously, but was mixed with other waste types, and not reported separately. Provided that the management of hazardous waste follows stringent rules and regulations, the increase is not necessarily a problem.

Figure 2.1 Generation of hazardous waste by type, EU-28, 2006–2012



Note: For Ireland, Eurostat data on hazardous waste generated in 2010 and 2012 are currently undergoing verification and are expected to be corrected.

Source: Eurostat, 2016a.

2.1.2 Hazardous waste-generating sectors

The largest volumes of hazardous waste were identified in the **waste sector**, during collection, treatment and disposal of waste. These volumes have increased significantly over the last 10 years or so indicating a shift in waste management towards more recycling and other recovery operations that in turn generate waste such as treatment residues. The second largest sector generating hazardous waste is **construction**. The sector is, however, volatile because it is sensitive to economic cycles. In 2010, for example, recorded hazardous waste volumes fell sharply following the economic downturn in the previous years. For the EU-28 on average, amounts of hazardous waste generated in this sector dropped from 38 kg per person in 2008 to 32 kg per person in 2010 (Eurostat, 2016a).

The mining and quarrying sector is the third sector generating large quantities of hazardous waste. The recorded European average for this sector was 27 kg per person in 2012, with considerable national variations. Bulgaria had the highest figure (1 816 kg generated per person), due to its intensive mining activities (Eurostat, 2016a).

The household sector, an important source of hazardous waste, generated approximately a fifth of all European hazardous waste in 2012, and volumes coming from this sector are rising. Statistics indicate an increase from 6 to 7 kg per person between 2006 and 2012. This upward trend can partly be explained by the fact that more waste is separated, which allows better identification of hazardous waste and consequently better reporting. Another reason might be the introduction, revision and enforcement of specific legislation and targets from waste electrical and electronic equipment (WEEE) (see Box 3.1), but also the generally increasing amount in discarded electrical and electronic equipment, one of the fastest-growing waste streams. Moreover, in some countries, hazardous waste from households includes, among other things, end-of-life vehicles, which the vehicles disposed of in those countries accounted for approximately 46 % of household hazardous waste in the whole EU-28 in 2012. The statistics should be taken with caution, as these items are not accounted for in the household sector in all countries analysed.

Other important sources of hazardous waste are chemical and medical wastes. According to Eurostat (2016a), 60 % of chemical waste comes from the manufacturing sector; in particular, manufacture of coke and refined petroleum, manufacture of chemical, pharmaceutical, rubber and plastic products, and waste collection, treatment and disposal activities. Medical waste mainly comes from the service sector (also more than 60 %).

2.2 Hazardous waste intensity in European countries

One way to compare countries' performance is to compare the generation of hazardous waste per unit of GDP (Figure 2.2). This should, in theory, correct for economic differences between countries. However, although a country with a low ratio might appear to be performing well, this could be the result of under-reporting or a low level of activities that generate hazardous waste (ETC/SCP and ETC/WMGE, 2015).

Although most of the countries (25) performed better than the EU average of 7.4 tonnes per million EUR of GDP, hazardous waste intensity in 9 countries increased between 2008 and 2012, which goes against one of the objectives of the WFD: to reduce generation of hazardous waste (ETC/SCP and ETC/WMGE, 2015). However, it is also likely that part of the rising trend is due to increased awareness and better systems for separating hazardous waste.

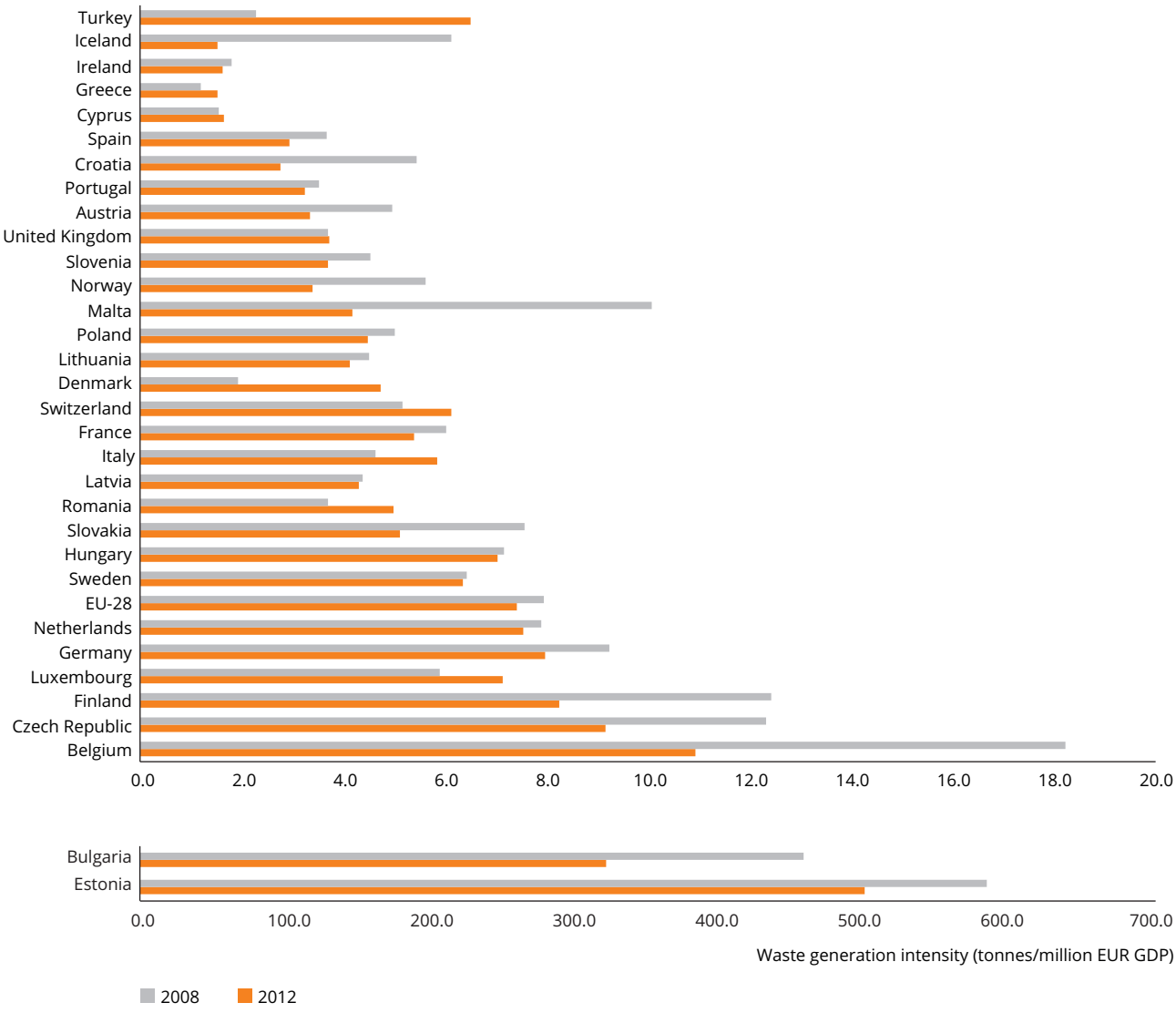
Improved performance (falling waste intensity) could suggest that a country is becoming more eco-efficient. However, it may also be that production of goods associated with high hazardous waste generation has been relocated outside Europe, as indicated by the EU's increasing trade deficit (imports higher than exports) between 2008 and 2012 (ETC/SCP and ETC/WMGE, 2015).

Changes in reporting methodology may also play a part. For example, the decrease in waste intensity in Malta can be attributed both to an actual decrease in the amount of waste oil from shipping and to a change in the reporting methodology. Since 2010, hazardous waste data have originated from waste export declarations and waste inputs into waste treatment facilities (ETC/SCP and ETC/WMGE, 2015).

Country-by-country analysis shows that in 2012, Estonia and Bulgaria were the countries with the highest recorded figures, 509 and close to 327 tonnes per million EUR of GDP, respectively.

For Estonia, this is due to the production of coke and refined petroleum products (shale oil), electricity, gas, steam and air conditioning supply, which together account for 98 % of the total amount of hazardous waste. This is an example where the decarbonisation of the energy system could generate two significant environmental benefits: large reductions in both greenhouse gas emissions and hazardous waste generation (ETC/SCP and ETC/WMGE, 2015; Section 5.3).

Figure 2.2 Hazardous waste intensity, 2008 and 2012



Note: For each country, the total amount of hazardous waste generated is divided by the GDP. For Ireland, estimates were provided for hazardous waste managed (0.3 million tonnes in 2008 and 0.28 million tonnes in 2012), which approximate generation figures. Data are currently undergoing verification and differ from data reported to Eurostat. High figures for Belgium could be explained by the facts that the country collects large amounts of hazardous waste, imports of hazardous waste for specialised treatment in Belgium could also be present, and in the Flemish Region, the classification of hazardous waste is stricter than in other countries, as eco-toxicity has been a concern for a long time.

Sources: Eurostat, 2016a; EPA, 2016a; Swiss Statistics, 2016.

For Bulgaria, 99 % of the hazardous waste is associated with mining and quarrying. Intensive mining activities, most notably coal, metallic minerals including iron, manganese, copper, chromium and zinc, and non-metallic minerals, mostly use open-pit excavation techniques (ETC/SCP and ETC/WMGE, 2015; Section 5.2).

Further detail on selected countries and region is provided in Chapter 5.

2.3 Hazardous waste generation per person in European countries

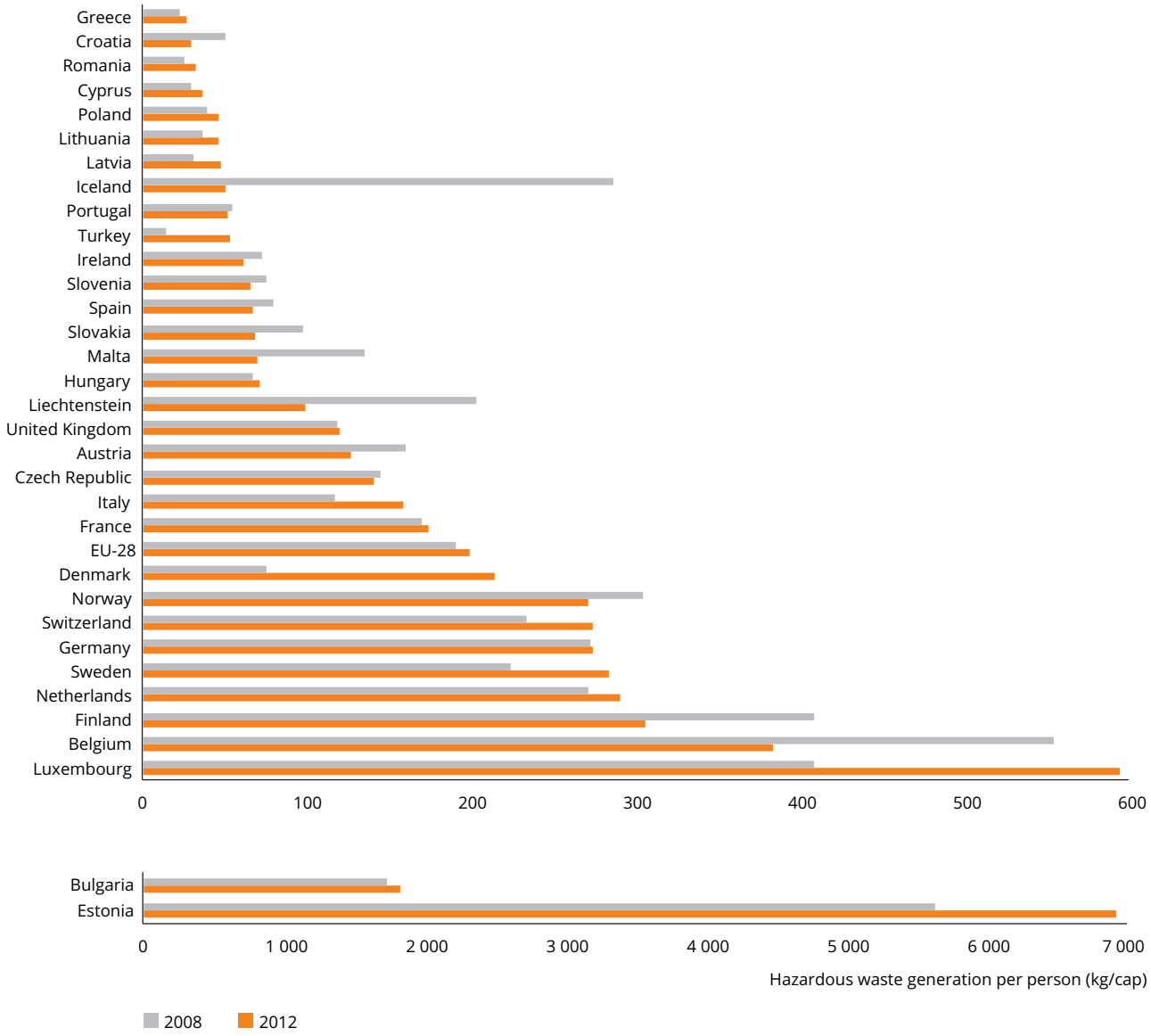
The EU average of 200 kg of hazardous waste generated per person has remained stable over the past several years. Results for EEA member countries are presented in Figure 2.3.

Country-by-country analysis reveals remarkable differences in amounts generated per person, with the highest recorded in Estonia and Bulgaria — close to 6 925 and 1 835 kg per person, respectively — and lowest in Greece — less than 30 kg per person. Eleven of the 33 EEA member countries generated more than the EU average.

2.4 Hazardous waste data

Analysis of the entire hazardous waste flow, from generation to treatment, is hampered by data quality issues.

Figure 2.3 Generation of hazardous waste per person, 2008 and 2012



Note: The total hazardous waste generated is divided by population for each country. For Ireland, estimates were provided for hazardous waste managed (0.3 million tonnes in 2008 and 0.28 million tonnes in 2012), which approximate generation figures. Data are currently undergoing verification and differ from data reported to Eurostat. High figures for Belgium could be explained by the facts that the country collects large amounts of hazardous waste, imports of hazardous waste for specialised treatment in Belgium could also be present, and in the Flemish Region the classification of hazardous waste is stricter than in other countries, as eco-toxicity has been a concern for a long time.

Sources: Eurostat, 2016a; EPA, 2016a; Swiss Statistics, 2016.

2.4.1 Data on hazardous waste

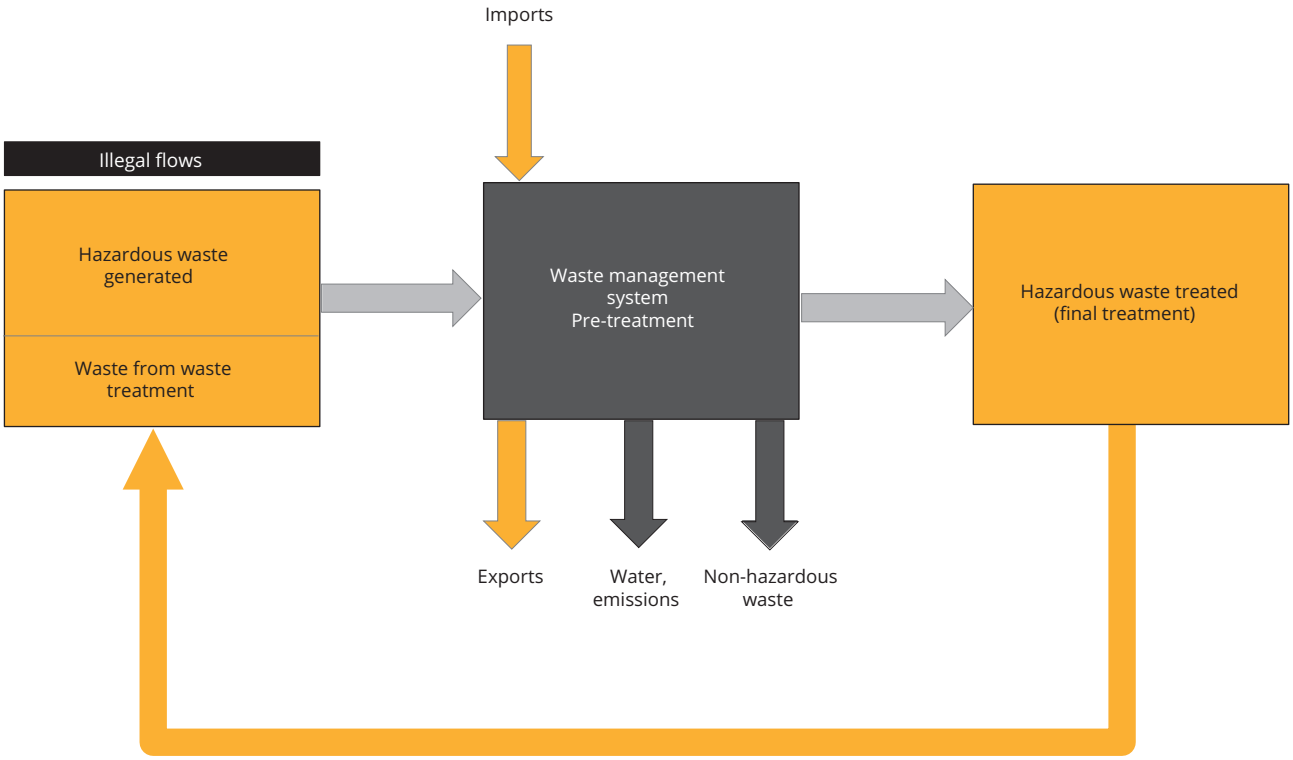
Waste data are reported to Eurostat by the EU-28, Iceland, Liechtenstein, Norway and Turkey in accordance with Regulation (EC) No 2150/2002 on waste statistics. The regulation was amended by Regulation (EU) No 849/2010 (EU, 2002a and 2010).

Figure 2.4 shows which data flows on waste generation, including hazardous waste, in each country and data on final waste treatment are reported (green boxes) to Eurostat, which maintains the Environmental Data Centre on Waste to collect and publish waste data.

Data on waste imports and exports are available in both datasets, but not according to the same waste categories and sectors of origin. What waste statistics do not reveal is what happens between waste generation and final treatment. That means that it is difficult to follow hazardous waste through the waste management system.

Additional data are available in the European Pollutant Release and Transfer Register (E-PRTR) (Box 2.1), which could, despite limitations, provide additional information that could be used to assess prevention measures for particular industries or installations.

Figure 2.4 What hazardous waste statistics do and do not reveal



Source: EEA.

Box 2.1 European Pollutant Release and Transfer Register (E-PRTR)

The register contains data reported annually by more than 33 000 industrial facilities covering 65 economic activities across the EU-28, Iceland, Liechtenstein, Norway, Serbia and Switzerland since 2007. 'For each facility, information is provided concerning the amounts of pollutant releases to air, water and land as well as off-site transfers of waste and of pollutants in waste water from a list of 91 key pollutants including heavy metals, pesticides, greenhouse gases and dioxins' (EEA, 2016a).

The E-PRTR information on waste transfers consists of the total transferred amounts per facility per year that transfers at least 2 tonnes of hazardous waste or 2 000 tonnes of non-hazardous waste. The information is disaggregated into disposal and recovery and, for transboundary movements of hazardous waste, also by waste recoverer and disposer.

The registry information does not, however, include every single waste transfer, and does not differentiate between different types of waste. Nevertheless, the registry does allow differentiation between hazardous and non-hazardous waste, as well as 'disposal', 'recovery' and 'unspecified' as treatment options.

The register contributes to transparency and public participation in environmental decision-making. It implements, for the EU, the Protocol on Pollutant Release and Transfer Register to the United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (UNECE, 2016b). The E-PRTR was established by Regulation (EC) No 166/2006 (EU, 2006c).

2.4.2 Data on hazardous waste shipments

In spring 2016, Eurostat launched an interactive web-based map of transboundary waste shipments, which are regulated in the EU by Regulation (EC) No 1013/2006. This regulation implements the Basel Convention ([6]) (Basel Convention, 2016) ban on hazardous waste exports from Organisation for Economic Co-operation and Development (OECD) countries to non-OECD countries. All hazardous waste movements must be notified in advance and EU Member States report on waste that is shipped across their borders (EU, 2006b; Eurostat, 2016b). Nonetheless, illegal waste shipments, in particular for hazardous waste, are a widespread problem (Box 3.2).

The data in the interactive map include imports and exports of all wastes, hazardous and non-hazardous. These amounts are to be reported to the Basel Convention Secretariat and to the EC. All shipments that cross borders are termed either exports or imports, regardless of whether or not they remain within the EU (Map 2.1) (Eurostat, 2016b).

2.5 Data quality issues

Uncertainties with regard to the availability and quality of statistics pose a specific challenge for the development and assessment of hazardous waste prevention policies. This concerns data on both waste generation and flows of hazardous waste. Discrepancies in hazardous waste data flows were identified for 10 selected countries, in particular regarding (BIPRO, 2015):

- reported Eurostat data and national statistics with regard to hazardous waste generation and treatment;
- data on reported hazardous waste generation and treatment.

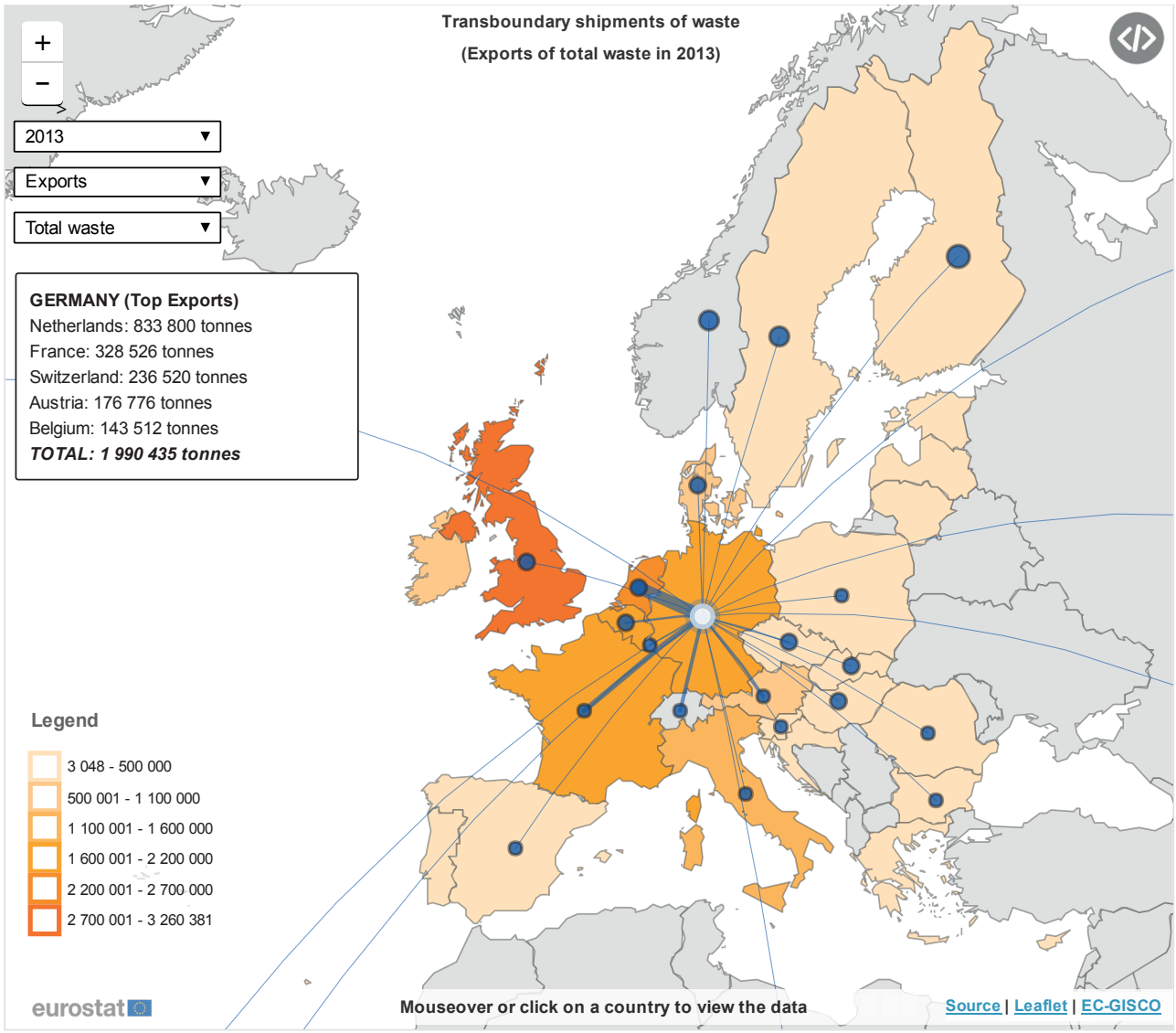
These hamper country comparison and the analysis of hazardous waste generation over time. The gaps can be explained mainly by differences between the reporting rules on waste generation and on waste treatment.

Member States also use different reporting systems. In addition, the study found that at the EU level there is a lack of guidelines or recommendations for a methodology to assess ecotoxic property HP 14. For that reason, assessment on HP 14 is performed differently across EU Member States. In addition, the revised waste legislation from June 2015 did not include amendments to the HP 14 property, for lack of a satisfactory methodology (BIPRO, 2015).

According to the 2015 study by the Consultancy for Integrated Solutions (*Beratungsgesellschaft für integrierte Problemlösungen*, BIPRO), the main reasons for the discrepancies between Eurostat and national data on hazardous waste are:

([6]) The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal from 1989.

Map 2.1 Transboundary exports of total waste, Germany, 2013



Source: Eurostat, 2016b.

- in-company amounts of hazardous waste treated on site are not covered by the record- keeping system;
- uncertainties in reporting, in some cases, are obvious mistakes;
- Eurostat statistics on hazardous waste treatment exclude certain recovery/disposal operations from the reporting obligation, leading to a statistical gap;
- hazardous waste may be generated in one year and temporarily stored for treatment in the next year, for example in the case of large amounts of contaminated soils;
- import/export statistics refer exclusively to the Basel Convention Y-code classification, and there is no additional information available in the List of Wastes codes;
- hazardous waste generated is partly double-counted, particularly waste amounts sent to transfer stations and for pre-treatment and waste coming from other sites;
- pre-treatment activities or flows of hazardous waste for reprocessing are not reported to Eurostat;

- amounts in national statistics are calculated based on fresh weight, whereas data for certain sludge (especially from the List of Wastes, in Chapters 3 and 12) in Eurostat are based on dry weight.

Tackling the highlighted issues and changing the hazardous waste classification system (Chapter 1) might improve data quality and consequently help in defining potential prevention targets and indicators.

The EC has initiated a project on waste statistics, a comprehensive review of weaknesses and key priority areas for the improvement of EU waste statistics, including reporting obligations to the Waste Framework Directive (EU, 2008), the Landfill Directive (EU, 1999), the Packaging and Packaging Waste Directive (EU, 1994), the End-of-Life Vehicles Directive (EU, 2000b), the Waste Electrical and Electronic Equipment Directive (EU, 2012), the Batteries Directive (EU, 2006a) and the Waste Shipments Regulation (EU, 2006b). The aim of the study is to screen the existing system of reporting waste statistics, identify the main sources of uncertainty, inconsistencies and gaps in waste statistics, and propose ways to improve the existing reporting system.

Eurostat has been especially studying secondary wastes to follow hazardous waste through the waste management system and will continue to discuss key definitions and priority sectors. This work might also improve future availability of relevant data for the analysis of hazardous waste prevention.

3 Institutional and policy frameworks

Prevention of hazardous waste, although very much linked to the management of hazardous waste, is lagging behind in terms of political and financial support in Europe. Implementation of prevention measures is scattered between many actors and players or is not explicitly the responsibility of any institution.

Hazardous waste has been subject to a broad range of legislation and policy frameworks across the globe for several decades. If developments in this area from around the world, or more specifically in Europe, were better understood, they could contribute to identifying challenges in preventing the generation of hazardous waste.

3.1 Diversity of actors and roles

As outlined in Chapter 1, preventing hazardous substances from entering the waste stream can be addressed at various stages of the value chain, from the extraction of raw materials to the management of end-of-life products. As well as being the subject of voluntary initiatives, the issue is integrated into a variety of legal frameworks including regulations for specific production processes and product-specific regulation at national and European levels.

Against this background, the institutional set-up for hazardous waste prevention is extremely complex and differs from Member State to Member State. As illustrated in previous EEA waste prevention reviews (EEA, 2014 and 2015), national and regional waste programmes address the avoidance of hazardous waste generation in very different ways — if at all. Priorities obviously differ based on the national or regional context, often depending on the economic importance of industrial sectors with high levels of hazardous waste generation.

Institutional responsibilities are often not precisely explained within waste prevention programmes and it is clear from the 12 country/region profiles (Chapter 5) that a coherent institutional framework for hazardous waste prevention is currently lacking. Responsibilities are shared between actors in various thematic fields including, for example, cleaner production, clean material cycles, sustainable product policy and consumer protection — to name just a few.

Improving the coordination between relevant actors and stakeholders at different stages of the value chain appears to be a key challenge for future hazardous waste prevention policy and could enable better evaluation of prevention implementation efforts.

3.2 Policy frameworks

3.2.1 Global policy framework

Since the early 1970s, several multilateral legally binding instruments have been developed. These instruments aim to improve the prevention and management of hazardous waste and chemicals. The list includes:

- **London Convention (1972)** — the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. The convention's objectives are to promote the effective control of all sources of marine pollution and to take practical steps to prevent pollution of the sea (IMO, 2016a).
- **MARPOL Convention (1973)** — the International Convention for the Prevention of Pollution from Ships. The convention includes regulations to prevent and minimise pollution from ships due to operational or accidental causes (IMO, 2016b).
- **Basel Convention (1989)** on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. The convention's objective is to protect human health and the environment against the adverse effects of hazardous waste by regulating its movements. One of its additional objectives is to minimise hazardous waste generation, in both qualitative and quantitative terms (Basel Convention, 2016).
- **Rotterdam Convention (1998)** on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. The convention's objectives are to promote shared

responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm, and to contribute to the environmentally sound use of those hazardous chemicals (Rotterdam Convention, 2016).

- **Stockholm Convention (2001)** on Persistent Organic Pollutants (POPs). The convention is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts. It lists 22 chemicals whose consumption, production and use, import and export, disposal and/or environmental release should be reduced, prohibited and/or eliminated (Stockholm Convention, 2016).

The Basel, Rotterdam and Stockholm Conventions are subject to the 'synergies process', an example of enhancing international environmental governance through coordination and cooperation. The process aims to strengthen their implementation at national, regional and global levels by providing coherent policy guidance, enhancing efficiency in the provision of support to Parties, reducing administrative burdens and maximising the effective and efficient use of resources at all levels (Synergies, 2016).

Trends in generation and transboundary movements of chemicals and hazardous wastes point to the increasing global challenges that these multilateral agreements address. With continuous increases in the global population and the consumption of resources and energy, impacts on the environment, such as pollution, waste generation and transboundary movements, are also rising. At the same time, material reuse and recycling are also increasing, as is the coverage of regulations and enforcement (Basel Convention, 2012).

The impacts of these trends on the human health and environment are of particular concern. The barriers linked to economic and social costs — such as discrepancies between the demand to minimise waste and the needs of the waste market, the rapid obsolescence of products and illegal trafficking of waste — impede the necessary changes that could reduce these impacts (Basel Convention, 2012).

3.2.2 European policy framework

Almost in parallel with the development of the first global environmental multilateral agreements, the EEC took the first steps to introducing environmental policy and legislation, and waste was among the first topics covered by the mid-1970s. 'The need to prevent the generation of waste, to encourage recycling, and to save materials and reduce the volumes for disposal' was recognised in both the first 'waste framework' directive, No 75/442 and the first 'dangerous waste' directive, No 78/319, but expressed only as an aspiration (Haigh, 2016).

Restricting waste movements came, however, much later, in 1989, in the first Community Strategy for Waste Management. The strategy was a 'prelude' to the introduction of the internal market in 1992 by the Single European Act. This anticipated an increase in exports of waste, driven by the location of the lower-cost disposal plants. As Haigh (2016) pointed out, the priority was not only to harmonise high disposal standards, but also to reduce movement of waste by 'favouring disposal in the nearest centres', the so-called 'proximity principle'.

By publishing the second strategy in 1997, the Commission marked a shift in EU policy from waste management to resource recovery, in terms of both waste and energy. It also reaffirmed the concept of a waste hierarchy covering prevention, recovery and safe disposal in that order of priority, in addition to the principles of proximity and self-sufficiency for waste disposal facilities. It also introduced, for the first time, the term 'producer responsibility', recognising the preeminent role of the product manufacturer, despite the fact that many entities share the responsibility for waste during the lifecycle of a product (Haigh, 2016).

In a parallel process, priority waste streams were identified and regulated, including batteries (1991), packaging (1994), end-of-life vehicles (2000) and electrical and electronic equipment (2002) (Box 3.1), to name but a few. Each of these pieces of legislation 'required the products to be designed so they were easy to recycle, restricted the use of dangerous substances that made recycling difficult and, in some cases, placed a duty on the manufacturer to take back the product at the end of its life, or arrange for this to be done' (Haigh, 2016).

From the consumption perspective, in 1992 the Ecolabel Regulation (880/92) was adopted to provide more information to consumers about products with reduced environmental impacts, and, at the same time, to put pressure on producers to market this type of product. More than a decade later, the Commission adopted the Ecodesign Directive (2005/32), which, although it is concerned with energy efficiency standards for products, provides 'a precedent for setting standards for recyclability and recycled content' (Haigh, 2016). It may also provide a precedent for minimum requirements

Box 3.1 Ban on the use of hazardous materials in electrical and electronic equipment

Policy efforts have been stepped up to reduce hazardous content of waste in Europe through the development of a number of regulatory instruments. An example is the EU's restriction on the use of six hazardous materials in electrical and electronic equipment, which is subject to two EU directives:

- The Restriction of Hazardous Substances (RoHS) Directive (2002/95/EC), with its revision RoHS2 (2011/65/EC), restricts the use of six hazardous materials — lead, mercury, cadmium, hexavalent chromium and two types of flame retardants — and ensures coherence with more recent policies and legislation linked to chemicals in products in Europe and their marketing. The legislation provides conditions for the creation of collection schemes to increase the recycling and/or reuse of such products (EEA, 2015; EC, 2016d).
- The Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC), revised by Directive 2012/19/EC, sets measures to reduce the generation of WEEE and to increase rates of collection, preparing for reuse, recycling and recovery, through a series of legally binding targets (EEA, 2015; EC, 2016g).

on product duration, reparability, availability of spare parts, hazardous substance contents or information requirements as means of 'design for prevention and reuse' (EAA, 2015a).

The Landfill Directive (1999/31) requires Member States to organise separate collection of different wastes with the objectives of reducing emissions of methane; encouraging prevention, recycling and recovery; and reducing shipments. Landfills were divided into three classes — hazardous, non-hazardous and inert waste — and mixing them was prohibited (Haigh, 2016).

The need to take further action to reduce waste was recognised in the Commission's Sixth Environmental Action Programme (EU, 2002b), which developed strategies on waste and resource use, among others. The Thematic Strategy on Waste Prevention and Recycling (COM(2005)666) took a lifecycle approach, with a new focus on waste prevention and a shift to a materials-based approach rather than the previous focus on particular types of end product (Haigh, 2016).

In 2011, the EC published a report on progress in improving and simplifying legislation, putting the accent on the concepts such as waste hierarchy and lifecycle thinking, increasing the focus on waste prevention and setting the new collection and recycling targets. Although progress was visible in improving the recycling rates, decreasing the waste going to landfill, decreasing the hazardous substances in some waste streams and decreasing the relative environmental impacts per tonne of waste treated, it could not compensate for the negative environmental impacts due to more waste generation (Haigh, 2016).

One example was the Waste Framework Directive 2008/98, which consolidated the previous Waste Framework Directive, the Hazardous Waste Directive (91/689/EEC) and the Waste Oils Directive (75/439/EEC). The new directive went much further by also introducing the concepts 'developed in the preceding strategies'. The directive introduced a new focus on prevention by requiring Member States to adopt their own national waste prevention programmes by December 2013. National legislation also had to introduce the waste hierarchy, including redefinition of the term 'reuse'. The distinction was made between the products and components not labelled as waste or reuse and the waste products that are prepared for reuse without reprocessing. This resulted in the introduction of an additional stage in the waste hierarchy: reuse of products that 'have and have not become waste' (Haigh, 2016).

Forty years on, the EU adopted the Roadmap to a Resource Efficient Europe, the EU's 7th Environment Action Programme (EAP) and the Circular Economy Strategy.

The Roadmap to a Resource Efficient Europe states that waste generation should be in decline by 2020, in addition to committing to working 'within the EU and with international partners to eradicate illegal waste shipments with a specific focus on hazardous waste' (EC, 2011).

The 7th EAP targets safe management of hazardous waste and generating less of it, and commits to 'set out a comprehensive approach to minimising exposure to hazardous substances, including chemicals in products' (EU, 2013).

The Circular Economy Package published in 2015 included an EU Action Plan for the Circular Economy. It introduced measures 'to cover the entire cycle: from production and consumption to waste management and the market for secondary raw materials'

(EC, 2016b). The aim of the action plan is to 'close the loop of product lifecycles through greater recycling and re-use, bringing benefits for both the environment and the economy' (EC, 2016b). The package also includes revised legislative proposals on waste 'to stimulate Europe's transition towards a circular economy, which will boost global competitiveness, foster sustainable economic growth and generate new jobs' (EC, 2016b).

3.2.3 Waste shipments

Hazardous waste movement across borders was one of the first issues to be regulated by EU legislation. Although the Dangerous Waste Directive (78/319) mainly focused on defining hazardous waste and how it is to be handled or managed, it did not cover hazardous waste shipments. The first mention of the issue was in the Transfrontier Shipment of Hazardous Waste Directive (84/631), which required 'anyone moving hazardous waste across frontiers, both within and out of the EU, to inform the authorities in the receiving country' (Haigh, 2016). The directive did not, however, consider the necessary disposal facilities at the final location or the consent of the receiving country.

The United Nations Environment Programme (UNEP) recommended that exports to developing world countries should take place only when they had the necessary disposal facilities, whereas the OECD recommended in 1985 that OECD countries should not allow exports without the consent of the receiving countries.

This led to the establishment of the Basel Convention in 1989, enabling parties to ban waste imports. At the EU level, Directive 84/631 was replaced by the Regulation 259/93 on the supervision and control of shipments, which was further replaced by Regulation 1013/2006 on shipments of waste, which details conditions on the movement of waste from one country to another. The regulation includes both the Basel Convention and the OECD Decision on shipments for recovery operations (EEA, 2013).

The regulation was further amended in 2014 (Regulation 660/2014), as in 2012 every fourth inspected waste shipment revealed a violation of the Waste Shipment Regulation (Box 3.2). The new regulation is intended to strengthen inspection systems in the Member States.

Box 3.2 Illegal waste shipments

Shipments of waste in the EU experienced a renaissance at the beginning of the 1990s due to the introduction of the Single European Market, improvements in waste management regulation and the establishment of the waste hierarchy. Although this inspired Member States to find new approaches to waste management, it created an unwanted effect: illegal waste shipments (EEA, 2012).

Hazardous waste exports stayed predominantly within the EU, driven by the lack of national capacity to handle waste streams, and differing costs of recovery or disposal in different locations. Regulation, among other drivers, led to a rise in hazardous waste cross-border movements (EEA, 2012).

Because sound hazardous waste treatment within the EU often costs a lot, there are economic incentives to ship it illegally to places with no or lower environmental standards. Such action often has severe consequences for the environment and/or human health (Basel Convention, 2014).

Despite the efforts of the European Commission, EU Member States and international organisations and initiatives (the Basel Convention, the Green Customs Initiative, etc.), illegal shipments of specific hazardous waste streams, for example discarded electronic products, are assumed to have increased significantly over the last decade (Geeraerts et al., 2015). Empirical data are highly uncertain, but the amount of WEEE that illegally leaves the EU each year has been estimated at around 2 million tonnes (Zoeteman, 2006).

Illegal shipments appear to be rising, with 2 500 cases reported in 2013 in the EU-27 ([7]), up from 400 in 2009. This could indicate an actual increase in the number of illegal shipments but, alternatively, it could reflect better reporting or more effective control measures (EC, 2016h).

In 2012, the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL) reported that on average 25 % of physical inspections found violations of the Waste Shipment Regulation (IMPEL, 2012). To strengthen Member States' inspection systems, the regulation was amended through Regulation (EU) No 660/2014, with a requirement to apply the changes in 2016/2017 (EU, 2014a).

([7]) The EU-27 does not include Croatia, which joined the EU only in July 2013.

4 Prevention of hazardous waste

Twenty-eight EU Member States plus three EFTA countries, Iceland, Liechtenstein and Norway, are legally obliged to adopt a waste prevention programme under the WFD.

As some countries have regional rather than national waste prevention, the total number of programmes (36) is higher than the number of countries (31). This review covers the 30 programmes in 25 EU countries and Norway that were adopted by the end of 2015 (Table 4.1). The remaining six programmes will be considered in future reviews.

This chapter summarises the key findings regarding the programmes' focus on hazardous waste, as expressed in waste prevention objectives, scope, targets, indicators, and policy instruments and measures. Examples extracted from country/region profiles (Chapter 5) are provided throughout this chapter.

4.1 Status of hazardous waste prevention

Of the 30 adopted programmes, hazardous waste is within the scope of 25. Of these, 17 programmes gave explicit objectives for the reduction of generated volumes and/or the reduction or elimination of hazardous substances in materials and products.

Only four programmes, in Bulgaria, Italy, Latvia and Sweden, have set quantitative prevention targets for hazardous waste, and seven, in Austria, Bulgaria, Cyprus, France, Germany, Latvia and Spain, have included prevention indicators (Table 4.2).

A lack of explicit objectives and scope in programmes does not necessarily mean that the country or region does not prioritise hazardous waste, as it may be included in more general objectives or scope categories. The absence of prevention targets is strongly linked to the classification of hazardous waste and the lack of a hazardous waste baseline across programmes, resulting in few defined prevention indicators. Revision of the waste classification system and attempts to improve waste statistics also contribute to the problem.

All of the above have implications for the effective monitoring and evaluation of implemented measures.

4.2 Prevention objectives and scope

4.2.1 Waste prevention objectives

Waste prevention **objectives** linked to the use or reduction of harmful substances are explicitly included in 17 waste prevention programmes (Annex 1; EEA, 2015).

Table 4.1 Countries and regions (30) covered by the 2015 waste prevention review

Austria	Finland	Latvia	Portugal
Brussels (a)	Flanders (a)	Lithuania	Scotland (a)
Bulgaria	France	Luxembourg	Slovakia
Cyprus	Germany	Malta	Spain
Czech Republic	Greece	Netherlands	Sweden
Denmark	Hungary	Nothern Ireland (a)	Wales (a)
England (a)	Ireland	Norway	
Estonia	Italy	Poland	

Note: (a) Region.

Table 4.2 Coverage of hazardous waste in the programmes adopted in European countries and regions, beginning of 2016

No (30)	EEA member countries (24)	17	4	7	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1	Austria																									
	Belgium																									
2	Brussels (a)																									∞
3	Flanders (a)																									
4	Wallonia (a)																									
5	Bulgaria																									
6	Croatia (b)																									
7	Cyprus																									
8	Czech Republic																									
9	Denmark																									2027
10	Estonia																									
11	Finland																									
12	France																									
13	Germany																									
14	Greece																									
15	Hungary																									
16	Iceland (c)																									2027
17	Ireland																									∞
18	Italy																									
19	Latvia																									
20	Liechtenstein																									
21	Lithuania																									
22	Luxembourg																									∞
23	Malta																									
24	Netherlands																									∞
25	Norway																									∞
26	Poland																									
27	Portugal																									
28	Romania																									
29	Slovakia																									
30	Slovenia																									
31	Spain																									
32	Sweden																									
	United Kingdom																									
33	England (a)																									∞
34	Northern Ireland (a)																									∞
35	Scotland (a)																									∞
36	Wales (a)																									∞

Hazardous waste

- Programme covered by 2015 review
- No programme
- No information
- Duration/coverage of the programme
- ∞ Virtually indefinite duration
- Scope
- Objectives
- Quantitative target
- Indicators
- Austrian waste prevention and recycling strategy

Note: (a) Region.

(b) Special agreement with the EC.

(c) The Icelandic waste prevention programme covers hazardous waste in WEEE in 2022–2023, hazardous waste in construction and demolition waste in 2024–2027 and hazardous waste in heavy industry in 2016–2027.

Sources: Annex 1 ([8]); EEA, 2014 and 2015.

([8]) Annex 1 provides both an overview of the status of the 36 waste prevention programmes across Europe and references/links to the waste prevention programmes that are subject to this review. Throughout the text it is cited in combination with other references: EEA, 2014 and/or EEA, 2015.

The majority of the existing programmes include qualitative aspects of waste prevention, for example, those that aim to reduce the content of harmful substances in materials and products, as defined in Article 3(12) of the WFD (Annex 1; EEA, 2015).

- Bulgaria aims to reduce the content of harmful substances in materials and products.
- Denmark aims to make it easier for consumers to buy products and services that require fewer resources, contain fewer problem substances and generate less waste. It also aims to support textile companies in reducing environmental impacts in the production phase and making it easier to reuse and recycle textiles, including by reducing the use of hazardous substances.
- Finland plans to reduce the use of certain hazardous chemicals and replace them with less hazardous alternatives.
- Flanders bans/prevents the use of hazardous materials in new buildings and retrieves hazardous substances during the demolition of buildings and infrastructure. During the pre-demolition audits, particular attention is paid to the presence of hazardous waste. Demolition monitoring ensures that no hazardous substances are present in the debris from which aggregates will be recycled. The reuse or recycling of building waste and aggregates containing hazardous substances is prohibited and final treatment is imposed.
- Germany has an operational goal of reducing and substituting hazardous substances.
- Latvia is committed to reducing the quantity of hazardous substances used in the production of materials and products.
- Lithuania is working to reduce the amount of harmful substances in materials and products.
- Poland has set an objective related to products and production with particular emphasis on limiting the use of harmful substances.
- Portugal aims to act progressively to reduce the presence of hazardous substances in products, materials and waste.
- Slovakia aims to further reduce the generation of hazardous waste by supporting extended producer responsibility (EPR) for other products and by support of the EU Eco-Management and Audit Scheme (EMAS) and the Environmental Management System (EMS) according to STN EN ISO 14001([9]).
- Spain puts emphasis on reducing the toxicity of substances in products.
- Wales aims to reduce the content of harmful substances in materials and products.

Several programmes include both qualitative and quantitative objectives, except those of Cyprus and the Czech Republic, which include only quantitative ones (Annex 1; EEA, 2015).

- Cyprus includes the objective of reducing the generation of hazardous municipal waste.
- The Czech Republic is working to stabilise volumes of hazardous waste and plans to reduce them in the coming years.
- Estonia has a strategic goal of preventing and reducing waste generation and its toxicity.
- Ireland's goal is to reduce the use of hazardous substances and the generation of hazardous waste.
- The Netherlands plans to introduce practical measures to improve product design — less material use, fewer harmful substances, more recycled material and longer product life — as part of its circular economy framework.
- Sweden aims to guide and inspire stakeholders so that environmental goals are met, less waste is generated and products are free of hazardous substances irrespective of how much the economy grows.

Austria's Waste Management Plan targets both quantitative and qualitative prevention. The objective of reducing the volume of hazardous materials and products was officially set in 2002 in the Strategy for Sustainable Development (BMLFUW, 2002).

Specific substances that should be banned or avoided are not listed or described in any of the programmes.

([9]) STN EN ISO 14001:2016 is an abbreviation of the Slovak translation of ISO 14001:2015, which stands for Environmental Management Systems Requirements with guidance for use.

Reducing the adverse impacts of generated waste on human health and the environment is also implicit but rather vague (EEA, 2015).

4.2.2 Waste prevention scope

In terms of scope, 25 programmes specifically cover the prevention of hazardous waste streams (Table 4.3). In Flanders, Northern Ireland and Portugal, programmes lack explicit coverage of hazardous waste but it may be covered in programmes that address other types of waste.

The main hazardous waste-generating sectors are mining, construction and households, as explained in Chapter 2. More information on the sectoral coverage of programmes is presented in Table 4.4.

4.3 Quantitative targets and indicators

4.3.1 Quantitative waste prevention targets

Many countries have decided not to include quantitative targets for the time being (Annex 1; EEA, 2015). Based on the conclusions of Chapter 2 and

Table 4.3 Waste prevention programmes by waste type, end of 2015

Countries and regions (30)	Austria	Brussels (a)	Bulgaria	Cyprus	Czech Republic	Denmark	England (a)	Estonia	Finland	Flanders (a)	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Northern Ireland (a)	Norway	Poland	Portugal	Scotland (a)	Slovakia	Spain	Sweden	Wales (a)
WEEE/batteries (29)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Hazardous waste (25)	■	■	■	■	■		■	■	■		■	■		■	■	■	■	■	■	■	■		■	■		■	■	■	■	■
Household/municipal waste (27)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■		■	■	■		■
Construction and demolition waste (26)	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■			■	■	■	■	■
Manufacturing waste (20)	■	■	■		■	■	■	■			■	■	■		■		■	■		■	■	■				■	■	■		■
Other (b) (23)	■	■	■	■	■	■	■	■			■		■	■	■			■		■	■	■	■	■	■	■	■	■	■	

Note: (a) Region.

(b) Other waste types include textiles, tyres, garden waste, vehicles and nappies.

Sources: Annex 1; EEA, 2015.

Table 4.4 Waste prevention programmes by sector, end of 2015

Countries and regions (30)	Austria	Brussels (a)	Bulgaria	Cyprus	Czech Republic	Denmark	England (a)	Estonia	Finland	Flanders (a)	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Northern Ireland (a)	Norway	Poland	Portugal	Scotland (a)	Slovakia	Spain	Sweden	Wales (a)
Households (30)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Construction/infrastructure (27)	■	■		■	■	■	■	■	■	■	■	■		■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Manufacturing (24)	■		■		■		■	■	■	■	■	■		■	■	■	■	■	■	■	■	■		■	■	■		■	■	■
Agriculture (11)											■	■		■	■	■		■			■			■		■		■	■	
Mining, raw material processing (10)					■			■	■		■	■									■			■		■	■	■		

Note: (a) Region.

Sources: Annex 1; EEA, 2015.

challenges linked to hazardous waste classification and data quality issues, countries' reservations about establishing quantitative targets are, however, no surprise.

Germany, for example, considers the setting of such targets premature owing to the poor quality of data and the problems associated with defining indicators and establishing evaluation mechanisms. Against this background, the German Federal Environment Agency (UBA) is in the process of starting a new research project to analyse the possibilities of a consistent set of waste prevention indicators and related targets (EEA, 2015).

Only three countries have set quantitative targets for preventing hazardous waste that should be achieved by 2020 (Annex 1; EEA, 2015).

- In Bulgaria, overall targets include ensuring that by 2020 the generation of hazardous waste per unit of GDP is less than in 2010.
- In Italy, by 2020 the ratio of special hazardous waste to GDP should be 10 % lower than in 2010 ([10]).
- In Latvia, not more than 50 000 tonnes per year of total hazardous waste is to be generated by 2020. Latvia recorded 95 100 tonnes of hazardous waste in 2012.

Sweden is explicitly striving to reduce the content of hazardous substances in materials and products, but without specifying a concrete target (Section 5.11) (EEA, 2015).

4.3.2 Waste prevention indicators

Indicators and benchmarks are crucial for monitoring progress against objectives and targets in waste prevention programmes, for quantitative as well as qualitative ones. Indeed, the programmes reviewed show a broad range of indicators concerning their characteristics, number and feasibility, but there is little clarity about which of these indicators will be either further researched or implemented (Annex 1; EEA, 2015).

Specific hazardous waste prevention indicators were found in seven programmes:

- Austria: generation of hazardous waste;
- Bulgaria: hazardous waste generated per unit of GDP;
- Cyprus: amount of hazardous waste separately collected (in tonnes per year) and the qualitative composition of municipal waste;
- France: generation of hazardous waste;
- Germany: number of banned hazardous substances;
- Latvia: total amounts of hazardous waste generated (tonnes per year), hazardous waste recycled (%) and hazardous waste landfilled (%);
- Spain: amount of hazardous waste generated per year per industrial unit of GDP (gross value added).

4.3.3 Waste prevention monitoring systems

So far, only 10 programmes in Austria (Box 4.1), Cyprus, France, England, Hungary, Italy, Malta, Poland, Spain and Sweden, stipulate a specific monitoring system for their waste prevention indicators, and the responsible actors for monitoring are explicitly mentioned in only four, in France, Italy, Spain and Sweden. None of these programmes has a specific monitoring scheme for hazardous waste prevention.

([10]) Special waste, according to Article 184, paragraph 3 of Italian Legislative Decree 152/2006, includes waste from agriculture and the agro-industry; from demolition, construction and excavation activities; from industrial processes; from manufacturing; from commercial activities; from activities of recovery and disposal of waste; and sludge from treatment of water and arising from sanitary activities.

Box 4.1 Monitoring system for waste prevention measures in Austria

The implementation of the Austrian waste prevention programme, within its waste management plan, is based on a comprehensive evaluation of specific waste prevention measures. The Federal Ministry of Agriculture, Forestry, Environment and Water Management, in cooperation with experts and stakeholders, conducts an assessment of the progress achieved throughout the lifespan of the plan. The current plan covers the 2011–2017 period. It is based on an evaluation of the measures of the preceding waste prevention strategy, which was valid for the 2006–2011 period. The evaluation of the current plan leads to a decision about which waste prevention measures will be continued in the subsequent plan, replaced, complemented or phased out (EAA, 2015a).

The current waste management plan includes five packages of 70 prevention measures. One of the packages concerns construction waste prevention and recycling and includes, among others, measures on selective demolition. These measures are still in the process of implementation (EAA, 2015b).

As a general rule, waste prevention strategies can be either evaluated as a whole or divided into measure packages or single measures. The assessment can focus on strategic objectives or quantitative targets. In the Austrian waste prevention programme, no baseline scenario for waste generation (without waste prevention) could be determined, as the speed of recovery after the economic downturn in 2008 was not foreseeable. Consequently, it is impossible to show the effect of the waste prevention programme as the difference between waste generation in practice and the originally expected waste generation of the baseline without waste prevention.

It is possible to compare the trends in waste generation up until the start of the programme with the trend since the start of the programme. However, there are only a few data points since the start of the programme, and also economic development was far from smooth. Therefore, to date it is possible to draw only rather general qualitative conclusions from the waste data (indicators).

When looking at the level of single waste prevention measures or at measure packages, the evaluation becomes even more qualitative.

In the case of the Austrian waste prevention programme 2011, the waste prevention measures were evaluated in two different phases of the programme development:

1. During programme design what could be the possible effects of the envisaged waste prevention measure. Table 4.5 provides an example of a description of the expected effects of the waste prevention strategy. It also estimates in which waste stream the measure is expected to show qualitative or quantitative effects in a certain time-frame. The effects relating to waste generation will probably be seen in 10–20 years, whereas the effects regarding waste composition will be visible within 5–10 years.

Table 4.5 Example of how waste measures under the 'construction waste prevention and recycling' package are evaluated in Austria

Measure	Expected effects	Measurable impact on		Effect in years
		waste stream generation	waste stream composition	
Selective dismantling or demolition?				
• Pilot projects of selective dismantlig and waste sorting islands on construction sites. • Standards of establishing a dismantling concept and criteria for dismantling public buildings. • Regulation to make waste management plans for construction sites, dismantling concepts, contaminant investigation before dismantling, and the installation of sorting islands on construction sites obligatory.	Pollutant content in big fractions of construction waste should decrease, therefore increased recycling rates are possible		Pollutant content in fractions of construction waste	About 10 years

Source: EAA, 2015b.

Box 4.1 Monitoring system for waste prevention measures in Austria (cont.)

2. After the waste prevention measure has been implemented, it is evaluated to see if it fulfilled expectations and if it should be continued, altered or complemented in the next programme. This evaluation comprises a description of the measure implemented, a qualitative estimate of the effects and an estimate of whether or not the measure is still usefully applicable considering changed framework conditions. The list of criteria used for this qualitative evaluation is based on (EAA, 2015b):

   - whether or not the implemented measures correspond to the original plan;
   - what effects can be expected;
   - if effects can already be seen;
   - if a measure contributes to the achievement of objectives;
   - if the measure is effective;
   - if the measure is adequate given recent developments;
   - what further steps are necessary or recommendable for future waste prevention plans.

4.4 Policy instruments and measures

4.4.1 Waste prevention measures

Measures to prevent hazardous waste are included in several waste prevention programmes as outlined in the WFD (Box 4.2). The programmes include, among other things, planned measures, activities, initiatives and policy instruments targeting hazardous waste. Many other measures do not specify which concrete waste streams are addressed and might also refer to hazardous waste, such as in green public procurement (GPP) guidelines.

Examples of specific hazardous waste prevention measures include the following (Annex 1; EEA, 2015):

- Austria: standardisation of the building passport, indicating the use of raw materials and pollutants, and collection of core data in the central building and apartment register.
- Brussels capital region: in the framework of the ecodynamic company label, organising meetings for exchange of food practices, so companies can learn from each other. The aim is to develop awareness-raising campaigns for small and medium-sized enterprises (SMEs) on proper prevention and management of hazardous waste.
- Denmark: partnership for the substitution of harmful chemicals.
- England: support of the Sustainable Clothing Action Plan, which aims to improve the sustainability of clothing throughout its lifecycle.
- Finland: when authorities draw up the guidelines for environmental permits, the harmful impacts caused by chemicals during the waste phase are to be included.
- Germany: including additional product groups in existing label schemes such as the *Blauer Engel* (Blue Angel), a well-known environmental label that already includes resource efficiency criteria.
- Greece: promotion of WEEE reuse in households. The measure is part of the broader initiative to promote the reuse and/or repair of appropriate

Box 4.2 Waste prevention measures

According to the Waste Framework Directive, Article 29(2), 'Member States shall describe the existing prevention measures and evaluate the usefulness of the examples of measures indicated in Annex IV or other appropriate measures'.

'The aim of such objectives and measures shall be to break the link between economic growth and the environmental impacts associated with the generation of waste' (EU, 2008).

discarded products or of their components, notably through the use of educational, economic, logistic or other measures such as support to or establishment of accredited repair and reuse centres and networks, especially in densely populated regions.

- Ireland: implementation of the revised National Hazardous Waste Management Plan. The plan sets out priority actions for stakeholders for hazardous waste prevention, reduction of hazardousness of materials and substances, and environmentally sound management of hazardous waste. Prevention initiatives are directed especially towards the pharmaceutical, agriculture, healthcare, household, and publishing and printing sectors.

- Latvia: development and application of regulations for the restriction of certain hazardous chemicals in electrical and electronic equipment by the Cabinet of Ministers.

- The Netherlands: initiation of technological improvements for textiles to reduce use of chemicals, making the textiles sector more environmentally friendly and extending service life.

- Norway: support by the Ministry of Climate and Environment for stricter international regulations on the use of chemicals in textiles.

- Poland: development of cleaner technologies (Box 4.3).

- Slovakia: promotion of the EMAS and EMS according to ISO 14001 for hazardous waste.

- Spain: substitution of harmful substances in production processes.

- Sweden: within the EU, seeking to ensure that environmental aspects such as longer lifespan, ability to be repaired and the content of hazardous substances are considered in the design of new products.

- Wales: collaboration of the government with industry, process efficiency experts and Natural Resources Wales to better understand the degree to which industry has optimised its processes, including hazardous waste. It will also review the regulator's role in monitoring the performance of permitted industry.

4.4.2 Waste prevention measures

Despite this extensive list of initiatives, the analysis shows a bias towards quantitative waste prevention. Only 5 % of the measures can be directly linked to hazardous waste prevention; most of them are linked to eco-design regulations, including bans on toxic materials. Looking at the types of instruments that have been chosen for hazardous waste prevention, there is a strong focus on regulatory ones compared with the overall picture of waste prevention policies in Europe (EEA, 2015). Voluntary and information instruments also play a strong role. No evidence has been found for market-based instruments in this field.

Table 4.6 shows an assessment of prevention tools for different waste streams including hazardous waste based on the Basel Convention Report (Basel Convention, 2012). This comparison also highlights the role of regulatory tools (e.g. product requirements) as well as voluntary agreements and information tools. The report also highlights financial incentives and GPP as potentially relevant instruments for hazardous waste prevention. Given the rather minor role they play in the waste prevention programmes, further research could look at the benefits of and barriers to such approaches.

Discussions with EEA member countries and other stakeholders have shown that, especially in the field of hazardous waste prevention, many successful and effective measures have not been mentioned in waste prevention programmes because they started after the completion of the programme or have, for other reasons, been omitted from the scope of the programme (Chapter 5). Against this background, the analysis for this report went beyond the programmes and aimed to identify additional examples of ongoing good practice in selected countries. Box 1.4 gives a first example on industrial symbiosis and hazardous waste prevention.

Table 4.6 Prevention tools for different waste streams

Waste strategies ↓ / Waste streams →	Metals	Plastics	Hazardous waste	Biowaste	Household waste	Mineral	Wood	Glass	Paper and cardboard
Product requirements ([a])									
Finanicial incentives									
Awareness and education									
Green public procurement ([b])									
Green marketing									
Voluntary agreements ([c])									
Ecodesign									
Techonological standards									
Labelling/certification									
Prevention targets									

Very efficient strategy for specific stream

Useful strategy

Inefficient strategy

No data or data not applicable

Note: ([a]) Prohibited toxic substance, packaging or volume requirements, etc.

([b]) Green organizations and public spending.

([c]) Environmental targets set in consultation with industry.

Source: Basel Convention, 2012.

Box 4.3 Mining waste in Poland

Mining and processing produce the largest waste group in Poland. In 2012, the sector generated 68 million tonnes or approximately 53 % of the country's total industrial waste ([11]). There are three main types: wastes from the mining and processing of hard coal, non-ferrous metal ores, and waste from rock mineral extraction (Galos and Szlugaj, 2014).

In the coal-mining industry, it is estimated that, for each tonne of coal mined, up to 0.5 tonnes of waste material is produced, resulting in the disposal of large amounts of waste. Feasibility studies have shown that recovery of coal from this waste is economically and ecologically justified and that there is an urgent need for new recovery sites (Gawor, 2014). Furthermore, this waste has been shown to have great potential as a component in the hydraulic backfilling of underground workings. Currently, up to 3 million tonnes of coal waste per year is utilised in this way, but economic and technical constraints have limited the growth of such reuse in recent years (Galos and Szlugaj, 2014).

Zero-waste excavation technologies are still under development and their implementation in the mining sector is a key challenge for preventing hazardous waste (Pietrzyk-Sokulska et al., 2015).

([11]) The data are based on questionnaire OS-6, which is filled in by entities that generate more than 1 000 tonnes of waste per year or have a landfill site containing more than 1 million tonnes of waste. However, the total amount of waste generated by the mining and processing industry was 68 million tonnes in 2012 and these data were reported to the EC as required by the Waste Statistics Regulation, 2150/2002.

5 Country/region profiles

This chapter provides preliminary information on measures to prevent hazardous waste that have so far been implemented in 12 territories (11 countries and a region). A summary of the country/region profiles is presented in Table 5.1.

The selection of the countries/region included was based on cross-referencing information collected during the first and second EEA reviews (EEA, 2014 and 2015). Information on the following was taken into account: programme scope, objectives, targets, indicators, evaluation systems, measures and policy instruments. Thirty programmes adopted by the end of 2015 were reviewed, and the scope was narrowed to 12. Although twice as many programmes cover prevention of hazardous waste, many countries and regions are still planning activities or not explicitly prioritising hazardous waste.

The profiles are based on bilateral interviews using a pre-determined set of questions (Annex 2). The structure of the interview consisted of three thematic elements, all in the context of waste prevention:

- looking at prioritised hazardous waste;
- challenges, drivers and barriers;
- existing policies and instruments.

In several cases, more than one interview was conducted (such as in Germany). Bulgaria and France provided written answers to the questionnaire by email, whereas profiles for Austria and Portugal were analysed in 2015 as a pilot activity, but the content has been adjusted in consultation with the countries.

Table 5.1 Summary of 12 selected country/region profiles

Country	Priority waste sector(s) and/or stream(s)	Key driver(s)	Key challenge(s)	Example(s) of good practice
Austria	Construction and demolition waste Households and enterprises	Applying the pay-as-you-throw principle Introducing financial incentives for cleaner production	Lack of time/capacity/ concern to give information about hazardous waste prevention options	Pollutant screening before demolition Funds to inform industries and to co-finance cleaner production Initiative on banning nickel-cadmium batteries in wireless tools (2006–2011)
Bulgaria	Mineral waste from the mining industry	Introducing EU legislation on restricting the use of certain hazardous substances in products Establishing the waste hierarchy Introducing EPR schemes Applying take-back schemes Introducing landfill tax	Lack of funds for research and innovation No assessment of the potential for savings by preventing waste generation	Project on preventing hazardous waste from households as part of Bulgarian–Swiss cooperation
Estonia	Alkaline ashes from the oil shale industry	Increasing energy efficiency Decreasing cost of waste management in the energy industry Introducing a stronger policy on lengthening product life Increasing reusability of products	Increasing recovery of priority waste stream	Development of a dedicated best available techniques reference document (BREF) for the oil shale sector

Table 5.1 Summary of 12 selected country/region profiles (cont.)

Country	Priority waste sector(s) and/or stream(s)	Key driver(s)	Key challenge(s)	Example(s) of good practice
France	Waste operations and manufacturing industry, in particular the chemical industry and the coke- and/or oil-processing sector	Reducing hazardous waste from households in absolute terms	Difficulties in finding or developing suitable substitutes for hazardous materials at the design stage	Development of economic levers to encourage use of less polluting technologies (e.g. favourable eco-contributions for light-emitting diode (LED) lamps compared with other types) Introduction of EPR Introduction of an economic tool, a tax on waste, to discourage waste generation
Germany	Water, wastewater and the waste sector; the construction sector; processing industry Chemicals; dyes; metals; surfaces	Public concern about risks to the environment and human health	Distribution of responsibilities between the national government and the 16 federal states	German law on industrial emissions, including a specific requirement for the licensing process of industrial facilities (BImschG § 5.1.3) The production-integrated environmental protection (PIUS) Check programme's aims include support for SMEs to increase their material efficiency The Blue Angel (*Blauer Engel*) eco-label includes criteria for the absence of specific hazardous substances in particular products
Ireland	Households; small businesses; farms; healthcare and construction sectors Industrial solvents; waste oils; medical waste; pesticides and veterinary waste	Improving cost efficiency of hazardous waste management in industry and primary production Improving health and wellbeing in households Introducing/proposing change in EU legislation (the Circular Economy Package) Introducing national legislation (the Irish frameworks for a sustainable future and resource efficiency)	Integrate prevention policies with other national policies Develop indicators and metrics to measure impacts (linking micro-level activities to data at the national level) Lack of awareness Lack of clarity around standards for second-life applications for industrial by-products	Green Public Procurement Action Plan National Hazardous Waste Management Plan, which identifies 'owners', i.e. organisations responsible for implementing each of the priority actions BeGreen programme, including Green Healthcare programme, triple-rinsed container protocol and Farm Hazardous Waste Collections
Latvia	No priority waste stream is highlighted, although the example of waste oils collected in harbours is mentioned	Introducing the EU requirements Fulfilling international obligations	No challenges are highlighted	Implementation of the Natural Resources Tax
Netherlands	Hazardous waste from the demolition of houses and infrastructure Polluted water from rinsing tanks of vessels in ports Hazardous waste from process chemistry, as the Netherlands hosts the most important production sites in the world	The transition towards a circular economy Limited physical space	Lack of suitable economic incentives for new and innovative business models	The Green Deal on Take Back Chemicals (TaBaChem) focuses on take-back systems for chemicals based on voluntary agreements
Portugal	Wood and metal wastes in the manufacturing sector Chemical and medical wastes in services	Case studies prepared for each industry including process mapping; identification of inputs and outputs; cost of waste and effluent treatment; and identification, selection and implementation of best prevention solutions	The focus of industrial/ business concerns was on controlling pollution through end-of-pipe treatment, with little knowledge of prevention	The Innovation and Eco-design in the Ceramic Industry (INEDIC) project (2009–2011)

Table 5.1 Summary of 12 selected country/region profiles (cont.)

Country	Priority waste sector(s) and/or stream(s)	Key driver(s)	Key challenge(s)	Example(s) of good practice
Spain	No priority given to any particular hazardous waste stream		Because of the severe economic crisis, lack of financial and human resources for investment, implementation and monitoring Lack of harmonisation on, for example, the classification of hazardous waste	Introduction of EPR Promotion of technical assistance to the chemical industry and transfer of results from research Introduction of voluntary agreements to apply the best available techniques (BATs) with a focus on substitution of harmful substances in the chemical industry Promotion of the implementation of creditable environmental management systems in the chemical industry A web portal with examples of good practice run by the Ministry of Agriculture, Food and Environment (MAGRAMA) and the Urban Ecology Agency of Barcelona (BCNecologia) (http://www.bcnecologia.net/en)
Sweden	Textiles, electronics, construction and demolition wastes	Phasing out hazardous substances	Lengthy and complex process of phasing out certain substances Insufficient link in producer responsibility schemes between the production and waste stages	Resource and waste guidelines for construction and demolition Tax deduction for repairing used products Tax on hazardous substances 'Negative' labelling of products containing hazardous substances
England ([a]), United Kingdom	No specific waste stream or sector	Economic cost-saving potentials	Lack of access to knowledge	Voluntary agreements and joint efforts by the private and public sectors Electrical and Electronic Equipment Sustainability Action Plan Sustainable Clothing Action Plan

Note: ([a]) Region.

Sources: Sections 5.1–5.12; Annex 1.

5.1 Austria

5.1.1 Introduction and overview

Austria has been a frontrunner in waste prevention policies since the 1980s — indeed, the chapter on waste prevention within its Waste Management Plan (2011–2017) is one of the most action-oriented programmes in Europe (BMLFUW, 2011). It includes more than 70 specific waste prevention measures split into five packages: prevention of construction waste; prevention of waste in enterprises; prevention of waste in households; prevention of food waste; and reuse. The country is currently carrying out an extensive review of all implemented measures of the current Waste Management Plan as a basis for preparing the upcoming 2017 Waste Prevention Programme.

Austria's Waste Management Plan targets both quantitative prevention (less generation) and qualitative prevention (less hazardous waste generation). The objective of reducing the volume of hazardous materials and products was officially set in 2002 in Austria's Strategy for Sustainable Development (Österreichische Bundesregierung, 2002).

5.1.2 Relevant hazardous waste streams

According to Eurostat (2016c), the total amount of hazardous waste generated in Austria in 2012 was 1.07 million tonnes (Tables 5.2 and 5.3), roughly the same as in 2004–2006.

Austria's yearly generation of about 0.13 tonnes per person per year is below the 2012 EU-28 level of 0.2 tonnes. Around 50 % of hazardous waste generated in the country undergoes chemical physical treatment, part of which is preparation for recycling, and 20 % is incinerated. A relatively high proportion, 25 %, is exported either for subsurface landfilling or for treatment (EAA, 2015). Austria is a net exporter of hazardous waste, the amount imported being about 45 % of that exported (BMLFUW, 2015). Hazardous waste management is carried out by the private sector within a strict regulatory framework.

In Austria's current waste prevention programme, hazardous fractions of construction and demolition waste, and hazardous waste from households and enterprises are regarded as priority waste streams.

Table 5.2 Austria, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
1 066	9	12	389	36	201	146	200	73

Source: Eurostat, 2016c.

Table 5.3 Austria, relevant hazardous European Waste Catalogue (EWC) waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	36
Chemical waste	175
Effluent sludge	21
Discharged equipment	56
Discharged vehicles	57
Mineral wastes from waste treatment	201
Combustion waste	134

Source: Eurostat, 2016c.

5.1.3 Drivers and challenges

Austria applies the pay-as-you-throw principle as far as is practical, with financial incentives acting as a significant driver for hazardous waste prevention. The management of hazardous waste from households, excluding waste management by EPR schemes, is mostly financed through municipal fees, while the management of industrial hazardous waste by waste treatment companies is paid for by industries on a free-market basis. The remediation of contaminated sites is financed through levies on landfilling (EUR 8–26 per tonne) and incineration (EUR 7 per tonne) (EAA, 2015).

In addition to financial incentives, Austria's action on waste prevention in enterprises includes a programme for cleaner production audits, training of industrial waste managers, planners and administrators (BMLFUW, 2011), and support for environmental investment (Umweltförderung im Inland, UFI). The UFI initiative offers companies the possibility of public co-financing for technologies with, among other properties, waste prevention potential. Prevention measures, which include the prevention of hazardous waste generation, are especially highly ranked within Austria's Sustainable Development Strategy (ETC/WMGE, 2015).

The UFI's objective is to set incentives for investments with cost-saving potentials, but with sufficiently long amortisation periods to be beneficial for, in particular, SMEs. Examples of successful projects include stimulating the eco-design of products to reduce the amount of waste generated in both production and use phases. Another example includes the development of innovative concepts of, for example, leasing chemicals rather than owning them (ETC/WMGE, 2015).

Between 2011 and 2013, the UFI supported 18 projects in the area of hazardous waste prevention and resource management by providing EUR 2.3 million. This financial injection led to a total investment of more than EUR 15.5 million (ETC/WMGE, 2015).

The challenges of reducing hazardous waste generation in households are tackled through awareness raising, relating both to consumer behaviour and to increasing the separation of hazardous waste. It should, however, be noted that waste separation in Austrian households is already at a quite high level.

An important example is WEEE, which makes up 73 % of hazardous household waste. Currently only 15 % of WEEE remains in mixed waste; the rest is separated for recycling and reuse (EAA, 2015b). In this context it is worth noting Austria's initiative on banning nickel–cadmium batteries in wireless tools as included in Austria's waste prevention programme 2006 (BMLFUW, 2006).

5.1.4 Policies and instruments

Based on the evaluation of the current waste prevention policies, Austria is set to publish a new programme in 2017. The programme will include measures that target the long-term, sustainable development of the country's economy. Design for prevention and reuse, and critical minerals have been identified as priorities, the latter increasing concern for the more efficient reuse of WEEE. Further global concerns such as climate change, resource scarcity and environmental impacts of the extraction and processing of raw materials in foreign countries have significantly contributed to setting a plan that requires a high level of commitment from public administration and the waste management sector. The new waste prevention programme also specifies a package of measures promoting design for prevention and reuse. Within this package, Austria will probably urge the European Community to develop and introduce further standards for limiting the use of hazardous substances in products.

The development of Austria's new programme is being carried out through a stakeholder participation process. It mainly involves the Federal Ministry of Agriculture, Forestry, Environment and Water Management, experts from regional governments, the Environment Agency Austria, the Austrian Chambers of Commerce and Labour, the Federation of Municipalities, and leading scientific experts and consultants/non-governmental organisations (NGOs) concerned with environmental protection and resource conservation.

5.2 Bulgaria

5.2.1 Introduction and overview

The prevention of hazardous waste generation in Bulgaria has developed in recent years, partly thanks to the requirements set by EU directives and legislation, but also because of Bulgaria's strategies for improving resource efficiency and developing a smart society.

Because of its structure, which is largely based on primary production, Bulgarian industry is hazardous-waste intense, producing 327 tonnes per million EUR of GDP in 2012. This indicates that the core economic activities of the country generate large amounts of hazardous waste, while producing a relatively low GDP; the EU-28 average is 7.4 tonnes of hazardous waste per million EUR of GDP. As a result of mining activities, Bulgaria produces 1.8 tonnes per person per year of hazardous waste, the second-highest amount in Europe (ETC/SCP and ETC/WMGE, 2015).

Bulgaria is a net importer of hazardous waste. In 2013, Bulgaria exported 3 000 tonnes, with the largest amount going to Germany, and imported 59 400 tonnes, most of which was destined for recycling. The largest proportions of imports come from the Netherlands and Romania (Eurostat, 2016b).

5.2.2 Relevant hazardous waste streams

The amount of hazardous waste generated in Bulgaria has remained quite stable since 2006, and in 2012 totalled 13.4 million tonnes. The largest proportion, 99 %, arises from the country's mining activities producing coal and lignite as well as metallic and non-metallic minerals (Tables 5.4 and 5.5).

Current priorities are larger non-hazardous flows; significant biodegradable waste and its diversion from landfill in accordance with EU legislation; and developing capacity for the management of EPR waste flows.

5.2.3 Drivers and challenges

Insufficient financing at a national level for research and innovation aimed at reducing the amounts of hazardous waste, and the absence of an overall assessment of the potential for savings through waste prevention for selected waste streams are seen as important barriers to the efficient implementation of hazardous waste prevention. The majority of consumers and businesses still do not take the environmental costs of their decisions into account, and they underestimate the value of waste prevention.

Key drivers of hazardous waste prevention are (1) EU legislation restricting the use of certain hazardous substances in electrical and electronic equipment and on the bans and restrictions as regards the placing on the market and use, (2) import and export of POPs in mixtures and products, (3) implementing the waste hierarchy according to the WFD, and (4) establishing producer responsibility for certain hazardous wastes and especially the product take-back schemes through

Table 5.4 Bulgaria, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
13 407	0.04	13 268	105	2.3	9	0.3	14	8

Source: Eurostat, 2016c.

Table 5.5 Bulgaria, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	12
Chemical waste	52
Sewage sludge from industrial wastewater	16
Discharged equipment	8
Mineral waste	13 268

Source: Eurostat, 2016c.

which products are returned for reuse or preparation for reuse. Moreover, financial incentives are given through the imposition of a landfill tax on hazardous waste.

The EU-wide approaches are seen as important especially for product design, however, legislation covering the replacement of the hazardous substances and materials in products with non-hazardous alternatives, thus preventing the generation of hazardous waste, would be needed.

5.2.4 Policies and instruments

The National Waste Prevention Programme is part of Bulgaria's National Waste Management Plan (NWMP) 2014–2020. The programme is rather new and emphasis is put on developing institutional capacity for prevention, as well as provision of technical support for companies and individuals generating hazardous waste. Hazardous waste is subject to a stricter control regime than non-hazardous wastes, for example through additional labelling, record keeping and monitoring, a ban on mixing of hazardous waste with any other waste, etc. Comprehensive data are collected, and published annually by the Executive Environment Agency, on producers of hazardous waste, arisings and the movements of such waste.

Monitoring and evaluation will take place in accordance with the NWMP, in which expected results and performance are provided for each measure in the various programmes. The monitoring system involves collecting information on the implementation of individual measures and reporting on the extent of their implementation.

Measures related to hazardous waste prevention in the NWMP are collected and summarised annually by the Waste Management and Soil Protection Directorate of the Ministry of Environment and Water. Again, depending on the sector in question, other ministries, municipalities or business can lead on individual measures.

Research and development projects relating to business or technical issues for solving specific hazardous waste problems are supported under the Priority Axis 'Technology Development and Innovation' of Bulgaria's operational programme, Competitiveness and Innovation 2014–2020.

Prevention of hazardous waste is closely related to resource efficiency, which is one of the priorities in the National Development Programme and its Action Plan 2015–2017. It includes:

- identifying subsidised environmentally harmful production, and planning activities for its gradual removal (EEA, 2016b);
- the introduction of incentives within public funding of projects, aimed at giving priority to activities related to higher levels of the waste hierarchy, according to the WFD;
- promoting the extension of producer responsibility to cover the full lifecycle of manufactured goods, including new business models, through the support of repair services; and technical assistance for companies to work together to make maximum use of waste and by-products, for example through industrial symbiosis.

Waste prevention is also included in Bulgaria's Innovation Strategy for Smart Specialisation. The priority activities include the promotion of innovation in the waste sector for prevention, collection, recycling and recovery.

Future activities will largely be based on the objectives laid down in the NWMP. Attention will be paid to promoting the reuse and/or repair of appropriate products or their components through educational, economic, logistical or other measures, such as supporting or establishing accredited repair and reuse centres and networks, especially in densely populated areas. These actions will primarily affect the generation of hazardous waste in households. There are few ongoing activities specifically related to industrial hazardous waste.

Prevention of hazardous waste from households is addressed in a current project run under the Bulgarian–Swiss Cooperation Programme. It aims to introduce pilot models for the separate collection of hazardous waste from households and the creation of major environmental infrastructure. The implementation will significantly reduce the generation of hazardous waste from households (MEWB, 2015). Another development project in the same programme supports hazardous waste management in the agricultural sector. Its purpose is to provide environmentally sound disposal of around 4 400 tonnes of obsolete pesticides and other crop protection products.

5.3 Estonia

5.3.1 Introduction and overview

In Estonia, the prevention of hazardous waste generation is connected to waste prevention as a whole, and is not given special attention in the National Waste Prevention Plan, which was approved in 2014. The plan does not include numerical targets for waste prevention.

Compared with other European countries, Estonia is in a special situation, as the majority of its hazardous waste is generated by one sector only: the oil shale industry. The primary policy affecting that waste flow is contained in a best available techniques reference document (BREF) for the sector, which was drawn up by Estonia and implemented in 2012. As the industry is unique in a European context, the country recognised the need to develop its own guidelines. Estonia sees following the dedicated BREF as a way of being more efficient rather than relying on more general European-level best available technique (BAT) documents and BREFs on fossil fuel processing and power production. The BREF underlines resource efficiency, and through this Estonia targets a relative decrease in the generation of hazardous waste.

5.3.2 Relevant hazardous waste streams

According to Eurostat (2016c), the total amount of hazardous waste generated in Estonia in 2012 was 9.16 million tonnes (Tables 5.6 and 5.7). Since 2004–2006, the amount has increased by 30–40 %.

The largest waste flow is of high alkaline ashes from the processing and utilisation of oil shales, which makes up more than 95 % of all hazardous waste. It is also why Estonia stands out in the European hazardous waste statistics: its generation in 2012 was about 7 tonnes per person whereas the EU-28 average was around 0.2 tonnes per person (ETC/SCP and ETC/WMGE, 2015).

Estonia's other hazardous waste flows are rather modest, and at the same level as in other EU-28 countries: the waste sector generates 28 000 tonnes per year, services generate 59 000 tonnes and households generate 11 000 tonnes. Table 5.6 shows the distribution of hazardous waste generation between sectors and the most relevant waste streams.

Although hazardous waste from the oil shale industry has not decreased in absolute terms, it has decreased relative to production as a result of the introduction of

Table 5.6 Estonia, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
9 159	0.5	0.3	2 850 (a)	6 203	28	4	62	11

Note: (a) Of which manufacture of coke and refined petroleum products 2 800 000 tonnes.

Source: Eurostat, 2016c.

Table 5.7 Estonia, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Soils	11
Chemical waste	1 518
Sewage sludge from industrial wastewater	20
Sorting residues	13
Liquid waste and sludges	35
Discharged vehicles	9
Sorting residues	13
Combustion waste	7 543

Source: Eurostat, 2016c.

more efficient processes. Restrictions on air emissions from production and environmental taxes have also affected the relative decrease in waste generation (increased energy efficiency).

Developing recycling and reuse of alkaline ashes is high on the agenda in Estonia. Efforts include the demonstration of environmentally sound recycling of oil shale ashes into road construction products (http://www.osamat.ee/en/). Technically the use of the waste in road construction is feasible, but the cost of transport and logistics remains a challenge to its wider use. It is also utilised as raw material in construction blocks (http://www.roclite.eu/en/products/) or recycled by the cement industry (http://www.knc.ee/et/node/4130).

Currently on average 3–5 % of all ash is recovered.

5.3.3 Drivers and challenges

Incineration of oil shale for power production produces ash, which is generally disposed of in the power company's own landfills. The oil shale industry in Estonia is made up of four large companies, of which one is state owned. Currently the generation of this waste is entirely dependent on fluctuations in the energy industry, in which resource efficiency and the cost of managing the waste act as drivers for prevention. For instance, the tax paid on landfilling is considerable, as the amounts generated are large.

A common issue in the generation of other hazardous waste is the decisive role played by product design. However, as the design of most products takes place outside Estonia's borders, even when assembly or production occurs within the country, Estonia cannot easily implement prevention. The development of the EU's Ecodesign Directive could, however, become a powerful prevention tool.

In addition to introducing a stronger policy on lengthening product life and increasing the reusability of products, Estonia's waste prevention programme, within its National Waste Management Plan (2014–2020), includes action to raise awareness of consumption patterns that are seen as important for further decreasing hazardous waste generation.

5.3.4 Policies and instruments

A mix of economic, information and regulatory instruments is seen as the most efficient way of preventing hazardous waste generation. In this context, the shale oil industry, the main producer of hazardous waste, is affected by informative (BREF) and economic (landfill tax) instruments. Direct taxation on the generation of waste is not considered feasible because of the risk of causing hidden flows.

In addition, increasing the share of renewable energy sources could, in principle, reduce the use of oil shale and thus the generation of hazardous waste. According to Eurostat, in 2014, 20.3 % of Estonia's energy was generated using renewable sources, mostly from the combustion of wood chips.

The Ministry of the Environment is the main institution responsible for waste management and waste prevention, and prepared the BREF on resource efficiency in the oil shale industry. In this, the Ministry of the Environment worked closely with the Ministry of the Economy and the energy industry.

Monitoring or evaluation of schemes for hazardous waste prevention takes place every 5 years in the framework of the National Waste Management Plan. Furthermore, the Estonian Environment Agency, in addition to yearly reporting on national waste generation to Eurostat, publishes a report on waste generation every 2 years.

5.4 France

5.4.1 Introduction and overview

The prevention of hazardous waste generation is included in France's national waste prevention programme, but prevention is primarily focused on sectors that produce large volumes of waste — packaging, food, paper, cardboard, textiles and plastic waste — but does not specify a target for hazardous waste, which makes up less than 3 % of all waste generated in France. Generation per person is slightly less than the European average of 200 kg a year. However, with one of the largest population in Europe, the actual volume of hazardous waste is significant and France is the third-largest generator of it in Europe.

In France, most hazardous organic waste is incinerated, while mineral hazardous waste is landfilled in one of 16 landfills. Controlled landfilling is considered necessary to avoid the dispersion of contaminants in the environment.

Upstream measures are seen as directly linked to the prevention of hazardous waste. As the classification of waste as hazardous is due to the presence of residues of dangerous products, affecting product policy by promoting ecodesign and restricting the marketing of some hazardous products are seen as key. The participatory Grenelle process, which involved the state and civil society, resulted in the Grenelle law, which specifies that 'the waste reduction policy, which is a priority over all forms of treatment, will be bolstered by the eco-design of products in manufacturing, distribution and consumption, through to the end of its lifecycle' (ESA, 2016).

5.4.2 Relevant hazardous waste streams

In 2014, France generated about 13 million tonnes of hazardous waste, a slight increase from previous years (Tables 5.8 and 5.9). The largest flows are generated in waste operations and manufacturing, with the chemical industry and coke and/or oil processing being the sectors that produce the most (ETC/SCP and ETC/WMGE, 2015).

With regard to the national waste policy, WEEE, polychlorinated biphenyl (PCB) waste and wastes containing asbestos are important, although these flows are smaller.

Table 5.8 France, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
11 301	341	3	2 792	15	4 024	2 375	1 554	197

Source: Eurostat, 2016c.

Table 5.9 France, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	624
Chemical waste	1 408
Spent solvents	440
Discharged vehicles	1 496
Discharged equipment	376
Soil	2 445
Mineral waste from construction and demolition	987
Healthcare and biological wastes	439
Wastes from waste treatment and stabilised wastes	844

Source: Eurostat, 2016c.

5.4.3 Drivers and challenges

The key drivers for preventing hazardous waste are the general drivers for reducing waste as a whole and particularly targeting hazardous wastes produced by households.

A clear challenge for preventing hazardous waste relates to product design is the difficulty of finding or developing appropriate substitutes for hazardous materials in products or hazardous products, which could ultimately prevent the generation of hazardous waste.

5.4.4 Policies and instruments

France's policy on preventing the production of hazardous substances is largely the result of EU regulations such as the Restriction of Hazardous Substances (RoHS) Directive (2002/95/EC) and the regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). The RoHS Directive seeks to limit the use of six hazardous substances in electrical and electronic equipment, while REACH seeks to restrict the use of certain dangerous substances, as well as developing substitutes for those substances by encouraging research and development (Box 3.1).

In parallel, France has developed economic levers to encourage less polluting technologies, such as a modulation of favourable eco-contributions for light-emitting diode (LED) lamps compared with other types (ESA, 2016).

As regards hazardous waste generated by households and subject to EPR schemes (principally WEEE), prevention initiatives are planned in accordance with the organisational set-up for the EPR scheme in question.

Financial incentives are in place as preventive measures for hazardous waste. Its treatment is generally more expensive than for non-hazardous wastes, although that is very variable depending on the nature of the hazardous waste. Producers are charged EUR 200 per tonne for the stabilisation and landfilling of hazardous waste.

The introduction of *La taxe générale sur les activités polluantes* (TGAP), a tax on waste, is an economic tool that seeks to encourage producers to reduce the quantities of waste they generate. The TGAP targets the elimination of hazardous waste management by landfilling, incineration and physical-chemical treatment, by providing incentives for the valorisation of the material instead.

Awareness raising is an important step especially in the prevention of hazardous waste in households. A survey of households revealed a clear increase since 2005 in people's knowledge of the prevention of hazardous waste. In 2011, 57 % of those surveyed claimed to know about ways to reduce the hazardousness of waste generated in households. Moreover, the number of consumers that had heard 'a lot' about such measures increased from 13 % in 2005 to 21 % in 2011.

A number of national institutions are involved in the dissemination of technical and scientific information on the various health and environmental aspects of hazardous waste. These include the National Institution for the Industrial Environment and Risks (INERIS) and the National Institution for Research and Safety (INRS) on chemical, physical and biological risks and occupational safety. The French Environment and Energy Management Agency (ADEME) is responsible for the introduction and monitoring of enterprise resource planning (ERP) channels in particular.

Finally, all regional waste planning has to incorporate hazardous waste. In addition, local prevention plans include support to businesses to reduce waste and decrease its hazardousness (ADEME, 2012).

An example of successful decontamination and valorisation of hazardous waste is the processing and utilisation of air pollution control residues (solid wastes from gas treatment) from municipal incinerators at two sites. Metals are removed from the waste by dissolving it in sodium bicarbonate and precipitating the metals with sodium sulphide. After the solid metals are removed by filtration, the sodium chloride solution can be reused in a sodium carbonate-producing plant, or discharged into the sea.

An example from industry of the decontamination and reuse of hazardous waste concerns red mud from aluminium oxide production. The mud is washed and thickened in a press-filter, modified with gypsum to neutralise it, as it is highly alkaline, and then used on soils and in water to immobilise contaminants or as topsoil or soil cover.

5.5 Germany

5.5.1 Introduction and overview

The prevention of hazardous waste generation has, for several decades, been one of the priorities in German environmental policy. Air pollution, and especially the pollution of rivers with hazardous substances in the 1960s, can be seen as two of the starting points of environmental policy. A variety of technical regulations, bans on hazardous substances and treatment requirements have led to a significant reduction in environmental burdens from hazardous waste generation and treatment.

The German waste prevention programme (BMU, 2013) also includes the reduction of environmental impacts from waste and specifically the reduction of pollutants in products and materials as main targets of waste prevention in Germany. Nevertheless, Germany decided not to focus specifically on qualitative waste prevention in its programme; rather, the programme is focused on measures to be taken by public authorities, while the use of hazardous substances and the generation of hazardous waste is seen as mainly a private responsibility, especially of industry. Against this background many activities that could be labelled as hazardous waste prevention are not included in the programme but are distributed over different activities including cleaner production, sustainable product design and EPR.

5.5.2 Relevant hazardous waste streams

According to the German statistics on waste generation (Destatis, 2015), the total amount of hazardous waste produced in Germany in 2013 was 23.7 million tonnes. The amount has been almost stable over the last decade, with 23.2 million tonnes produced in 2006 and only minor variations since then. Of this total, 0.557 million tonnes is classified as municipal solid waste; 7.5 million tonnes as construction and demolition waste; 9.0 million tonnes as waste from production, commercial activities and other sources; and 6.3 million tonnes as secondary waste, generated during the treatment of waste streams. Tables 5.10 and 5.11 show the distribution of hazardous waste generation between sectors as well as the most relevant waste streams by EWC codes.

These figures, however, give no specific indication of the environmental burdens of these waste streams or their toxicity to humans. Furthermore, the German

Table 5.10 Germany, generation of hazardous waste by economic sector, 2013 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households [a]
23 685	1	74	5 875	1 138	7 591	6 923	1 666	417

Note: [a] The figure for household waste is lower than for municipal solid waste (557 000 tonnes), as the latter also includes a portion of similar household waste.

Source: Destatis, 2015.

Table 5.11 Germany, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	1 177
Chemical waste	2 701
Sewage sludge from industrial wastewater	1 586
Wood waste	1 308
Sorting residues	1 817
Mineral construction and demolition waste	4 438
Soils	2 317
Mineral waste from waste treatment	2 608

Source: Destatis, 2015.

waste prevention programme does not specify any priority hazardous waste streams. Against this background, the UBA initiated a research project that, among other things, aims to identify the most relevant hazardous waste streams — not only from a prevention point of view but also taking into account recycling rates and infrastructure: chemicals, dyes, metals and surfaces were mentioned as relevant waste streams (EEA, 2016b).

5.5.3 Drivers and challenges

Public concern about risks to the environment and human health has been the key driver for hazardous waste prevention in Germany. Its waste policy addressed this issue quite early and had already picked many of the 'low hanging fruits' during the 1990s. One of the key challenges for waste prevention, and especially for hazardous waste prevention, is the distribution of responsibility between the national government and the 16 federal states; strategies and programmes are mainly developed at the national level, while the actual implementation is the responsibility of the federal states. Against this background, most of the measures included in the national programme focus on voluntary action.

One example of these difficulties is batteries, for which a variety of bans on specific substances are in place, not only for Germany but through the European Battery Directive (2006/66/EC). Nevertheless, empirical analysis has shown that significant quantities of batteries that contain these substances are still put on the market. Strict enforcement of these qualitative prevention regulations would require time-consuming and costly checks, especially of imported batteries.

Another challenge mentioned in this context that probably applies not only to Germany is the environmental assessment of hazardous waste prevention. Prevention should be the top priority according to the waste hierarchy but, given the existence of high-quality waste treatment infrastructures (including waste incineration), recycling is often preferred to prevention. For many years, environmental policy in Germany followed an approach based on environmental media (water, air, etc.) but, for a comprehensive assessment of hazardous waste prevention, a switch towards a sectoral approach would be necessary, e.g. by looking at total hazardous waste generation in specific industries.

5.5.4 Policies and instruments

As outlined, hazardous waste prevention activities in Germany are spread over a broad range of specific policy areas. Among this variety of instruments, the following have proved to contribute positively to avoiding hazardous waste generation.

In the 1990s the German law on industrial emissions included a specific requirement for the licensing of industrial facilities (BImschG § 5.1.3); operators were obligated to show how they included waste prevention aspects in the design of their production processes. This regulation did not focus specifically on hazardous waste but led to some innovations, for example in the field of hazardous foundry sands (Dehoust et al., 2010). The national waste prevention programme picked up this successful regulatory instrument, and there is a plan to explore broadening its requirements to cover other industrial processes.

Under the heading of cleaner production, several initiatives aimed to support SMEs in their attempts to use material more efficiently and thus strengthen their competitiveness in international markets. Avoiding hazardous waste and replacing it with other materials has been a key element in this process. A specific instrument was the so-called check for production-integrated environmental protection (PIUS Check): this programme supported SMEs financially in a first feasibility study, specific measures of which could lead to the reduction of environmental burdens and, at the same time, financial cost savings from investments with short pay-back periods.

With regard to hazardous waste prevention and specific products, the German Blue Angel eco-label (*Blauer Engel*) has been a success in Germany. The eco-label includes criteria for eliminating specific hazardous substances from specific products. The label is known by an overwhelming majority of households and, among other things, is used in GPP.

For the future, the German waste prevention programme includes several measures that aim to prevent hazardous waste, such as supporting environmental management systems in companies, implementing EPR schemes with incentives for the use of less hazardous products, thereby lowering costs in the end-of-life phase, or supporting further research on innovative production processes that use smaller quantities of hazardous waste.

5.6 Ireland

5.6.1 Introduction and overview

Ireland's National Waste Prevention Programme (NWPP) includes provisions to reduce the hazardousness of materials and substances in both products and processes. Using a sectoral approach, the programme aims to determine material usage and waste generation profiles, and utilise expert knowledge and financial support to propose improved management practices. Hazardousness of waste is specifically acknowledged in the programme's plans for prevention, and indeed the NWPP's definition of waste prevention includes the hazardousness of materials and substances.

Ireland has developed a National Hazardous Waste Management Plan (NHWMP) 2014–2020, which sets priorities for stakeholders: reducing the hazardousness of materials and substances while improving hazardous waste collection and environmentally sound management. Ireland has taken a sectoral approach to preventing hazardous waste, with initiatives directed particularly towards the pharmaceutical and chemicals industry, agriculture, healthcare, households, publishing and printing, and transport.

Ireland also has regional waste management plans adopted by the municipalities. The plans include the following action: 'Promote the prevention of hazardous wastes to households, communities and small businesses building on effective initiatives and disseminating best practice throughout the region by implementing one campaign per annum' (EPA, 2016b).

Around half of Ireland's hazardous waste is exported for treatment. As the NHWMP also includes the objective of moving towards self-sufficiency in waste treatment, minimising exports, it is clear that prevention objectives are very much aligned with the goal of developing technically and economically feasible options for the national management of hazardous waste.

5.6.2 Relevant hazardous waste streams

According to Eurostat statistics, Ireland's hazardous waste generation increased noticeably between 2006 and 2012. In 2012, the average generation per person was around 62 kg a year. The Environmental Protection Agency (EPA) in Ireland has estimated that 0.28 million tonnes ([12]) of hazardous waste was generated in 2012 (ETC/SCP and ETC/WMGE, 2015; EPA, 2012).

The largest hazardous waste flows in Ireland are industrial solvents, sludges, oils and chemicals. Households, small businesses, farms, healthcare and construction also generate quantities of hazardous waste including batteries, WEEE, healthcare products, solvent-based paint, varnish, sheep dip and fluorescent bulbs. More information on hazardous waste estimates is provided in Table 5.12.

Prevention action is especially directed at the pharmaceutical and chemicals industry, agriculture, healthcare, households, and publishing and printing. Moreover, several waste prevention projects include components on transport and energy efficiency. For example, GPP criteria for road transport vehicles

Table 5.12 Ireland, preliminary estimate of hazardous waste generation based on (mainly) Waste Statistics Regulation and Transfrontier Shipment of Waste submissions, 2012 (kilotonnes)

Description	Generation
Hazardous waste that underwent final treatment according to the Waste Statistics Regulation submission	67.7
Non-final treatment of hazardous waste based on data compiled for Waste Statistics Regulation reporting (not published)	62.0
Secondary hazardous waste arising according to data compiled for Waste Statistics Regulation submission	10.3
Transfrontier Shipment of Waste amber-listed entries that mainly contain hazardous waste ([a])	143.5
Total	283.5

Note: Data are currently subject to further revision/corrections.

([a]) There is likely to be an overlap between this figure and the non-final treatment figure given above.

Source: EPA, 2012.

([12]) This figure is a preliminary estimation that is currently undergoing verification, which will result in the correction of data published by Eurostat.

and services contain a detailed lifecycle costing (LCC) methodology, which is in line with the requirements of the Clean Vehicles Directive (2009/33/EC).

Ten of the world's major pharmaceutical companies have bases in Ireland and the country is the largest net exporter of pharmaceuticals in the EU; pharmaceuticals make up more than 50 % of the country's exports (IPHA, 2016). Information relating to key processes/waste management options for industries producing solvent waste has been collected in a separate report (CTC, 2010). While the ongoing responsibility for preventing such waste lies with industrial support agencies, the EPA, as a promoter of the NHWMP, supports relevant activities. Together with industrial support agencies, the EPA encourages reducing solvent waste by facilitating the exchange of experience and promoting available state funding mechanisms for process improvements with a view to avoiding waste.

Ireland's large agricultural sector makes widespread use of pesticides, herbicides and veterinary medicines. The combined volumes are large but their dispersed use ([13]) makes management difficult. Prevention action includes guidance on the safe and environmentally friendly recovery of empty plant-protection and dairy-hygiene product containers, and advice on how to treat the containers so that they can be classified as non-hazardous waste.

Another EPA initiative is the Green*Healthcare* Programme, which aims to prevent healthcare waste and consequently reduce costs in Irish hospitals. Hands-on guidance is given and a number of best practice guides and factsheets have been produced, providing benchmarks and case studies.

Livegreen.ie is an online resource for households launched by the EPA in spring 2016. Livegreen.ie (EPA, 2016c) provides reliable advice and guidance on a range of environmental and health matters, giving the public access to up-to-date environmental information. Furthermore, the EPA has published the *Greener Cleaning* and *Greener Gardening* guides specifically targeting hazardous waste prevention in households.

5.6.3 Drivers and challenges

Cost efficiency is recognised as an important driver for the prevention of waste, especially for hazardous waste, as managing it is expensive. To analyse whether or not value for money was being delivered, NWPP expenditure on both hazardous and non-hazardous waste was reviewed in 2012.

It has been noted, however, that, while cost efficiency was a decisive driver in industry and primary production, general health and wellbeing was the key driver for households.

National and EU legislation, such as the EU's Circular Economy Package and the Irish frameworks for a sustainable future and resource efficiency, are also recognised as major drivers of change in the use and management of hazardous substances.

Future challenges relate to integrating the prevention policies with other national programmes, such as the National Resource Efficiency Plan; developing indicators and metrics to follow up their impact; and, in this context, linking micro-level activities and data to national statistics. More action is needed to spread prevention practices in business, including the growing agri-food sector.

Although the EPA has implemented a number of awareness-raising and capacity-building activities, lack of awareness remains a barrier both in industry and among consumers. Some industrial users still believe that more benign alternative materials are either less efficient or more expensive, and so may be reluctant to even consider switching to less hazardous inputs. Furthermore, reluctance to change long-standing production practices can even be reinforced by regulatory agencies such as the Food and Drug Administration, which may require extensive proof before approving new processes. There is also still a lack of clarity around standards for second-life applications for industrial by-products. This means that substances that could be kept in productive use are easily and sometimes needlessly classified as waste. Moreover, the disjunction between chemicals listed in the EU's REACH and waste legislation and in the Stockholm Convention complicates planning for hazardous waste prevention, as listed chemicals may not have been classified as hazardous when they were placed on the market.

5.6.4 Policies and instruments

Ireland's NWPP is the vehicle used to deliver some of the ambitions set out in the NHWMP. Ireland's National Waste Prevention Committee oversees the development and implementation of the NWPP. The

([13]) There were 139 860 farm holdings operating in Ireland in 2010 (CSO, 2012).

committee is chaired by the EPA and is made up of a wide range of stakeholders from industry, commerce, agriculture, local authorities, NGOs and government departments.

Prevention projects to reduce the generation of hazardous waste in priority sectors are led by the EPA under the NWPP. Prevention initiatives are incorporated into regional waste management plans and, moreover, the Green Public Procurement Action Plan provides for substitution and reduction in the use of hazardous materials. Waste characterisation studies of certain waste streams should be carried out to evaluate the reduction of the hazardous content of such wastes.

5.6.5 Examples of ongoing projects

Farm Hazardous Waste collection campaign (2013–2015)

The EPA, the farm advisory service (Teagasc), the Department of Agriculture, Food and the Marine (DAFM), the Department of Communications, Climate Action and Environment (DCCAE), municipalities and WEEE compliance schemes collaborated in a joint initiative to facilitate the collection, recovery and disposal of hazardous waste from farms.

The farm hazardous waste collections of 2013, 2014 and 2015 combined removed over 163 tonnes of farm hazardous wastes (pesticides, veterinary medicines and needles, paints, oil filters, corrosives, aerosols, etc.), 275 tonnes of waste engine and hydraulic oils and over 158 tonnes of WEEE and waste batteries. Of the pesticides and veterinary medicines collected, 1 220 kg is classified as POPs. Over 5 000 farmers have voluntarily used the collection centres to date. More information is available (http://www.epa.ie/pubs/reports/waste/haz/farmhazwastereport2014.html).

Ten more collections were planned for 2014 (http://www.epa.ie/pubs/reports/waste/haz/pilotfarmhazardouswastebringcentresin2013interimreport.html).

SMART Farming

Waste prevention is one element of this programme. Others include energy, grassland, water, soil fertility, feed and machinery. The programme is fully costed for targeted efficiencies (http://smartfarming.ie/inputs-and-waste/).

Green Healthcare

The Green Healthcare programme is another collaborative resource efficiency project funded by the EPA under the NWPP. One of the waste streams examined in this project is healthcare risk waste. More information and case studies can be found at: http://www.greenhealthcare.ie/topics/risk-waste/.

5.7 Latvia

5.7.1 Introduction and overview

With an overall population of around 2 million people, Latvia generates a considerably smaller amount of hazardous waste than larger European countries.

Since becoming a Member State of the EU, Latvia has developed its capacity for processing hazardous waste. Today, Latvia has one landfill and processing plant that meets EU regulations for hazardous waste. In 2012, the country exported 14 % of the hazardous waste it generated. As harbour operations are important for Latvia's economy and because of strict documentation regulations, the movement of this hazardous waste is well under control.

5.7.2 Relevant hazardous waste streams

Thanks to Latvia's geographical location, transport services are highly developed, along with timber and wood processing, agriculture and food production, and manufacturing of machinery and electronic devices. Manufacturing is not prominent, which is reflected in modest industrial waste generation. Hazardous waste generation per person is quite low compared with the EU average. In 2012, the average annual generation of hazardous waste was 47 kg per person while the EU average was 200 kg (ETC/SCP and ETC/WMGE, 2015).

Hazardous waste generation in Latvia increased significantly between 2006 and 2012. One probable reason for this was remediation activities, as a substantial increase in hazardous soil waste contributed to the overall increase.

Latvia is one of the few countries in Europe in which households generate more than 50 % of the total hazardous waste flow (Tables 5.13 and 5.14).

Legislation includes special regulation of certain wastes, but currently Latvia has not identified any priority streams. Waste oils from garages and bilge water collected in harbours are, however, mentioned as important in certain cases.

Some significant hazardous waste concerns have been resolved since 2006, thanks to dedicated management campaigns. One UN-funded project, for example, concerned dedicated collection campaigns for obsolescent pesticides that were then exported to Germany for incineration.

Table 5.13 Latvia, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
95	0.04	0.002	12	7	7	0.08	14	55

Source: Eurostat, 2016c.

Table 5.14 Latvia, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	8
Chemical waste	9
Discharged vehicles	10
Discharged equipment	4
Soils	30
Sorting residues	6
Ashes	8
Industrial sludges	6

Source: Eurostat, 2016c.

5.7.3 Drivers and challenges

Both EU requirements and international obligations are powerful drivers of hazardous waste prevention. The requirements of EU directives, especially in the fields of waste, enable countries to set quantitative targets and rigid time-frames in national policies and legislation. Moreover, environmental sustainability in general is an important factor, as it implies sustainable production and consumption.

In Latvia, as it is one of Europe's smaller countries and has limited industry, the highest potential for waste prevention lies in changing household and public consumption patterns.

5.7.4 Policies and instruments

Latvia's overarching Sustainable Development Strategy (SDS) to 2030 (SDS, 2010), the most important document in the national policy planning hierarchy, addresses resource efficiency in three chapters. Several initiatives are suggested that support waste prevention; for example, support to firms for eco-innovative technology and support for environmental awareness and education.

Latvia's National Waste Management Programme 2013–2020 includes 16 instruments relating to waste prevention as a whole. None of the instruments, however, is specifically directed at hazardous waste.

Of the financial instruments that are in place to support hazardous waste prevention, the most important is the natural resources tax (NRT). The main approach in setting an NRT is based on the hazardousness principle. Currently the tax concerns, among other things, waste disposal, packaging, goods harmful to the environment and vehicle registration. Tax rates on landfilling municipal, construction and industrial waste were increased considerably in 2014 — for municipal waste, from EUR 1.78 per tonnes in 2009 to EUR 12 in 2014. Further, gradual, increases are envisaged, starting in 2016.

5.7.5 Institutional set-up

The highest national-level authority for coordinating policy planning and state development is the Cross Sectoral Coordination Centre, which reports directly to the prime minister. It is responsible for drafting, supervising and monitoring implementation of the long-term Sustainable Development Strategy and the mid-term National Development Plan.

The Ministry of Environmental Protection and Regional Development (MEPRD) is responsible for waste related to environmental sectors as well as GPP. Major stakeholder groups are represented in policy planning and the legislative drafting process through participation in consultative boards. These are mainly made up of representatives of professional associations or NGOs. Each ministry has created its own framework for consultative boards.

The cross-sectoral integration of interests in policy planning and legislation drafting is ensured by the Environmental Consultative Board, a body to which 20 representatives from different NGOs and professional associations are elected through a transparent process. Apart from participating in this board, its members are delegated to represent the public on various other commissions and bodies.

5.8 The Netherlands

5.8.1 Introduction and overview

In recent decades, the ever-increasing level of material consumption and the significant lack of physical space, together with environmental deterioration, have forced the Dutch government to take measures to reduce the landfilling of waste. Increasing the recyclability of waste by using fewer and less hazardous substances has been the focus of many activities. To this end, the avoidance of hazardous waste generation has been a key element and is approached from an integrated perspective of lifecycle thinking that goes beyond pure waste prevention.

This focus on improving circularity is also reflected in the Dutch waste prevention programme, which includes objectives to:

- improve product design by using less harmful substances;
- reduce waste generation in the production phase, with a specific focus on harmful substances.

5.8.2 Relevant hazardous waste streams

The Dutch waste prevention programme covers use of materials throughout the economy and focuses on streams that produce large quantities of waste, have significant environmental impacts across the whole chain, and exert environmental pressure in the waste phase. These are food, textile and carpet, metal, paper and cardboard, wood, plastic, and construction and demolition waste. Hazardous waste is included in several of these streams and is also mentioned as a specific category of waste to be covered by the programme. The Dutch programme does not have a specific target for hazardous waste but did set a very ambitious, quantified target for textile waste, which often includes hazardous substances. By the end of 2015, the amount of textile waste discarded in residual waste in the Netherlands should have been reduced by 50 % compared with 2011.

Hazardous waste prevention in the Netherlands also addresses three specific waste streams that are of particular relevance in the Dutch economy:

- hazardous waste from the demolition of houses and infrastructure;
- polluted water from rinsing tanks of vessels in Dutch ports;
- process chemistry, for which the Netherlands has some of the most important production sites in the world.

5.8.3 Drivers and challenges

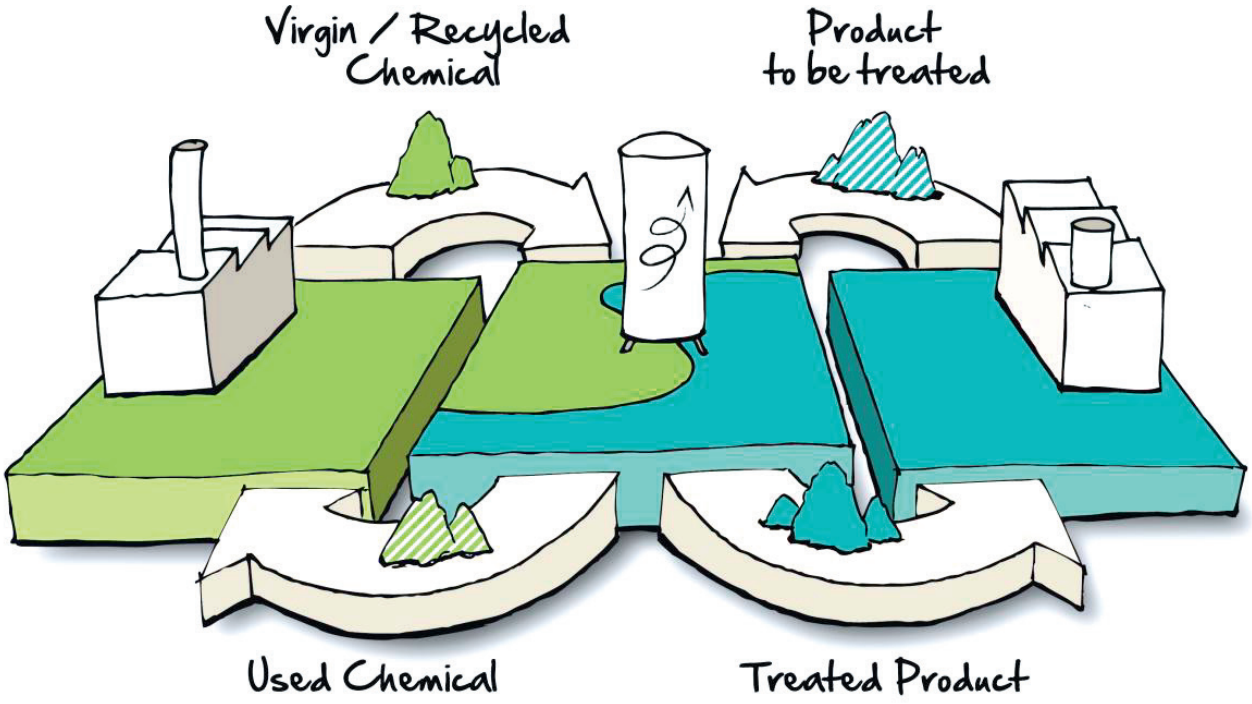
The transition to a circular economy can be considered the key driver for hazardous waste prevention in the Netherlands. Circularity is seen as a significant economic opportunity for the Dutch economy, which is, on the one hand, almost completely dependent on imports of raw materials and, on the other, one of the leading actors in research and development for innovative products that can be reused and recycled better (Bastein et al., 2014). However, it can be achieved only if hazardous substances do not hinder keeping materials in the loop. Thus, phasing hazardous substances out by design is of not only environmental but also economic importance. Limited space is another driver of overall prevention, not only of hazardous waste. For decades the Netherlands has exported large quantities of hazardous waste, often to countries with insufficient environmental standards or capacity to dispose of it safely.

One of the key challenges for hazardous waste prevention is the lack of suitable economic incentives for new and innovative business models that could demonstrate the potential for saving costs by producing smaller quantities of hazardous waste. Green business models, e.g. in the field of chemical leasing, offer chemical-related services instead of chemicals as a product. These are called product service systems. These models often struggle because of high transaction costs, confidentiality issues or unclear warranties.

5.8.4 Policies and instruments

Against the background of these challenges, one of the most promising policy approaches for hazardous waste prevention in the Netherlands is TaBaChem, an official green deal that focuses on take-back systems for chemicals (Figure 5.1). Green deals have been a very successful Dutch environmental policy approach that aims to go beyond technical regulations and instead focus on innovation opportunities for a systemic and radical transition towards a sustainable society and green growth. They are voluntary agreements between private and public partners that have to prove technical, legal and economic feasibility within 3 years. In return for commitment from the private sector, the government ensures the removal of identified

Figure 5.1 The TaBaChem concept



Source: Nederland MVO, 2015.

regulatory barriers, political support for market development and improved access to financial markets (van der Ahé, 2015).

TaBaChem deals specifically with chemicals. In November 2014, several key stakeholders from industry, academia and public authorities committed themselves to bringing the concept into practice and selected the food, metallurgy and textile industries as case studies. The TaBaChem service model is an innovative business model in which the concept of chemical leasing is combined with circular-economy thinking.

This model establishes a new mode of cooperation between the chemical supplier and the user/processor. Within it, the supplier is paid no longer per unit volume, but for the function performed by the chemicals; for example, payment per square metre of surface cleaned. The chemicals remain the property of the supplier and are taken back after use for recycling or (re)processing so they can re-enter the value chain. The purpose of the TaBaChem model is to encourage both the customer and the supplier to use the product as efficiently as possible and to build a strategic relationship for cooperation. The model creates a continuous driving force for preventing hazardous waste by optimising the chemicals used and the process of applying them. This results in both cost and material savings for both parties, bringing both economic and environmental benefits (Tabachem II, 2015).

5.9 Portugal

5.9.1 Introduction and overview

Portugal's national waste plan specifically addresses hazardous waste, the majority of which is generated by the chemical, metallurgy and wood/furniture industries. However, between 5 % and 7 % of municipal solid waste is also considered to be hazardous (Couto et al., 2013), although this is not reported separately (APA, 2015).

With strong manufacturing and agricultural industries, the prevention of hazardous waste, as well as food waste, is an important topic.

The Strategic Plan for Industrial Waste Management (2001–2015) (PESGRI) focused on the prevention of waste production, and the promotion and development of options for reuse and recycling. The implementation of the ambitious programme required considerable stakeholder engagement, but that was affected by the serious economic downturn, which had a significant impact on industrial production and therefore waste generation (APA, 2015).

5.9.2 Relevant hazardous waste streams

According to Eurostat (2016c), the total amount of hazardous waste generated in Portugal in 2012 was 545 000 tonnes.

The largest waste flows are generated by the manufacturing sector, mainly wood and metal, and services, mainly chemical and health waste (Tables 5.15 and 5.16). Compared with the European average for 2012 of 0.2 tonnes per person per year, Portugal's generation is rather modest; around 0.05 tonnes. Calculated per unit of economic output, the amount of hazardous waste generated is also relatively low. In 2012, Portugal generated 3.2 tonnes per million EUR of GDP, lower than the EU-28 average of 7.4 tonnes (ETC/SCP and ETC/WMGE, 2015).

Table 5.15 Portugal, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services (incl. sales of scrap)	Households
545	1	2	199	10	148	37	148	0.1

Source: Eurostat, 2016c.

Table 5.16 Portugal, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	40
Chemical waste	97
Liquid waste (industrial sludge etc.)	103
Waste batteries and accumulators	44
Wood waste	32
Discharged vehicles	68
Healthcare and biological wastes	30
Combustion waste	56

Source: Eurostat, 2016c.

The generation of hazardous waste in Portugal decreased remarkably from 6.1 million tonnes in 2006 to 0.5 million tonnes in 2012 — the largest relative change in Europe for the period. Reductions in chemical and medical waste, of which 57 % were used oils, contributed 72 % of the change. Hazardous waste from construction and services also contributed to the decrease (ETC/SCP and ETC/WMGE, 2015).

A notable campaign for waste prevention that targeted several industrial sectors contributed significantly to the change in the level of hazardousness in waste. Overall, the contribution of hazardous waste to the total production of industrial waste was about 1 % in 2012 (APA, 2015; Eurostat, 2016c).

In the context of PESGRI and the National Plan for Industrial Waste Prevention (PNAPRI), the Portuguese Environment Agency (APA), in collaboration with the Institute for Energy (INETI), developed a planning tool aimed primarily at reducing the amount and hazardousness of industrial waste by implementing pollution prevention technologies within production processes. It included 21 sectoral technical guides, technical tools available to companies, aiming to optimise resource use in industrial production and lead to reduced spillage of materials, save water and energy, and ultimately increase the market availability of products with low environmental impacts and extended lifecycles. The sectors were selected based on their relevance to the national economy and whether or not the sector had signed environmental adaptation contracts (Gonzalvez, 2015).

The priority for the measures was to reduce the amount and hazardousness of industrial waste by implementing prevention good practice and new technologies in industrial production processes, as well as changing economic models and consumer behaviour.

The stakeholder group for the programme was extensive, involving 33 industrial associations, 5 technological organisations and several companies from 21 industrial sectors. The sectors creating the majority of hazardous waste are the chemical, metallurgy, and wood and furniture industries, which together are responsible for more than 80 % of the industrial hazardous waste generated in Portugal (Eurostat, 2016c).

5.9.3 Policies and instruments

The policy framework for Portugal's waste prevention plans is its National Waste Plan (PNGR), which has the overall target of promoting prevention and waste management operations throughout product lifecycles and focuses on boosting the efficient use of resources in the context of developing circularity within the country's economy.

Portugal's Prevention Programme for Municipal Waste (2009–2016) was recently revised and integrated into PERSU2020 ([14]). The general strategy for prevention remained, with some adjustments to the current situation, in particular by imposing a more demanding goal and priority measures (Gonzalvez, 2015).

With the aim of reducing both generation and hazardousness of waste, the plan sets targets for lower waste generation, increased resource productivity and increased recovery, among others. The financing of the prevention measures will be partly through fees and other financial instruments.

One of the objectives of PERSU2020 is the promotion of qualitative prevention. It prescribes a reduction in the generation of hazardous municipal waste. Without setting quantified targets, the plan includes a comprehensive list of measures, introducing preventive measures for local and central authorities to carry out with both business (industry/commerce) and consumers.

Specifically targeting the prevention of waste generated in the industry and trade, the plan promotes the inclusion of environmental criteria in the design of products and packaging (eco-design) and aims to stimulate the supply of products that generate less waste and do not contain hazardous substances. At a product level, this translates into increasing the durability of the products, reducing the size of products and packaging and the quantity of materials used in them, and marketing products that generate less waste throughout their lifecycles. As far as hazardous municipal waste is concerned, local and central administrations are to increase the collection of small quantities of hazardous waste, as a way of promoting its proper management.

([14]) PERSU2020 stands for Plano Estratégico para os Resíduos Urbanos (2014) (http://www.apambiente.pt/_zdata/DESTAQUES/2014/Portaria_PlanoEstrategico_PERSU2020_final.pdf) accessed 24 November 2016.

Portugal's new legislation on WEEE, Decree-Law No 67/2014, contains some measures to promote and encourage reuse, as well as giving entities running reuse programmes the opportunity to apply for funding under the waste management fee regulation (APA, 2015).

In the context of previous WEEE legislation, reuse activities were mainly promoted by collective schemes. One, RECriar, was developed in 2008 to promote entrepreneurship and, in particular, the reuse of electrical and electronic equipment. The programme aimed to fund and promote people with viable business initiatives who had difficulty in accessing credit to support the creation of micro-enterprises, as well as jobs. In 2012, the Reuse Laboratory (RLAB) (http://www.lipor.pt/pt/sustentabilidade-e-responsabilidade-social/projetos-de-sustentabilidade/rlab/) was launched in association with Lipor, Porto's waste management organisation, in a renovated space where its users learn how to recover and extend the lifespan of electrical and electronic equipment. This space is geared towards innovation, training, recovery and social work, with the recovered equipment being passed on to charities. The RLAB was awarded an honourable mention in the 2013 Enterprise Promotion of European Awards.

5.9.4 Eco-design in Portugal

Eco-innovation and eco-design are acknowledged as important tools for decreasing the use of hazardous material in production and thereby the amount of hazardous waste. Selling less environmentally friendly products means that production is more harmful to the environment. Recognising this feedback loop further feeds into Portugal's drive for industrial eco-innovation.

Da Silva et al.'s (2014) study on eco-innovation in Portuguese manufacturing provided statistical evidence that environmental benefits resulting from the use phase of a product are related to the introduction of innovation in manufacturing. That is, the environmental benefits resulting from the use of a product will influence innovation in manufacturing industries.

An example of best practice for waste prevention was the Innovation and Eco-design in the Ceramic Industry (INEDIC) project, which was carried out between 2009 and 2011 (http://www.prepare-net.com/project/inedic-innovation-and-ecodesign-ceramic-industry). The project developed eco-design training materials and tools to provide designers, training and education organisations and businesses with the skills for the systematic integration of environmental considerations in the development of their products. The materials have been tested in a business environment through pilot training and demonstration projects, and include the INEDIC Eco-design Manual, support material for trainers, databases of materials and technologies, and case studies (Ecopol, 2014).

In addition to this voluntary activity, prevention measures were also implemented based on product requirements related to the maximum concentration of certain hazardous components that are allowed to be used in products set in, for example, the Packaging (94/62/EC), Batteries (2006/66/EC) and WEEE Directives (2011/65/EU).

5.10 Spain

5.10.1 Introduction and overview

Preventing hazardous waste, or more specifically reducing its hazardousness, is one of the four key objectives of the Spanish waste prevention programme, alongside generating less waste, reducing its impacts on the environment and health, and extending products' useful lives. As in other EU Member States, interest in hazardous waste prevention has risen significantly in response to the rapid increase in its generation. This is linked to Spain's dynamic economic development, which also led to an almost 80 % rise in the generation of hazardous waste between 1990 and 2000. The issue and its related threats to the people have also become matters of public concern following coverage of several environmental crimes (Pelimskaya, 2005).

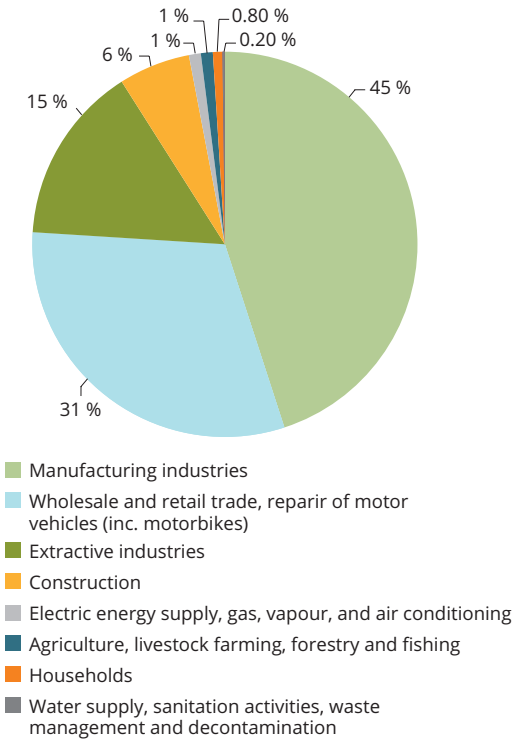
In Spain, responsibility for hazardous waste is distributed between the national, regional and local authorities, with waste management and waste prevention plans developed at the national level. According to Article 43 of the Spanish Law on Waste, regional authorities have responsibility for authorising, monitoring, inspecting and penalising all processes that generate hazardous waste, while municipalities are in charge of enforcing environmental law. As a result of this sharing of responsibilities, approaches to hazardous waste prevention can vary across three administrative levels.

5.10.2 Relevant hazardous waste streams

The Spanish waste prevention programme (MAGRAMA, 2013), specifically addresses hazardous waste prevention and includes the generation of hazardous waste as one of the key elements to monitor. Neither the waste prevention programme nor other national/regional plans specify priority hazardous waste streams, but the manufacturing industry, which generates around 45 % (in weight) of all hazardous waste generated in Spain, could be considered a key focus for prevention (Figure 5.2). Other key waste streams are chemical wastes (22 %), acid, alkaline or saline wastes (14 %) and combustion wastes (10 %).

The programme has set an ambitious target of reducing the amount (in tonnes) of non-hazardous and hazardous waste produced in 2020 to 90 % of the 2010 total.

Figure 5.2 Spain, generation of hazardous waste by economic sector, 2010 (%)



Source: MAGRAMA, 2013.

As outlined, Spain has strongly emphasised hazardous waste prevention. However, although the severe economic crisis led to a decline of many industrial activities responsible for hazardous waste generation, in many cases the necessary financial and human resources to invest in or implement and monitor hazardous waste prevention activities have been lacking.

With 17 different competent bodies, one in each region, there is a lack of harmonisation on the classification of hazardous waste. This means that, depending on the classifying region, the same waste can be considered hazardous or non-hazardous (BIPRO, 2015), which makes monitoring of hazardous waste streams particularly challenging.

5.10.3 Policies and instruments

One of the key approaches to hazardous waste prevention in Spain is EPR. According to Article 17.6 of

the Law on Waste, producers of hazardous waste are obliged to present studies or plans for its minimisation and must commit to reducing its generation. In this context, Spain's waste prevention programme strongly emphasises strengthening the effectiveness of hazardous waste minimisation plans by analysis and the establishment of substitution programmes. This focus on planning is also reflected in regional plans; for example, in Catalonia public administrations have to specify quantifiable prevention and valorisation targets in their management programmes and set aside the resources needed to achieve them.

Several of the measures in the Spanish waste prevention programme focus on hazardous waste prevention in the chemical industry, including:

- the promotion of technical assistance and transfer of results from research through technical centres and similar institutions;
- the promotion of training programmes for staff responsible for providing authorisations to and inspection of the chemical industry to ensure prevention is considered and achieved;
- voluntary agreements to apply the best available technologies in the substitution of harmful substances;
- the promotion of credible environmental management systems.

One of the practical actions taken has been the development of a web portal by the Ministry of Agriculture, Food and the Environment (MAGRAMA) and the Urban Ecology Agency of Barcelona (BCNecologia) (http://www.bcnecologia.net/en) dedicated to good practice and waste management in Spain. It includes documents, regulations, statistics and industry experience on waste generation and treatment, and is emerging as a valuable educational tool for students, professionals and environmentalists alike. This web portal addresses the need for accessible information on the fast-developing area of waste management and prevention. The goal is to encourage sustainable practices through education and case studies, as this sector has undergone significant change over the past few decades. Prevention is one of the key topics, and another is the transport of hazardous waste (BCNecologia, 2016).

5.11 Sweden

5.11.1 Introduction and overview

Sweden's first waste prevention programme (2014–2018) aimed to show what companies, sector organisations and authorities could do to reduce waste while improving their economic and environmental performance. It identified areas in which the largest gains could be made including textiles, electronics, construction and demolition, and food. Although hazardous waste was not addressed separately, with the exception of food waste, these focal waste streams include significant amounts of hazardous substances. The programme aimed to highlight the economic benefits of reducing hazardous substances in materials and products. As an example, taking measures to prevent waste could cut the cost of building a house by 1 %, reduce the use of natural resources and lower environmental impacts.

Overall, the level of separation of hazardous waste is quite high relative to other European countries (ETC/SCP and ETC/WMGE, 2015), although some leakage occurs (Riksrevisionen, 2015).

The Swedish Environmental Protection Agency (SEPA) is responsible for developing the prevention programme, but measures are implemented by various operators such as national authorities, county administrative boards, municipalities, businesses, industry associations and voluntary organisations.

5.11.2 Relevant hazardous waste streams

According to Eurostat (2016c), the total amount of hazardous waste generated in Sweden in 2012 was 2.7 million tonnes. Per person generation, at 283 kg per year, is above the EU-28 average, of 200 kg per person per year, but Sweden is one of the few countries with relatively high levels of generation that show a downward trend compared with 2006 (ETC/SCP and ETC/WMGE, 2015).

The largest waste flow comes from construction and demolition, which produces a third of all hazardous waste generated in Sweden (Table 5.17). The largest part of this waste is contaminated soil (Table 5.18). Other major waste streams are generated in services, the manufacturing industry, households and energy

Table 5.17 Sweden, generation of hazardous waste by economic sector, 2012 (kilotonnes)

Total generation	Agriculture/ fishing	Mining	Manufacturing industry	Energy production	Water, wastewater and waste	Construction	Services	Households
2 697	19	6	438	246	150	893	533	412

Source: Eurostat, 2016c.

Table 5.18 Sweden, relevant hazardous EWC waste streams, 2012 (kilotonnes)

EWC waste streams	Generation
Used oils	194
Chemical waste	697
Discharged equipment	194
Discharged vehicles	281
Wood waste	101
Soil	872
Combustion waste	102

Source: Eurostat, 2016c.

production. On the other hand, although the mining sector is quite strong in Sweden, it generates a small amount of hazardous waste.

The National Waste Prevention Programme includes objectives for the main hazardous waste streams. For example, by 2020, WEEE pre-processors and recyclers should have access to more useful information on the composition of products and the content of hazardous substances than in 2014. A first baseline study has been made targeting access to and the need for information on hazardous substances by waste treatment facilities in the sector.

Within the National Waste Prevention Programme, a target is set to significantly increase knowledge in the textile sector on the use and content of hazardous substances compared with 2014. The dialogue on textiles has focused on increasing knowledge for all participants through meetings and seminars, and one of the conclusions of the dialogue was that the knowledge effectively increased over time. Another outcome from the dialogue was a suggested target of ensuring that by 2020 textiles do not contain any hazardous components that hamper reuse. Currently around 10 % of waste textiles are not suitable for recycling material; these are typically sport and work wear impregnated with fire-proofing and dirt-repelling substances, and textiles with thick plastic printing and/or azo dyes. The REACH regulation currently restricts azo dyes. However, a large number of azo dyes have been identified for use in the textile industry, and the rules in REACH are unclear and difficult to supervise (Kemikalieinspektionen, 2015).

The prevention of textile waste has also been a focus of the SEPA. The consumption of textiles has increased by 40 % since 2006, with reuse accounting for just 20 % of the textile market and the majority of waste textiles currently being incinerated. The SEPA has an ongoing government assignment (Naturvardsverket, 2016) to propose a way of managing textiles in a sustainable way. The proposal should work towards reaching higher up the waste hierarchy through preventive measures and increased reuse and recycling of textiles, as well as making the cycle non-toxic. It should be based on the polluter pays principle. As part of the proposal, SEPA is investigating the possibility of introducing a mandatory EPR system in addition to ways of raising consumer awareness.

5.11.3 Drivers and challenges

The process of phasing out certain substances is complex and lengthy. That applies to all identified key drivers for phasing out hazardous substances. Another problem is the insufficient link in producer responsibility schemes between production and the management of a product in the waste stage. Hazardous waste generated from demolition largely arises from material that was used in building, often more than 50 years ago. To address this more efficiently in the future, there should be control over what is used in new and renovated buildings. Sweden has developed a number of voluntary systems for this purpose: Byggvarubedömningen, Basta Online, SundaHus and BREEAM ([15]). Recently the National Board of Housing, Building and Planning investigated how to develop and enforce a mandatory system of documentation for building products. Moreover, the Swedish Chemical Agency is investigating how to develop and enforce a ban on certain hazardous substances in building products. These ongoing efforts will be further progressed through a national consultation with various stakeholders.

5.11.4 Policies and instruments

The Swedish approach to waste prevention relies to a great extent on cooperation between industry and the authorities. In the case of construction and demolition waste, the industry and authorities have developed a system for using products that do not contain harmful substances in buildings, as mentioned above. The building and construction industry has also formulated an industry standard for waste management, producing 'Resource and waste guidelines for construction and demolition', which also aims to improve overall resource management.

Tax deductions for repairing used products, taxes on hazardous substances and the labelling of products containing hazardous substances are examples of policy instruments evaluated by a research programme financed by SEPA (Ekvall and Malmheden, 2014). The programme's proposals will be further analysed by SEPA in new national waste management plans, which will also include a waste prevention programme.

([15]) BREEAM is the world's leading sustainability assessment method for project planning, infrastructure and buildings. It addresses a number of lifecycle stages such as new construction, refurbishment and 'in-use' (http://www.breeam.com/) accessed 24 November 2016.

5.12 England, United Kingdom

5.12.1 Introduction and overview

Waste prevention in England is focused on support for a resource-efficient economy to improve the state of the environment and protect human health. This includes, among other things, the objective of the English waste prevention programme to reduce the impact of generated waste. The prevention of hazardous waste is highlighted in the National Policy Statement for Hazardous Waste, although this largely concentrates on waste infrastructure planning (Defra, 2013a).

5.12.2 Relevant hazardous waste streams

England's waste prevention programme covers hazardous waste without defining specific waste streams or sectors. Figure 5.3 shows the hazardous waste generation split by NACE ([16]) economic activity in England in 2012 and the specific proportions by weight (Defra, 2015). Looking at the specific EWC chapters, in 2012, construction and demolition waste accounted for 19.7 %, oil and oil/water mixtures for 16 % and organic chemical processes for 10.8 % (Defra, 2015).

The overall English waste prevention programme does include specific targets, even for hazardous waste, although some initiatives within it do have their own targets aimed at different materials/sectors such as the Courtauld Commitment on food waste and packaging. These action plans, however, do not differentiate between hazardous and non-hazardous wastes but focus on environmental benefits.

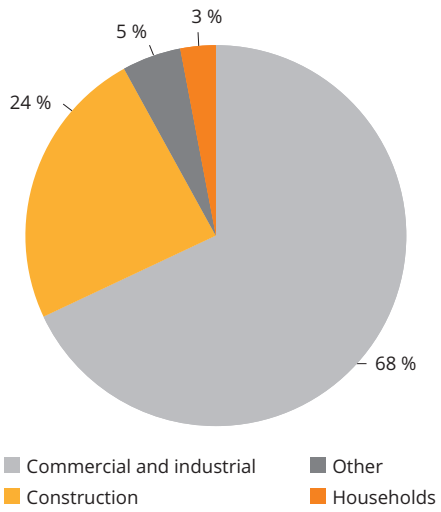
5.12.3 Drivers and challenges

With resource efficiency as one of the key objectives, waste prevention in England is very much driven by potential economic cost savings. Several studies and implementation-oriented tools aim to support households and especially industry in becoming more efficient in their use of resources and, in this way, prevent waste generation: 'taking action to minimise the amount of waste produced and make best use of resources makes business sense. Evidence shows simple measures to produce less waste, which pay back within a year, could save businesses GBP 18 billion (or around EUR 22 billion). So, changing wasteful practices can have a significant financial impact and can help increase competitiveness. Reducing reliance on material requirements may also help resource security and protect against price volatility' (Defra, 2013b).

Against this background, waste from hospitals, for example, is seen as a priority, as its disposal costs GBP 42 million (or around EUR 50 million) per year. Ongoing work with the National Health Service is designed to improve knowledge and understanding of chemical and healthcare waste, with the aim of identifying opportunities to reduce its quantity and hazardous content.

Despite the economic potential, many companies and households struggle to realise cost savings. Access to knowledge is considered a key obstacle that a number of activities are addressing.

Figure 5.3 England, generation of hazardous waste by NACE economic activity, 2012 (%)



Source: Defra, 2015.

([16]) NACE stands for the Statistical Classification of Economic Activities in the European Community (*nomenclature statistique des activités économiques dans la Communauté européenne*).

5.12.4 Policies and instruments

Waste prevention policies and instruments are very much focused on voluntary agreements and joint efforts between the private and public sectors. Several agreements set medium- to long-term targets for reducing the environmental footprint of products or value chains. These often include hazardous waste prevention targets.

In November 2014, for example, more than 50 organisations from across the English electrical sector decided to address WEEE, a key hazardous waste stream, and signed up to the Electrical and Electronic Equipment Sustainability Action Plan (ESAP), which 'seeks to catalyse sector action, share evidence and bring together the many different stakeholders to provide tangible economic and environmental benefits' (Defra, 2014). Implementation is coordinated on behalf of English local authorities by the Waste and Resources Action Plan (WRAP), which helps organisations that design, manufacture, sell, repair, reuse and recycle electrical and electronic products to work collaboratively across product lifecycles. The ESAP is linked to hazardous waste prevention by efforts to extend product durability through design and the provision of customer information on the reparability of their purchases.

Another joint action plan has been developed for clothing. The objective of the Sustainable Clothing Action Plan (SCAP) is to improve sustainability in the manufacture and use of clothing (WRAP, 2014). By bringing together industry, government and the voluntary sector, SCAP aims to reduce resource use and improve corporate performance by developing sector-wide targets. The majority of activities focus on recycling textile waste and diverting it from landfill but SCAP is also concerned with preventing hazardous waste through design, increasing longevity and encouraging reuse. In a further effort to reduce hazardous waste, SCAP is also working to assess the economic and environmental effects of washing and drying contaminated textiles. Leading clothing companies have signed up to the SCAP 2020 Commitment and pledged to measure and reduce their environmental footprints. By 2020, the partners are committed to preventing at least 16 000 tonnes of hazardous and non-hazardous textile waste.

6 Key findings and prospects

6.1 Key findings

The **general** picture regarding waste prevention across Europe is that a variety of national approaches, patterns and trends exist. Overall, the policy focus still appears to be more on waste management issues than on prevention, as reflected in target setting, measures, monitoring efforts and institutional arrangements.

Data limitations related to reporting procedures and waste classification hamper comparative analysis of country data and trends. Changing the classification of hazardous and non-hazardous waste, for example, has an influence on data quality and has created/will create discontinuity in long-term data trends. This means that waste that was previously classified as hazardous could now be considered non-hazardous, and vice versa. In addition, the discrepancies between the revision of hazardous characteristics and the status quo of the waste codes might lead to more classification problems.

This discontinuity makes establishing a baseline problematic, creating difficulties in determining or following targets and indicators. Ultimately, evaluating the effectiveness of implemented waste prevention measures might rely on mostly qualitative rather than quantitative analysis at both the European and country/region levels.

Specific findings are as follows:

- In 2012, the EU-28 discarded 2.5 billion tonnes of waste, of which close to 4 % was classified as hazardous. The trend shows a slight increase since 2008, although changes are more pronounced in waste fractions than in absolute numbers.

- In the EU-28, the largest hazardous waste volumes are generated by the waste sector, including collection, treatment and disposal activities. The sectors responsible for the second- and third-largest volumes are construction, and mining and quarrying, respectively. Hazardous waste emerging from households, although minor, is an important source. Nevertheless, the different programmes focus on different waste streams and sectors.

- Of European countries, Bulgaria and Estonia generate the highest amounts of hazardous waste, due to the size and intensity of their mining and quarrying, and oil shale sectors, respectively.

- The management of hazardous waste is high on national political agendas, but prevention lags behind, although developments in and preference for prevention (rather than management) at the European level are key drivers in political shifts.

- Institutional set-ups for prevention in some countries are not always clearly defined, while in others they are spread across various institutions/ departments, which might lead to delays or otherwise hinder implementation activities.

- Many countries' policy frameworks for the prevention of hazardous waste are covered in national or regional waste prevention programmes. In others, including Germany, however, the prevention of hazardous waste is separated from the more general waste prevention programme.

The scope of programmes covers prevention of hazardous waste in 25 out of 30 cases. The construction sector is covered in 27 programmes, whereas mining is covered by 11. Household hazardous waste is covered in all programmes.

Prevention objectives for hazardous waste are formulated in different ways across the programmes. A total of 17 programmes explicitly include reduction of harmful substances as one of the objectives. A lack of explicit objectives on prevention of hazardous waste does not necessarily mean that hazardous waste is excluded from the programme. For example, given the nature of its programme, Austria does not include hazardous waste among its programme objectives; rather, it is separately covered by specific prevention measures.

Quantitative prevention targets for hazardous waste do not figure in most programmes analysed, because of challenges linked to classification and data quality issues. However, four programmes, in Bulgaria, Italy, Latvia and Sweden, do include some kind of

quantitative targets, although those in Sweden are not numerical.

Waste prevention indicators for hazardous waste were suggested in seven programmes, in Austria, Bulgaria, Cyprus, France, Germany, Latvia and Spain. Barriers to developing adequate indicators are the same as for targets.

Waste prevention measures are included in 16 programmes that target the reduction of hazardous waste generation. Most of the measures are linked to regulation relating to production, including bans on toxic materials. Many other measures do not specify which waste streams are addressed, but may cover hazardous waste, such as Germany's GPP guidelines.

Waste prevention instruments for hazardous waste tend to be regulatory, although voluntary and informative instruments play a strong role as well. No market-based instruments were found, although most countries have EPR schemes.

Waste prevention monitoring systems are stipulated in 10 programmes, although none of them have specific monitoring schemes for hazardous waste prevention.

6.2 Prospects

The waste prevention reviews aim to contribute to the ongoing European and country/national political and policy processes. The review process is to some extent hampered by data quality issues and a lack of common waste prevention targets, while indicators and analytical frameworks are hindered by the time lag between the adoption and implementation of waste prevention programmes. Analyses beyond waste prevention — for example of the circular economy or resource efficiency — might be required to understand waste generation trends and drivers and link them to the overall waste prevention efforts.

Following up on the first three reports, there is potential in a stronger focus on specific waste types or waste-generating sectors, such as construction and demolition, mining, and manufacturing. The analyses of specific themes could be periodically repeated to measure progress within 5–10 years.

This approach would allow improved analysis at country/regional levels and provide a baseline review and eventually a transition from qualitative to more quantitative assessments. Inclusion of quantitative data and information in areas such as industrial emissions or greenhouse gas emissions might potentially be interesting (only as approximations).

Another important aspect is the reporting frequency. Delivering reviews every other year or every third year, rather than annually, provides more time to conduct theme-specific analyses and may improve the quality, extent and depth of the analysis.

Finally, the continued involvement of a broad range of waste prevention stakeholders and actors — from policymakers at European and national/regional levels to the public and private sector, international organisations and EEA Eionet partners — will be crucial. It allows access to up-to-date and accurate data and information on waste prevention, and a better understanding of implementation efforts and existing institutional frameworks. A positive spin-off is capacity building within Eionet, with exchange of experience in waste prevention measures and the promotion of good practice examples. Linking the EEA waste prevention review process to other well-established processes and networks at European and global levels will allow access to broader networks of actors and extend the knowledge base on waste prevention and management. Examples include the review of waste prevention policies in OECD countries.

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Annex 1 Status of the waste prevention programmes in Europe as of 1 November 2016

Country/region	Programme adopted by 1 November 2016	Title and link to the programme If programme is not ready, status of the programme
Austria	Yes	Abfallvermeidungsprogramm 2011 (http://www.bundesabfallwirtschaftsplan.at/vermeidungsprogramm.html) Waste prevention programme 2011 (Chapter 6 of the Federal Waste Management Plan 2011) (www.bundesabfallwirtschaftsplan.at/dms/bawp/BAWP_Band_1_EN.pdf)
Belgium		
Brussels Region (a)	Yes	Plan de Prévention et de Gestion des Déchets (http://documentation.bruxellesenvironnement.be/documents/Plandechets_2010_FR.PDF) Plan voor de preventie en het beheer van afvalstoffen (http://documentatie.leefmilieubrussel.be/documents/AfvalPlan_2010_NL.PDF)
Flemish Region (a)	Yes	Uitvoeringsplan milieuverantwoord beheer van huishoudelijke afvalstoffen (http://www.ovam.be/sites/default/files/2014_UMBHA-geconsolideerd-DEF.pdf) Materiaalbewust bouwen in kringlopen (http://www.ovam.be/sites/default/files/2014-DEF-Milieuverantwoord-milieugebruik-bouw-3luik-LR.pdf) Note: a revision of the programme is currently under way.
Walloon Region (a)	No	The waste prevention programme was redrafted in June 2015 and is currently under political discussion. The programme is expected to be adopted by the end of the year.
Bulgaria	Yes	НАЦИОНАЛЕН ПЛАН ЗА УПРАВЛЕНИЕ НА ОТПАДЪЦИТЕ (http://www.moew.government.bg/wp-content/uploads/filebase/Waste/NACIONALEN_PLAN/_/NPUO_2014-2020.pdf)
Croatia	Special Agreement with the European Commission	A new waste management plan that will include the waste prevention programme will be prepared no later than 2016
Cyprus	Yes	ΠΡΟΓΡΑΜΜΑ ΠΡΟΛΗΨΗΣ ΔΗΜΙΟΥΡΓΙΑ ΑΠΟΒΛΗΤΩΝ 2015–2021 (http://www.ypeka.gr/Default.aspx?tabid=238&)
Czech Republic	Yes	Program Předcházení Vzniku Odpadů ČR (http://www.mzp.cz/c1257458002f0dc7/cz/predchazeni_vzniku_odpadu_navrh/$file/oodp-ppvo-2014_10_27.pdf)
Denmark	Yes	Danmark uden affald II — Udkast til Strategi for affaldsforebyggelse (http://mst.dk/media/130620/danmark_uden_affald_ii_web-endelig.pdf) Denmark without waste II – a waste prevention strategy (http://eng.mst.dk/topics/waste/denmark-without-waste-ii/)
Estonia	Yes	RIIGI JÄÄTMEKAVA 2014–2020 (http://www.envir.ee/sites/default/files/riigi_jaatmekava_2014-2020.pdf)
Finland	Yes	Kohti kierrätysyhteiskuntaa — Valtakunnallinen jätesuunnitelma vuoteen 2016 (http://www.ym.fi/fi-FI/Ymparisto/Jatteet/Valtakunnallinen_jatesuunnitelma) Mot ett återvinningssamhälle — Riksomfattande avfallsplan fram till år 2016 (http://www.ym.fi/sv-FI/Miljo/Avfall/Den_riksomfattande_avfallsplanen) Towards a recycling society — The National Waste Plan for 2016 (http://www.ym.fi/en-US/The_environment/Waste/The_National_Waste_Plan)
France	Yes	Programme national de prévention des déchets 2014–2020 (http://www.developpement-durable.gouv.fr/IMG/pdf/Programme_national_prevention_dechets_2014-2020.pdf)
Germany	Yes	Abfallvermeidungsprogramm des Bundes unter Beteiligung der Länder (http://www.bmub.bund.de/service/publikationen/downloads/details/artikel/abfallvermeidungsprogramm/)
Greece	Yes	ΕΘΝΙΚΟ ΣΡΑΣΗΓΙΚΟ ΣΧΕΔΙΟ ΠΡΟΛΗΨΗΣ ΔΗΜΙΟΤΡΓΙΑΣ ΑΠΟΒΛΗΣΩΝ (http://www.ypeka.gr/LinkClick.aspx?fileticket=2Y2%2B%2BPSM4P0%3D&tabid= 238&language=elGR)
Hungary	Yes	Országos Megelőzési Program (Országos Hulladékgazdálkodási Terv 2014–2020) (http://www.szelektivinfo.hu/iparfejlesztes/uj-uton-a-hazai-hulladekgazdalkodas/az-orszagos-hulladekgazdalkodasi-terv-es-az-orszagos-megelozesi-program)

Country/region	Programme adopted by 1 November 2016	Title and link to the programme If programme is not ready, status of the programme
Iceland	Yes	Saman gegn sóun — Almenn stefna um úrgangsforvarnir 2016–2027 (https://www.umhverfisraduneyti.is/media/PDF_skrar/Saman-gegn-soun-2016_2027.pdf)
Ireland	Yes	Towards a Resource Efficient Ireland — National Waste Prevention Programme, 2014–2020 (http://www.epa.ie/waste/nwpp/#.VkH3YWfbly8)
Italy	Yes	Programma Nazionale di Prevenzione dei Rifiuti (http://www.minambiente.it/sites/default/files/archivio/comunicati/Programma%20nazionale%20prevenzione%20rifiuti.pdf)
Latvia	Yes	Atkritumu apsaimniekošanas valsts plans 2013.–2020.gadam (http://polsis.mk.gov.lv/view.do?id=4276)
Liechtenstein	No	No information
Lithuania	Yes	Dėl Valstybinės Atliekų Prevencijos programos Patvirtinimo (http://www.litlex.lt/scripts/sarasas2.dll?Tekstas=1&Id=173128)
Luxembourg	Yes	Plan général de gestion des déchets (http://www.environnement.public.lu/dechets/dossiers/pggd/pggd_plan_general.pdf)
Malta	Yes	Waste Management Plan for the Maltese Islands — A Resource Management Approach, 2014–2020 (https://environment.gov.mt/en/document%20repository/waste%20management%20plan%202014%20-%202020%20-%20final%20document.pdf)
Netherlands	Yes	Afvalpreventieprogramnd (https://zoek.officielebekendmakingen.nl/stcrt-2013-27383.html)
Norway	Yes	Forebygging av avfall (Chapter 4 of the waste management plan Fra avfall til ressurs) (https://www.regjeringen.no/contentassets/27128ced39e74b0ba1213a09522de084/t-1531_web.pdf)
Poland	Yes	National Waste Prevention Programme (adopted by the Council of Ministers on 26 June 2014 as a separate document) (http://www.mos.gov.pl/g2/big/2014_10/a400f6bb998e8fbc1bc8451fe5c41b11.pdf)
Portugal	Yes	Urban Waste Prevention Programme — Programa de Prevenção de Resíduos Urbanos (http://www.apambiente.pt/index.php?ref=16&subref=84&sub2ref=10 6&sub3ref=268) (Click Anexos in bottom left corner)
Romania	No	Romania started a project to develop a waste prevention programme in 2014; the project is ongoing
Slovakia	Yes	Program predchádzania vzniku odpadu SR na roky 2014–2018 (http://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/ppvo-vlastnymaterial.pdf)
Slovenia	Yes	Program ravnanja z odpadki in program preprečevanja odpadkov Republike Slovenije (http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/zakonodaja/varstvo_okolja/operativni_programi/op_odpadki.pdf)
Spain	Yes	Programa estatal de prevencion de residuos 2014–2020 (http://www.mapama.gob.es/es/calidad-y-evaluacion-ambiental/planes-y-estrategias/Programa_de_prevencion_aprobado_actualizado_ANFABRA_11_02_2014_tcm7-310254.pdf)
Sweden	Yes	Tillsammans vinner vi på ett giftfritt och resurseffektivt samhälle — Sveriges program för att förebygga avfall 2014–2017 (http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Avfall/Avfallsforebyggande-program/)
United Kingdom		
England (a)	Yes	Prevention is better than cure — The role of waste prevention in moving to a more resource efficient economy (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265022/pb14091-waste-prevention-20131211.pdf)
Northern Ireland (a)	Yes	The waste prevention programme for Northern Ireland — The road to zero waste (https://www.daera-ni.gov.uk/publications/waste-prevention-programme-northern-ireland-road-zero-waste)
Scotland (a)	Yes	Making Things Last A Circular Economy Strategy for Scotland (http://www.gov.scot/Resource/0049/00494471.pdf)
Wales (a)	Yes	Towards Zero Waste — One Wales: One Planet —The Waste Prevention Programme for Wales (http://gov.wales/docs/desh/publications/100621wastetowardszeroen.pdf)

Note: The shaded boxes indicate the 30 waste prevention programmes that are the subject of this review.

(a) Region.

Annex 2 Questionnaire for interview with country/region

To gain a better overview of activities, drivers, challenges and expectations in the area of waste prevention, the 2015 Eionet workshop on waste suggested conducting **bilateral interviews** with experts from selected countries. This questionnaire, which was sent to interviewees beforehand, aimed to structure the interviews.

The questionnaire was designed for bilateral interviews within the context of reviewing national and regional waste prevention programmes. Article 29 of the **Waste Framework Directive** (WFD) (2008/98/EC) required Member States to adopt waste prevention programmes by 12 December 2013. Article 30(2) of the directive invited the EEA to include a review of progress in the completion and implementation of national waste prevention programmes in its annual report.

Initiating bilateral interviews with selected **Eionet countries** was seen as a continuation of previous work done in the area of waste prevention, with its particular emphasis on prevention of hazardous waste. Hazardous waste is a large area of work and also very complex, in particular concerning industrial processes, where economic factors represent an important incentive for both prevention and recycling.

Topic 1: Relevant hazardous waste streams

- What are relevant hazardous waste streams in your country/region?
- What are the most important production processes or activities that cause the generation of hazardous waste?
- Does your national/regional waste prevention programme include any objectives, targets or indicators for hazardous waste?

Topic 2: Challenges, drivers and barriers

- What do you consider as key drivers for hazardous waste prevention in your country/region?
- Do you have information on costs related to the management of hazardous waste (economy-wide or on company level)? How did these costs develop over time?
- What do you see as relevant barriers that hinder the prevention of hazardous waste?
- Which of these barriers require an EU-wide approach or coordination between Member States?

Topic 3: Policies and instruments

- Which instruments have proven to be successful approaches for hazardous waste prevention in your country?
- Are there any monitoring or evaluation schemes for hazardous waste prevention policies/instruments?
- What is the institutional set-up for hazardous waste prevention in your country (involved ministries, responsible institutions, etc.)?
- Which instruments do you consider for future activities?
- Are there any specific projects/activities that you would like to showcase in the upcoming hazardous waste prevention report? If so, could you provide us with additional material/contact persons?

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