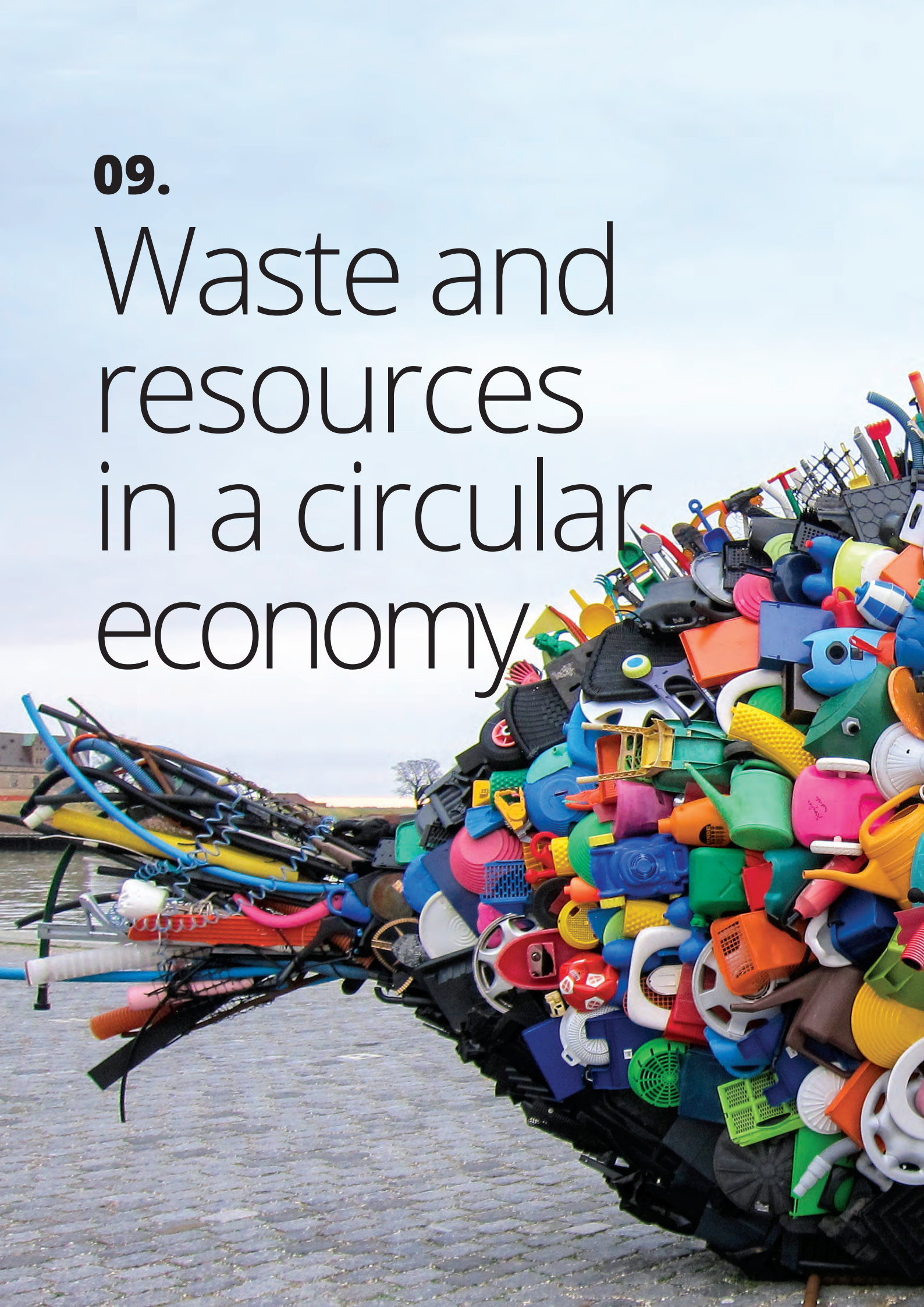
09.
Waste and resources in a circular economy

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Key messages

- Increasing resource efficiency, preventing waste generation and using waste as a resource are at the core of the circular economy, and have considerable potential to reduce environmental pressures both within Europe and outside Europe's borders. These strategies may also contribute to alleviating the growing concern over Europe's dependency on imported resources and over securing access to critical raw materials, some of which play a fundamental role in deploying low-carbon, renewable energy technologies.

- Resource use in the economy of the 28 EU Member States declined over the last decade, while resource productivity improved. This was largely due to trends in overall economic growth and certain structural changes in the economy, rather than a result of direct policy intervention. Resource efficiency is expected to further improve in Europe, albeit with increasing levels of material resource use.

- At the other end of the materials chain, Europe continues to generate a large amount of waste but is increasingly moving towards more recycling. However, progress is slow and several countries are at risk of not meeting agreed targets. Waste-related targets and requirements will help Europe to increase recycling, although the prospects for reducing waste generation are less certain.

- Overall, the large amounts of resources used and waste generated and the rather low contribution of recycled materials to the material demands of the economy indicate that Europe is still far away from the goal of becoming a circular economy.

- Recently, policies have started to improve the framework conditions for a circular economy, albeit with the main focus on waste. In order to fully realise the potential benefits, it will be crucial to design materials and products in a way that enables durability, reuse, repair and upgrading, refurbishment, remanufacturing and recycling, and that prevents contamination of material cycles.

Thematic summary assessment

Theme	Past trends and outlook		Prospects of meeting policy objectives/targets	
	Past trends (10-15 years)	Outlook to 2030	2020	2030
Circular use of materials	Improving trends dominate	Developments show a mixed picture		☐ Partly on track
Material resource efficiency	Improving trends dominate	Developments show a mixed picture	☑ Largely on track	
Waste generation	Trends show a mixed picture	Developments show a mixed picture	☐ Partly on track	
Waste management	Improving trends dominate	Improving developments dominate	☐ Partly on track	

Note: For the methodology of the summary assessment table, see the introduction to Part 2. The justification for the colour coding is explained in Section 9.3, Key trends and outlooks (Tables 9.2, 9.3, 9.4 and 9.5).

09.

Waste and resources in a circular economy

9.1 Scope of the theme

Increasing resource efficiency, preventing waste generation and using waste as a resource are important strategies on the road to the circular economy (Figure 9.1). They have considerable potential to reduce the environmental pressures associated with Europe's economic activities (both within Europe and outside), as well as bringing benefits to the economy. Therefore, they are important environmental goals in Europe.

The scope of this chapter covers material resources (including the use of material resources, resource efficiency, and security of supply and access to critical raw materials) and waste (including waste prevention, and waste generation and management). Total waste, excluding major mineral wastes, has been selected as a broad waste type for the assessment, together with some subcategories for which specific targets apply (municipal waste, packaging waste, waste electrical and electronic equipment, end-of-life vehicles, batteries). While food waste, hazardous waste, construction and demolition waste, and mining waste are important waste streams, they have not been assessed in this chapter.

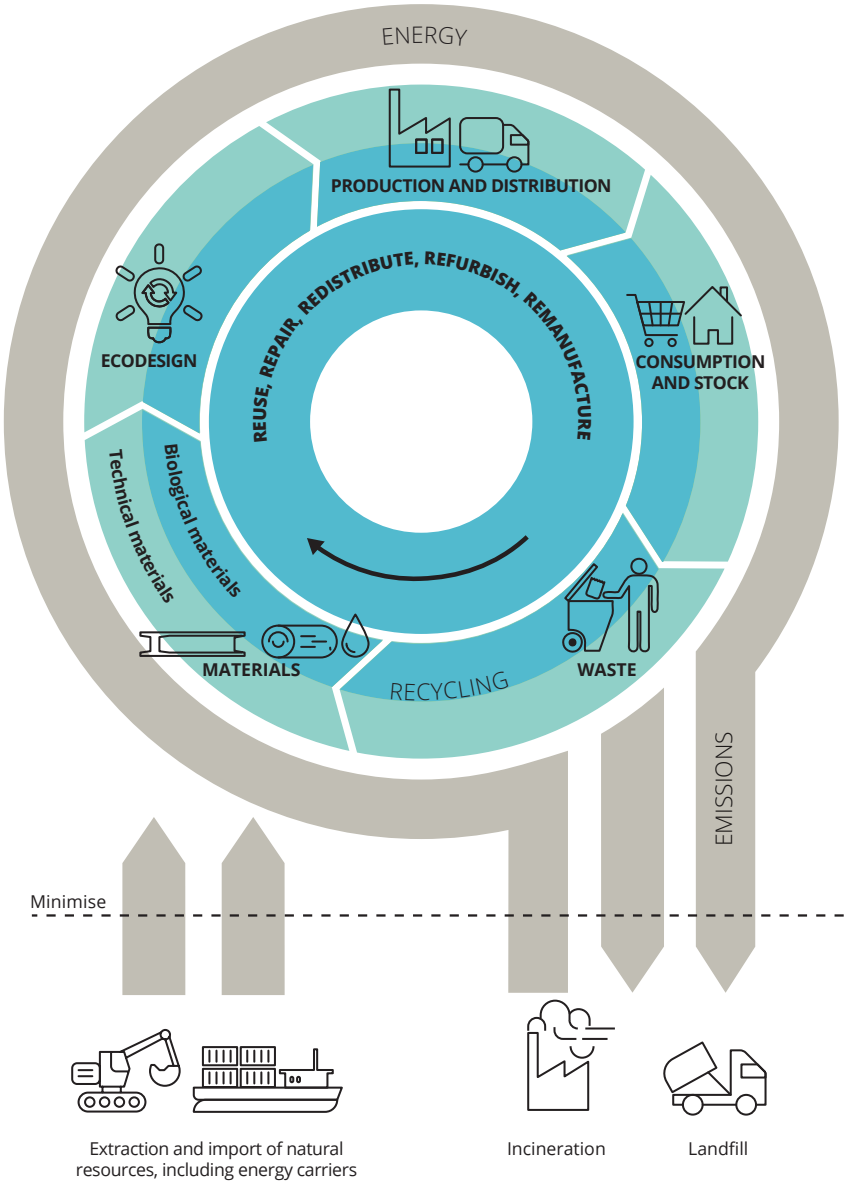
Resource efficiency, waste prevention and using waste as a resource are at the core of the circular economy.

9.2 Policy landscape

The overall objectives of EU and European countries' policies related to waste and resources are to improve resource efficiency, reduce waste generation and improve waste management, thereby moving towards a circular, low-carbon economy and carbon neutrality. The EU's circular economy action plan (EC, 2015) provides a framework of measures towards achieving these objectives (Chapter 2) across the life cycle of materials and products. While the revised Waste Framework Directive (EU, 2008, 2018b) and other revised waste directives introduce a large range of new provisions aiming to move waste up the waste hierarchy, other measures aim to align other policy areas, such as chemicals, ecodesign and water use, with circular economy goals.

The EU has not set quantitative targets for the use of resources or for improvements in resource productivity, although a few Member States have adopted national targets. In recent years, policies on ensuring security of supply of raw materials, and in particular access to critical raw materials, increasingly address resource use (EC, 2008, 2011b). For industrial facilities, the Industrial Emissions Directive (EU, 2010) requires improving material efficiency and reducing waste generation; however,

FIGURE 9.1 Circular economy system diagram



Source: EEA (2016a).

the related best available techniques conclusions currently contain no binding provisions in this area (Chapter 12).

The waste hierarchy is the overarching principle of EU waste policies in which waste prevention has the highest priority, followed by preparing for reuse, recycling and other recovery and finally disposal as the least desirable option (EU, 2008, 2018b). In line with the waste hierarchy, EU waste legislation includes more than 30 binding targets for the management of waste for the period 2015-2035 but none for waste prevention. However, EU Member States are obliged to take measures on waste prevention including food waste and plastic bags and to report on reuse. Most recently, the Single-use Plastics Directive introduces, inter alia, a ban on certain plastics items, targets for separate collection and recycled content for plastic bottles and producer responsibility schemes for cigarette butts and fishing gear (EU, 2019b).

In addition, several of the United Nations 2030 Sustainable Development Goals (SDGs) address waste and resources, notably SDG 12 on sustainable consumption.

Table 9.1 presents a selected set of relevant policy objectives and targets addressed in this report.

9.3 Key trends and outlooks

9.3.1 Circular use of materials

►See Table 9.2

The circular economy aims to keep materials and products in use for as long as possible, extracting the maximum value from them while in use and recycling them at the end of their life cycle. From a circular and low-carbon economy perspective, achieving a more circular use of materials is key to improving resource efficiency and helps to reduce the demand for virgin materials (EEA, 2016a). The European Commission's circular economy monitoring framework (EC, 2018c) aims to measure progress towards the circular economy. It focuses on macroeconomic indicators and waste, reflecting a lack of data on new business models, longevity of products, reuse, repair and remanufacturing.

The road towards a more circular use of materials and products starts at the very beginning of the life cycle. One of the most important factors is

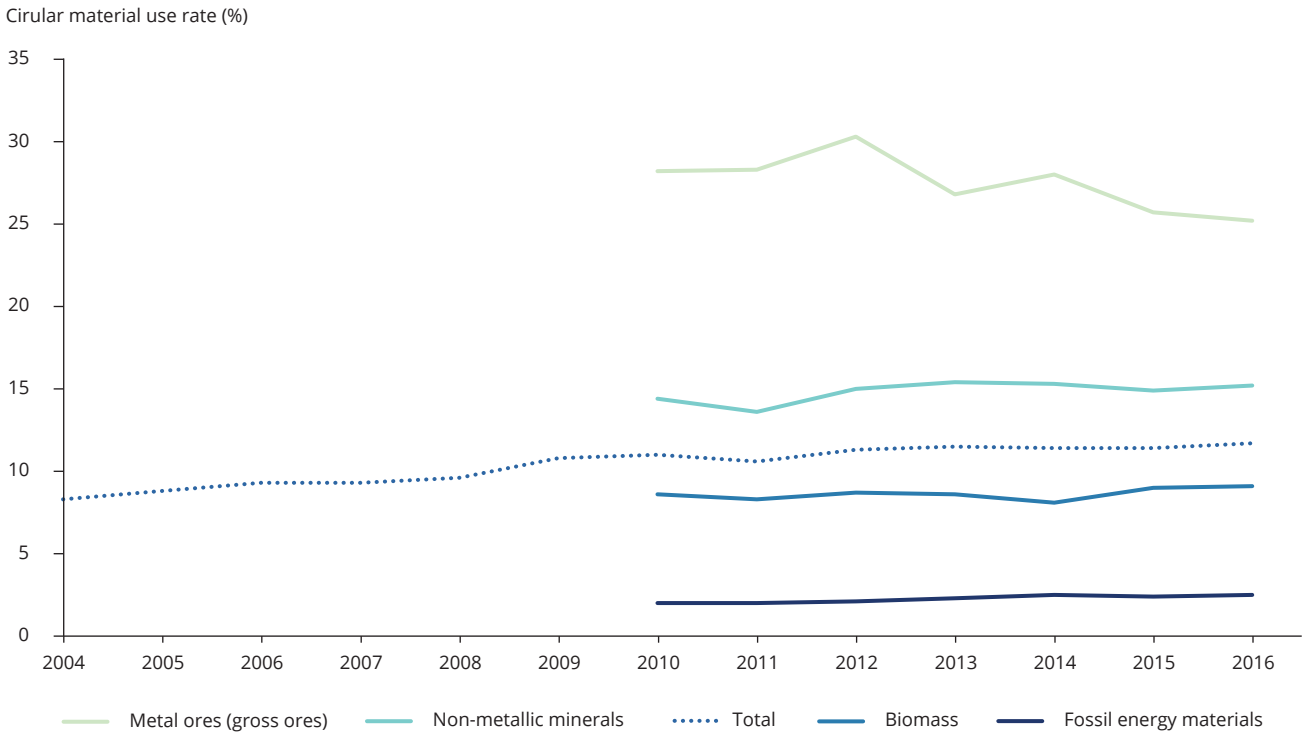
TABLE 9.1 Overview of selected policy objectives and targets

Policy objectives and targets	Sources	Target year	Agreement
Resource use and efficiency			
Improve resource efficiency	7th EAP (EU, 2013); Roadmap to a resource efficient Europe (EC, 2011a)	2020	Non-binding commitments
Strive towards an absolute decoupling of economic growth and environmental degradation	7th EAP (EU, 2013)	2020	Non-binding commitments
Create more with less, delivering greater value with less input, using resources in a sustainable way and minimising their impacts on the environment	7th EAP (EU, 2013)	2050	Non-binding commitments
Achieve the sustainable management and efficient use of natural resources	SDG 12.2 (global, national) (UN, 2015); 7th EAP (EU, 2013)	2030	Non-binding commitments
Waste generation and management			
50 %/55 %/60 %/65 % of municipal waste is prepared for reuse or recycled (differing calculation method for the 50 % target)	Waste Framework Directive (EU, 2008, 2018b)	2020/2025/2030/2035	Legally binding
Reduce landfill of biodegradable municipal waste to 75 %/50 %/35 % of the same waste generated in 1995	Landfill Directive (EU, 1999)	2006/2009/2013	Legally binding
Reduce landfill to a maximum of 10 % of municipal waste generated	Landfill Directive (EU, 1999, 2018a)	2035	Legally binding
Specific targets for collection, recycling and/or recovery of packaging waste, construction and demolition waste, WEEE, end-of-life vehicles, batteries, single-use plastics (incl. market restrictions and requirements for recycled content)	Waste Framework Directive (EU, 2008, 2018b), Packaging Waste Directive (EU, 1994, 2018c), WEEE Directive, ELV Directive (EU, 2000), Batteries Directive (EU, 2006); Single-use Plastics Directive (EU, 2019b))	2008-2035	Legally binding
All plastics packaging should be recyclable	EU plastics strategy (EC, 2018a)	2030	Non-binding commitments
Waste generation to decline absolutely and per capita, and reduction and sound management of hazardous waste	7th EAP (EU, 2013)	2020	Non-binding commitments
Energy recovery to be limited to non-recyclable waste	7th EAP (EU, 2013)	2020	Non-binding commitments
Halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	SDG 12.3 (UN, 2015)	2030	Non-binding commitments

Note: 7th EAP, Seventh Environment Action Programme; ELV Directive, End-of-life Vehicles Directive; WEEE Directive, Waste Electrical and Electronic Equipment Directive.

the design of materials and products. Better design can make products last longer and repairable, easier to be disassembled at the end of their life and recycled, and hence can help recyclers to recover valuable materials and components for reuse. Avoiding the use of substances of concern reduces both environmental and health hazards as well as waste management costs and enables clean material cycles. Moreover, through better design, products can contain significant quantities of recycled materials, and reused components can be integrated into new products. The design of products and materials heavily influences the costs of subsequent steps towards using waste as a resource and

FIGURE 9.2 Trends in the circular material use rate, EU-28



Source: Eurostat (2019a).

thus the competitiveness of secondary materials compared with virgin materials.

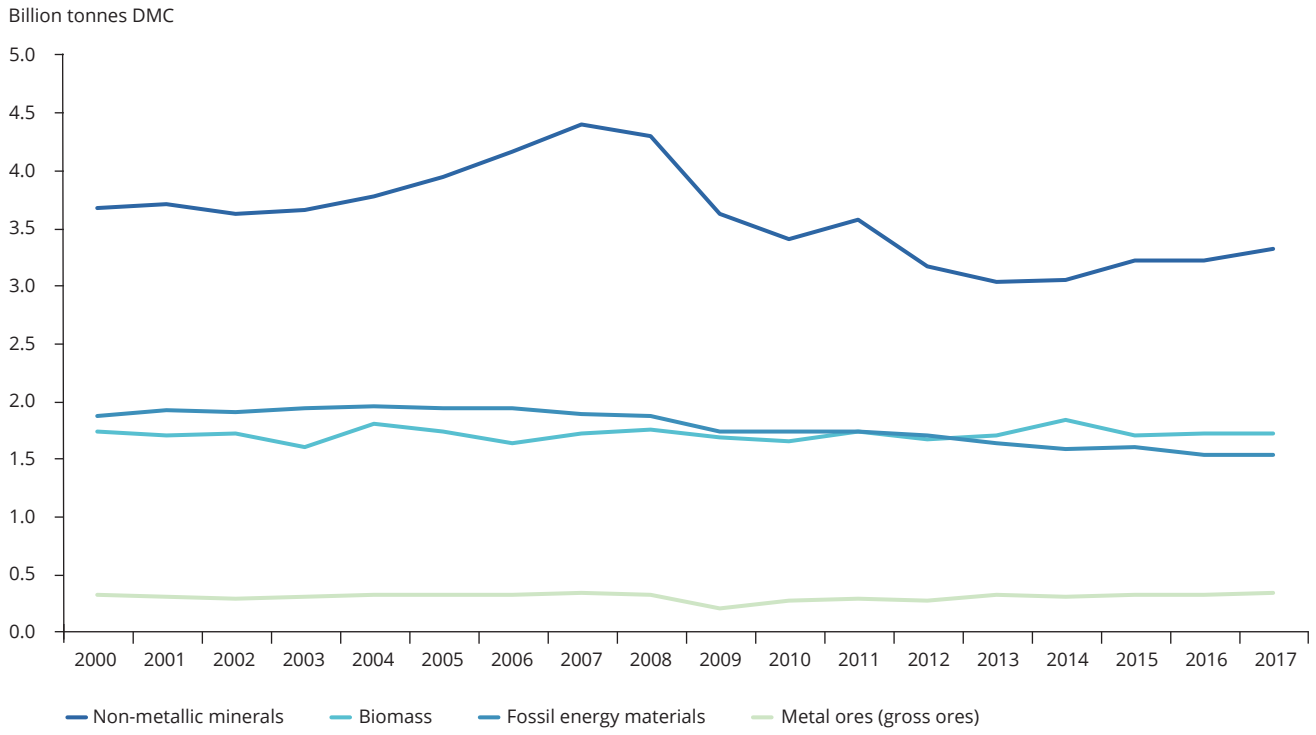
The 'circular material use' (CMU) rate (EC, 2018c) — one of the indicators in the circular economy monitoring framework — measures the contribution of recycled materials to the overall demand for materials. The higher this rate, the lower the need for extracting primary raw materials. In the period 2004-2016, the CMU rate in the 28 EU Member States (EU-28) slowly, but steadily, increased from about 8 % to around 12 %. The CMU rate is highest for metals and metal ores, followed by non-metallic minerals (Figure 9.2).

Recycling is also key for improving environmental sustainability, due to the generally lower impacts of recycling processes compared with extracting raw materials and primary production (EC, 2018h; OECD, 2019). As the availability and concentrations of ores are generally decreasing, the role of recycling becomes even more crucial to guarantee the security of the supply of raw materials, especially for those that are considered critical to the functioning and competitiveness of the EU economy (British Geological Survey et al., 2017).

A more circular use of materials is key to improving resource efficiency and to reducing the demand for virgin materials.

While the CMU rate gives a general picture at an aggregated level, the contribution of secondary materials to material use varies significantly among different materials. The highest contributions are found for lead (75 %) and silver (55 %). Among the critical raw materials, the highest shares are found for vanadium (44 %), tungsten (42 %) and cobalt (35 %). This is partly a result of materials being used in easily collected appliances. It is also driven by waste legislation that requires recycling of materials and the extraction and recovery of specific components from products at the end of life (EC, 2018h). However, for most low-volume metals and rare Earth elements, recycling contributes

FIGURE 9.3 Trends in materials use by type of material, EU-28



Note: 2017 data are Eurostat estimates.

Source: Eurostat (2019g).

only marginally to meeting the demand for materials. This is because primary extraction is often cheaper than recycling or recovery, as these materials are integrated into products in small quantities, making their recycling costly. It is worth noting that demand for these materials in modern technologies such as renewable energy systems and communication, are expected to increase rapidly (EC, 2018h) (Box 9.1).

Many factors currently limit recycling's potential to meet materials demand, including (EC, 2018f):

- dissipative material losses during the use phase of a product;
- loss of material through improper collection;
- material quality becoming degraded during collection and processing (downcycling),
- build-up of stocks;
- product designs that impede recycling;
- lack of suitable recycling infrastructure;
- contamination with hazardous substances; and
- economic factors resulting, for example, from the need for decontamination and price competition with virgin materials.

Materials containing substances that were previously widely used but are now identified as substances of concern pose risks to health (such as phthalates) (Pivnenko et al., 2016) and create a large burden for society, and such legacy materials will have to be managed for many years to come (Chapter 10). Turning waste into a resource requires addressing these limiting factors, and several initiatives are under way. For example, the new recycling targets and related requirements in the revised waste directives require stepping up recycling efforts. The European strategy for plastics in a circular economy (EC, 2018a) envisages measures to improve the economics and quality of plastics recycling, and the European Chemicals Agency is developing a database of hazardous materials in products (EU, 2008, 2018b). The Single-use Plastics Directive for the first time sets a target for recycled content,

TABLE 9.2 Summary assessment — circular use of materials

Past trends and outlook		
Past trends (10-15 years)		The limited available data show a slowly improving trend from a very low baseline.
Outlook to 2030		The implementation of policies focused on the circular economy, ensuring security of supply and the low-carbon economy and carbon neutrality agenda is expected to foster the circular use of materials. However, the uncertain outlook for resource use might hamper improvements, and multiple barriers to exploiting the full potential of reuse, refurbishment, remanufacturing and recycling need addressing.
Prospects of meeting policy objectives/targets		
2030	□	Europe is partially on track regarding meeting the circular economy objective to keep resources in use for as long as possible by extracting the maximum value from them while in use, and recycling and regenerating products and materials at the end of their life cycles. Existing targets are likely to drive the economy towards more circularity but the pace of development is currently highly uncertain.
Robustness		The methodology to calculate the circular material use rate is reliable, but it is dominated by minerals and fossil fuels and does not capture qualitative aspects of circular material use and related environmental impacts. Outlook information is lacking, so the assessment relies primarily on expert judgement.

BOX 9.1
Renewable energy and critical raw materials

Wind and photovoltaic energy technologies rely on a variety of materials. Six of these materials, namely neodymium, praseodymium, dysprosium, indium, gallium and silicon metal, are identified as critical materials and thus their supply is at a high risk (EC, 2017b).

Europe's demand for these and other critical materials is expected to increase in the future, depending on the deployment rates of wind and photovoltaic technologies as well as developments in the technologies. If supply of these materials is expected to be low, wind and photovoltaic power may not grow as fast as expected. Nonetheless, the consequences of a demand/supply imbalance can be mitigated by incentivising actions that support resource efficiency, recycling and substitution of these critical materials with other, non-critical, materials. For instance, rare Earth elements are no longer used in some new generation wind turbines (EC, 2018h). ■

related to plastic bottles. At the same time, technological developments have made recycling more effective and can be expected to continue doing so.

In the future, the extent to which demand for materials can be met with recycled materials depends both on developments in materials demand and on the generation and management of waste. The high degree of uncertainty in these two aspects means an even higher uncertainty regarding future trends in circular material use. Nonetheless, the increased policy and research focus on the circular economy is likely to foster a more circular use of materials in the future.

9.3.2 Material resource efficiency

► *See Table 9.3*

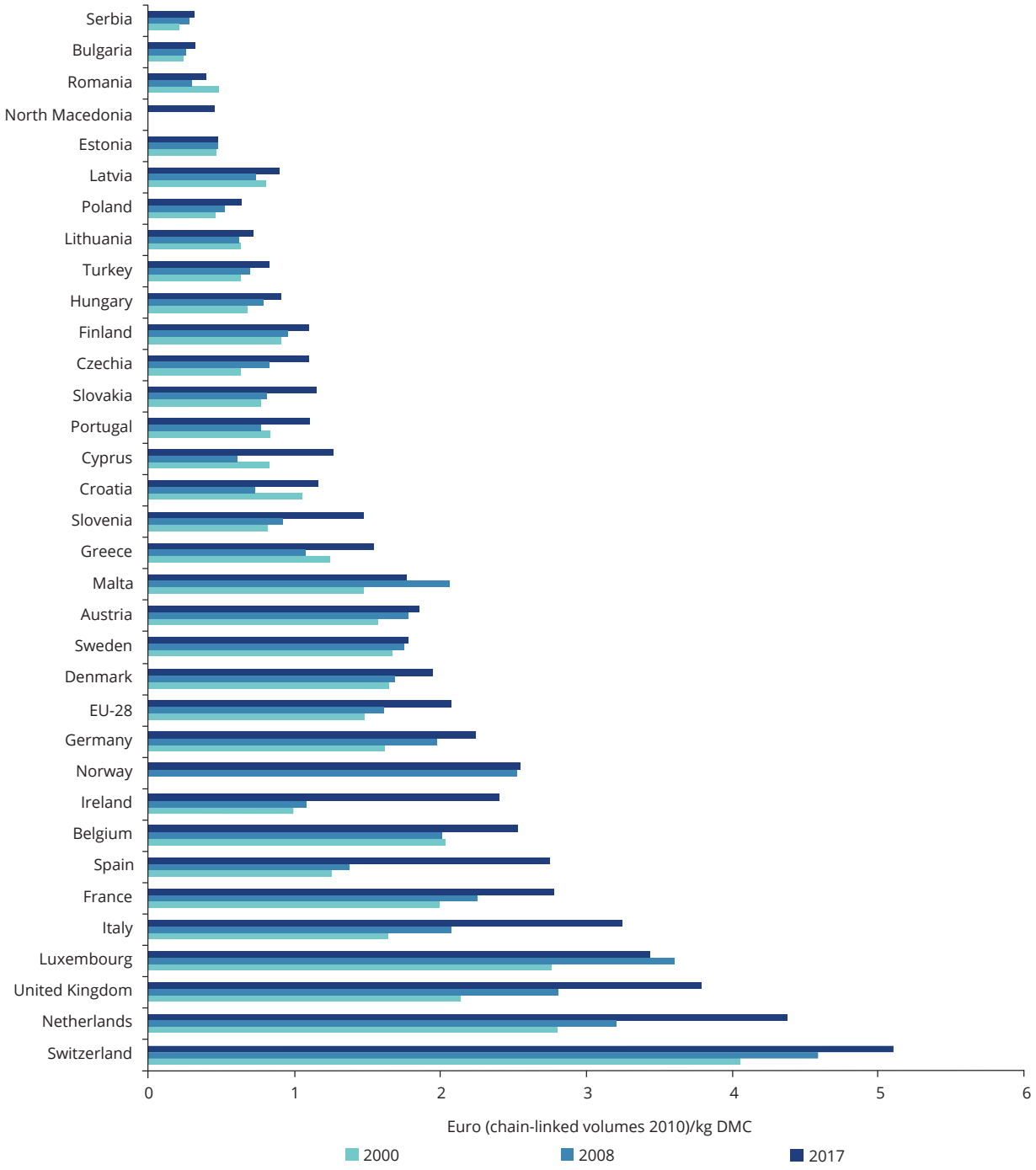
Europe continues to use a large amount of material resources, as measured by domestic material consumption (DMC). Total resource use in the EU-28 decreased by 9 % between 2000 and 2017, from 7.6 billion tonnes DMC to 6.8 billion tonnes (and from 15.5 tonnes/capita in 2000 to 13.4 t/capita in 2017). However, much of this decline was caused by the financial crisis of 2008 and the resulting drop in construction activities, accompanied by a shift in the economy towards a higher share of services (Eurostat, 2019f). Prior to the crisis (the period between 2000 and 2007), material consumption in the EU-28 actually increased steadily (Figure 9.3), only to drop by 17 % between 2007 and 2017 for total DMC, and by 28 % for non-metallic minerals. Provisional data for 2018 indicate again an increase for total DMC (Eurostat, 2019g).

An increasing share of the resource input to the EU-28 economy comes from abroad (23 % in 2017). Reliance on imports is particularly high for metals and fossil fuels; for the latter category,

23 %

of the EU's resource inputs in 2017 came from abroad.

FIGURE 9.4 Country comparison — resource productivity in Europe



Note: For Turkey, 2016 substituted for 2017 data. For Serbia, 2001 substituted for 2000 data. 2017 data include estimates and provisional data.

Source: Eurostat (2019m).

TABLE 9.3 Summary assessment — material resource efficiency

Past trends and outlook		
Past trends (10-15 years)		Material consumption in the EU-28 declined during the last decade, and resource efficiency improved. The economic recession contributed to this trend, along with decreasing use of fossil fuels and the changing structure of the economy.
Outlook to 2030		Most projections and/or scenarios envisage the use of materials increasing globally, and to a lesser extent in the EU, while resource efficiency is projected to increase. Recent policies on the circular economy as well as on climate change mitigation can be expected to contribute to improve resource efficiency.
Prospects of meeting policy objectives/targets		
2020	☑	Europe is on track to meet the Seventh Environment Action Programme objective of improving resource efficiency by 2020. However, policy objectives are non-binding and without measurable targets or a clear threshold to indicate when objectives have been achieved.
Robustness		Eurostat has compiled a long, reliable time series of data on material flows and resource productivity for more than 30 European countries. However, material flow-based indicators do not capture important issues such as impacts of resource use, or environmental burdens related to extraction of imported resources, which can be significant. Trends shown by material flow-based indicators are also heavily influenced by the high share of largely inert construction materials. Outlook information for Europe is sparse, thus the outlook assessment relies partly on expert judgement.

the share of imports is increasing continuously (Eurostat, 2019g). This results in some shifting of the environmental burden to countries outside the EU, whereby pressures related to the extraction of resources occur in the producing country and not where those resources are actually used (Chapters 1 and 16).

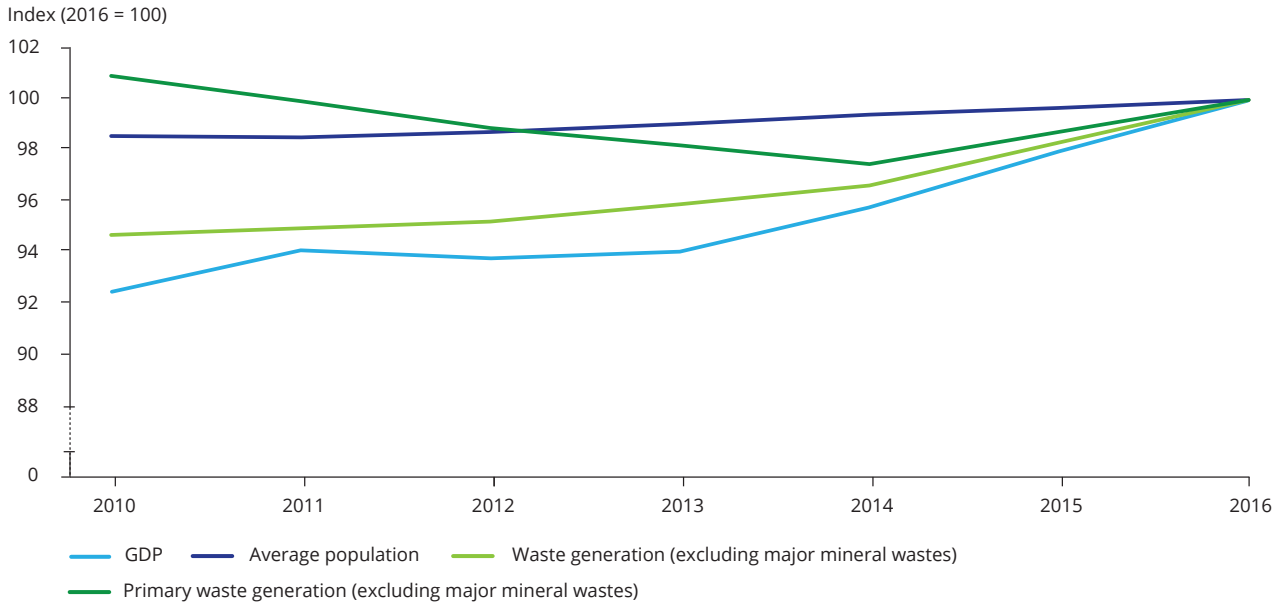
Resource productivity — the ratio between gross domestic product (GDP) and DMC — in the EU as a whole increased by 40 % between 2000 and 2017. However, as shown in Figure 9.4, there are large differences between individual countries, both in absolute terms and in trends over time. For example, within the EU, resource productivity varies by a factor of 14 between the Netherlands and Bulgaria. The change in resource productivity in the period between 2000 and 2017 varied from an increase of 143 % in Ireland and 119 % in Spain to a decline of 18 % in Romania.

Resource efficiency in the EU is expected to improve, albeit with an increase in material use.

Notably, the same countries (Switzerland, Netherlands, United Kingdom, Luxembourg and Italy) have remained at the top of the resource productivity rankings in Europe, with another group of countries consistently remaining at the bottom (Bulgaria, Romania, Estonia, Poland and Lithuania). These differences are strongly influenced by countries' differing economic structures, including the highly relevant mining sector in Bulgaria, Romania, Estonia and Poland (Eurostat, 2019i). Within the latter group, the improvement in resource efficiency has been limited, which means that the gap between these countries and the most resource-efficient countries is increasing (Eurostat, 2019m).

Some of the countries with the highest resource efficiency also have a high share of imports in their material input. Replacing domestically extracted resources with imports may result in an 'artificial' increase in importing countries' resource productivity. To highlight this, Eurostat has developed the raw material consumption indicator, available for the EU-28 as a bloc. In 2016, the EU's raw material consumption per capita was about 14.2 tonnes, compared with 13.4 tonnes of DMC (and largely followed

FIGURE 9.5 **Trends in waste generation (excluding major mineral wastes), economic development and population, EEA-33**



Note: Country coverage: EU-28, Iceland, Norway. Waste data for 2011, 2013 and 2015 are interpolated.

Source: EEA, based on data from Eurostat (Eurostat, 2019e, 2019d, 2019l).

the same trend as DMC) (Eurostat, 2019g, 2019h).

On a positive note, there has been a clear, long-term decrease in the use of fossil fuels (down by 19 % between 2000 and 2017), mainly due to an increasing shift to energy from renewable sources and overall improvements in energy efficiency. This positive outlook is expected to continue in the light of policy focus on energy efficiency and decarbonisation (Chapter 7). Meanwhile, the demand for biomass for energy use is expected to increase in most decarbonisation scenarios (EC, 2018e) and might increase as well as a substitute for non-renewable materials in the framework of Europe's move towards a bioeconomy (EC, 2018b).

The outlook for the other two categories (i.e. non-metallic minerals and metals) is difficult to assess, as it is largely driven by macroeconomic conditions and the investment climate.

Waste (excluding major mineral wastes) generation increased slightly to 1.8 tonnes per person in 2016.

Globally, most projections indicate continued growth in the extraction and use of resources — a key driver of global environmental change (Chapter 1), with the highest growth expected in developing countries. Material use is still expected to grow in EU Member States as well, while resource efficiency is projected to increase (IRP, 2019; OECD, 2019). Closing material loops and increasing recovery and recycling of materials are necessary steps to decrease our reliance on imports and to reduce environmental pressures. However, there are concerns that continuously growing demand will increasingly lead to resource extraction in new areas with potentially high environmental risks, such as the Arctic or the deep sea.

9.3.3 Waste generation

▶ See Table 9.4

The amount of total waste (excluding major mineral wastes) has increased in the 33 EEA member countries (EEA-33) since 2010 alongside GDP (Figure 9.5). This comprises both primary and secondary waste such as residues from

TABLE 9.4 Summary assessment — waste generation

Past trends and outlook		
Past trends (10-15 years)		Generation of waste (primary waste excluding major mineral wastes) has stayed rather stable, and it is partially decoupled from economic development and population growth.
Outlook to 2030		While outlook information is sparse, generation of some waste types is projected to increase slightly. The renewed policy focus on waste prevention measures can be expected to counter growth in waste generation, but a lack of clear targets as well as many other factors influencing waste generation makes their effects uncertain.
Prospects of meeting policy objectives/targets		
2020	□	Prospects for meeting the Seventh Environment Action Programme objective to reduce waste generation are mixed. Recent data show an increase, along with growth in GDP. While waste prevention programmes are expected to reduce the amount of waste generated, many measures are rather weak and their overall effectiveness has not been evaluated so far on a European level.
Robustness		Total waste excluding major mineral wastes was selected to show trends in waste generation, because the uncertainty for mineral waste is rather high and because it covers a broad range of waste types. The time series is rather short, as earlier data (2004-2008) are excluded as they are influenced by data consolidation. Outlook information is very limited and is only available for some smaller waste streams; therefore, outlook and prospects of meeting the policy objectives are only assessed qualitatively and mainly rely on expert judgement.

Europe is increasingly moving towards more recycling but progress is slow.

waste sorting and incineration (about 17 % of total waste). The observed increase is mainly driven by secondary waste resulting from an increase in waste incineration and waste sorting operations. Meanwhile, developments in primary waste have been more stable. Waste (excluding major mineral wastes) generated per inhabitant increased slightly to 1.8 tonnes per person in 2016. This average masks large country differences, ranging from less than 1 to more than 3 tonnes per person (Eurostat, 2019e), partly reflecting the different structures of countries' economies. The generation of municipal waste, representing about 10 % of total waste, decreased between 2007 and 2013 in the EU-28 but has been increasing again since 2013 (Eurostat, 2019j). Many factors influence waste generation, including economic development, incomes and prices, structural changes in the economy, consumption and fashion trends and technological developments, as well as policies on waste prevention and resource efficiency. These factors vary strongly by waste type.

Outlook information for waste generation is very sparse and limited to a few waste types. For example, the generation of municipal waste in the EU-28 is projected to increase by about 2 % over the period 2015-2035 (ETC/WMGE, 2018). End-of-life vehicles are expected to increase slightly until 2020 (Peck et al., 2017). Waste electric and electronic equipment (WEEE) and waste batteries have been increasing continuously since 1995 and 2006, respectively, and that is expected to continue until 2020 (Huisman et al., 2016). WEEE generation in the Western Balkans is estimated to grow by one third by 2030 (Hogg et al., 2017). Waste incineration residues and sorting residues are likely to increase along with expected changes in waste management.

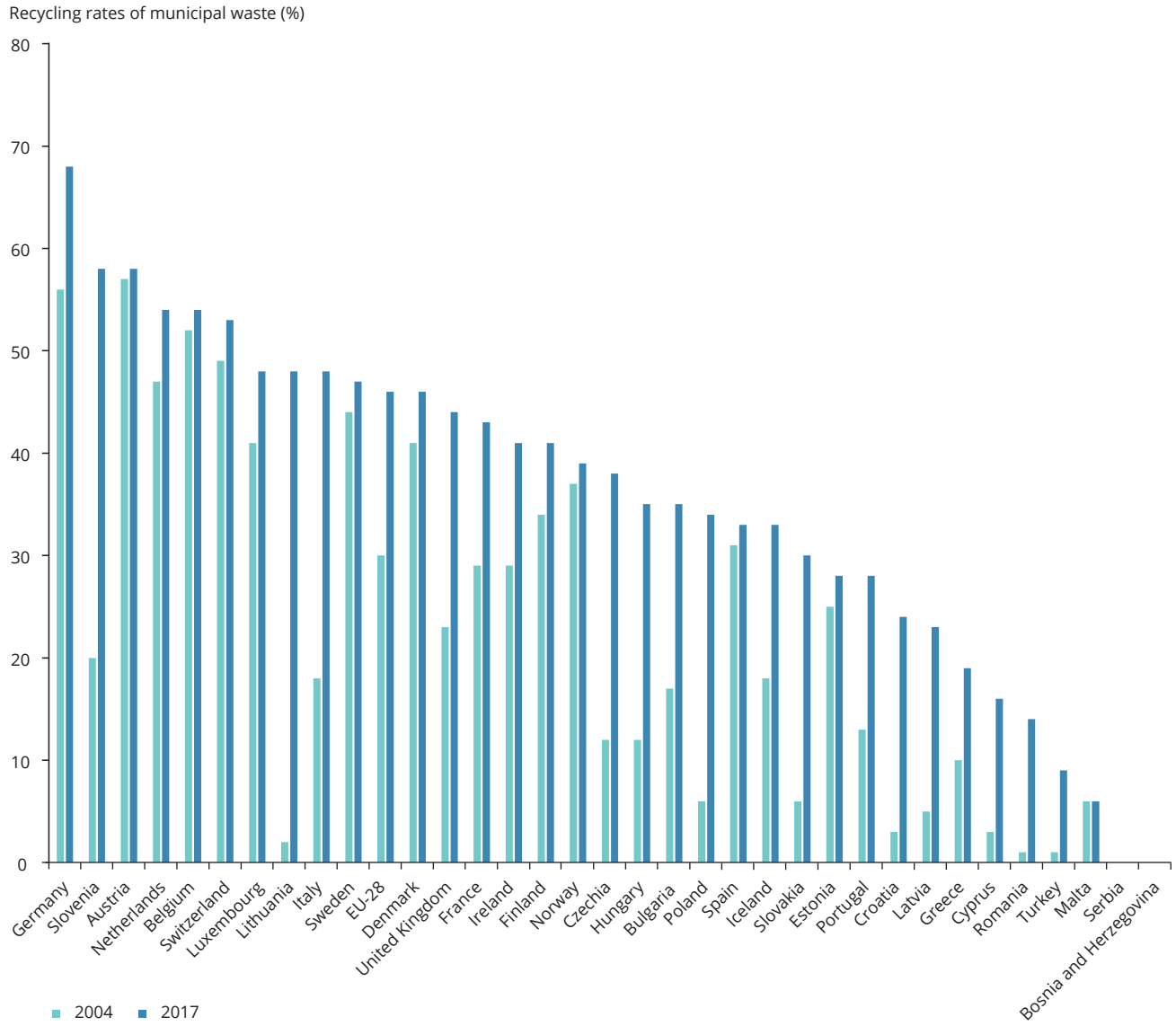
9.3.4 Waste management

►*See Table 9.5*

Waste management in the EU-28 is improving but rather slowly. In 2016, 53.7 % of total waste, excluding major mineral wastes, was recycled, 23.5 % disposed in landfill and 20.5 % incinerated; backfilling and other disposal accounted for the remainder. Although the waste hierarchy gives priority to recycling over incineration, shares of both recycling and incineration have increased by 2 percentage points each since 2010, and landfilling has dropped by 4 percentage points (Eurostat, 2019o). These trends are likely to be influenced by the many waste targets and requirements, including mandatory separate collection (Section 9.2).

Nearly all countries have increased their shares of municipal waste recycled since

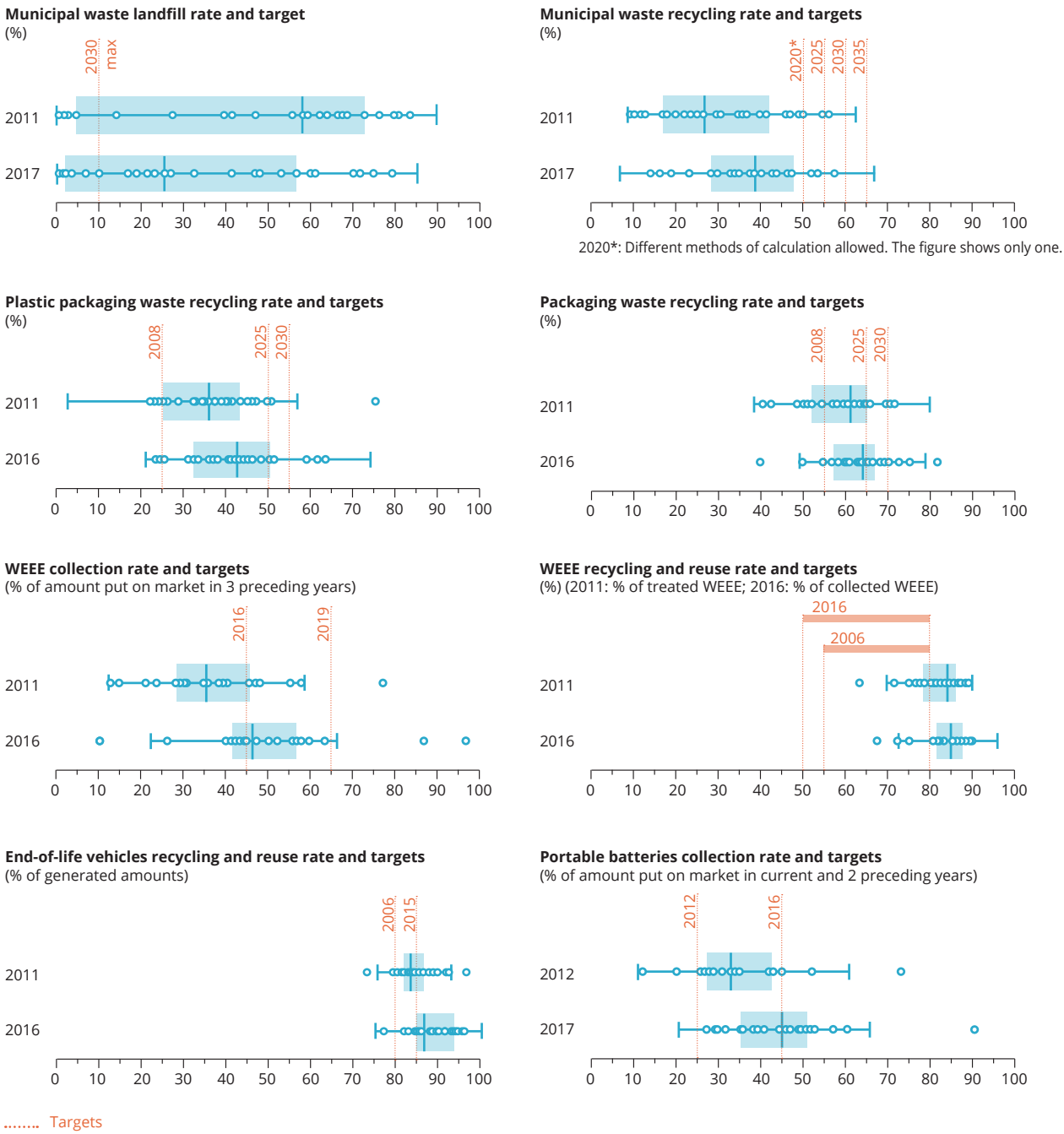
FIGURE 9.6 **Country comparison — recycling rates of municipal waste, EEA-33, Bosnia and Herzegovina, and Serbia**



Notes: The recycling rate is calculated as the percentage of municipal waste generated that is recycled, composted and anaerobically digested, and it might also include preparing for reuse. Changes in reporting methodology mean that 2017 data are not fully comparable with 2004 data for Austria, Belgium, Croatia, Cyprus, Estonia, Lithuania, Italy, Norway, Malta, Poland, Romania, Slovakia, Slovenia and Spain. 2005 data were used instead of 2004 data for Poland because of changes in methodology. On account of data availability, instead of 2004 data, 2003 data were used for Iceland, 2007 data for Croatia, 2008 data for Bosnia and Herzegovina and 2006 data for Serbia; and instead of 2017 data, 2016 data were used for Iceland and Ireland. 2017 data for Cyprus, Germany, France, Luxembourg, Poland, Slovenia, Switzerland, Spain and Turkey include estimates. The EU-28 data for 2004 are calculated with 2007 data for Croatia.

Sources: EEA, based on Eurostat (2019j) and data from the Czech Ministry of the Environment for Czechia.

FIGURE 9.7 Progress towards selected waste management targets, EEA-33



Notes: The boxes show the upper and lower quartiles for all countries, the line in the box shows the median and the dots show countries. For municipal waste, the calculation methods for compliance with the targets differ from the data shown in the figure. Derogation periods apply for several countries for some of the targets. Municipal waste and packaging waste: recycling rates calculated as shares of generated waste. In some cases, WEEE collection rates and packaging recycling rates are overestimated because the amounts put on the market are underreported (Eurostat, 2017). Gap-filling of data was applied in some cases to increase the comparability of the trends across data years. Country coverage: EEA-33 (excluding Switzerland and Turkey) for packaging waste, batteries, WEEE and end-of-life vehicles, and EEA-33 for municipal waste.

Sources: EEA based on Eurostat (2019c, 2019j, 2019k, 2019n, 2019p). Targets: relevant EU waste directives (EU, 1994, 2000, 2002, 2006, 2012, 2018b, 2018a, 2018c).

TABLE 9.5 Summary assessment — waste management

Past trends and outlook		
Past trends (10-15 years)		Management of total waste (excluding major mineral wastes) as well as of several specific waste streams moves slowly towards recycling and away from landfill, but large differences between countries persist. Substandard and illegal practices are still of concern.
Outlook to 2030		Waste management is expected to improve further, driven by existing and new waste management targets and new requirements introduced in the recently revised waste legislation. However, strong implementation efforts are required. The quality aspects of recycled materials, including substances of concern, need more attention.
Prospects of meeting policy objectives/targets		
2020	□	On average, EU Member States are progressing towards the binding waste management targets, but several countries are at risk of missing the targets unless efforts are considerably intensified.
Robustness		Information on waste management is rather robust, but earlier data are still influenced by data consolidation issues, and shortcomings in reporting are documented for some countries. Information on illegal waste activities is extremely limited. Outlook information exists only for a few selected waste streams; therefore, the assessment of outlooks and prospects of meeting policy targets/objectives is largely based on expert judgement.

2004, but differences among countries are still high (Figure 9.6).

Across European countries, key measures that aim to increase recycling have included bans or restrictions on landfilling, mandatory separate collection; landfill and incineration taxes, and waste collection fees designed to incentivise separate collection (such as pay-as-you-throw schemes) (EEA, 2016b). In particular, the targets to reduce landfilling of biodegradable municipal waste have triggered investments in incineration and pre-treatment of mixed waste such as mechanical-biological treatment. While these technologies have lower environmental pressures than landfill, high treatment capacities might discourage separate collection and waste prevention and can create lock-ins to less favourable waste management options. Latvia, Lithuania, Poland and Spain have mechanical-biological treatment capacities to treat more than 50 % of their municipal waste (ETC/WMGE, 2019), while Belgium, Denmark, Estonia, Finland, the Netherlands, Norway, Sweden and Switzerland have dedicated incineration capacities to incinerate more than 50 % of their municipal waste (ETC/WMGE, 2017).

While on average, countries are progressing towards EU waste management targets, several countries are at risk of not meeting them.

Policies adopted before 2018 are expected to deliver an increase of only 6 percentage points in municipal waste recycling. Full implementation of the targets under the new EU waste legislation adopted in 2018 is expected to result in a 26 percentage point increase by 2035 (ETC/WMGE, 2019). Outlook information for the management of most other waste types is not available. Key influencing factors include prices for virgin materials and energy (competing with recycled materials and energy from waste), developments in sorting and recycling technologies and the composition and recyclability of new products and novel materials, as well as prices and capacities for different types of waste treatment, and waste and broader circular economy policies.

On average, countries are moving closer to the EU's specific waste management targets (Figure 9.7). However, several countries are still lagging behind targets (EC, 2018g), and in some countries improper waste management still exists (Box 9.2).

BOX 9.2
Substandard and illegal waste activities pose risks to human health and the environment

Improper waste management, such as inefficient collection services, dumping of waste in dumpsites, illegal waste disposal activities and littering, still exist in Europe, posing risks to human health and the environment, including soil pollution. In the period 2015-2018, the European Commission has referred Bulgaria, Greece, Italy, Romania, Slovakia, Slovenia and Spain to the European Court of Justice for breaching the requirements of the EU Landfill Directive (EC, 2019b). Many municipalities in the Western Balkan countries and Turkey use substandard dumps to dispose of waste (ETC/WMGE, 2016; Hogg et al., 2017), and Serbia operates one of the world's 50 biggest still active dumpsites (D-Waste Environmental Consultants Ltd., 2014). The region also lacks treatment capacity for hazardous waste, and stockpiled hazardous wastes are often not stored appropriately (Hogg et al., 2017).

According to a report by EnviCrimeNet and Europol (2015), the waste industry is one of the biggest businesses targeted by criminal groups, as it offers potentially higher profits than those from illegal drugs but much lower sanctions and risks of detection. The report warns that this situation 'enables organised crime groups to further infiltrate the legal economy. Environmental crimes undermine the rule of law and damage the reputation of the EU and its [Member States].' In particular, the illegal disposal of asbestos and the illegal export of WEEE and end-of-life vehicles offer high profits. The Countering WEEE Illegal Trade project (Huisman et al., 2015) found that, in 2012, 4.65 million tonnes of electronic waste were not properly managed or illegally traded within the EU, and that only 35 % of all such waste reached the official collection and treatment system. This leads to potential hazards for human health and the environment but also represents a loss of valuable materials.

Littering and dumping of waste on both land and sea, as well as improper waste management systems are important sources of marine litter, affecting marine ecosystems (Chapter 6). The recently adopted EU Directives on single-use plastics (EU, 2019b) and port reception facilities (EU, 2019a) aim to prevent waste becoming marine litter. ■

9.4 Responses and prospects of meeting agreed targets and objectives

Both resource use and waste generation are closely linked to Europe's patterns of production and consumption (Chapter 16). In the 2015 circular economy action plan (EC, 2015), the European Commission identified a wide variety of initiatives to be implemented across the value chain. A larger number of steps have already been taken to implement these initiatives (EC, 2019c). Strategic objectives of the 7th EAP include creating 'a resource efficient, competitive, green low-carbon economy', reducing the generation of waste both in absolute terms and per capita and improving waste management. However, there

EU waste policies drive recycling but the outlook for limiting waste generation is uncertain.

are no concrete targets for resource use, resource efficiency and waste prevention in the EU legislation, and only a handful of countries have adopted national targets for resource efficiency or waste prevention. Meanwhile, many specific waste management targets specify the waste hierarchy for a range of products/materials (Section 9.2).

9.4.1 Relevance, effectiveness and coherence of current policies

The circular economy policy objectives are still rather new and it is therefore premature to assess their effects. However, one notable trend is that several countries and regions/devolved administrations have already adopted strategies, action plans or roadmaps for developing the circular economy (Box 9.3). As of spring 2019, these include Belgium (and in addition Flanders and Brussels Capital Region), Denmark, Finland, France, Italy, the Netherlands, Portugal, Slovenia, and Scotland in the United Kingdom. Poland

BOX 9.3
National experience of circular economy policies

A recent EEA review of experience and lessons learned from developing circular economy policies (EEA, forthcoming) shows some common threads in the frontrunner countries. The development of circular economy policies needs to involve a broad range of stakeholders. In several countries, the government increasingly plays the role of a facilitator and moderator in this process, not just a regulator and enforcer. A number of actions rely on voluntary approaches, underpinned by a clear business case. Several governments estimated and promoted the benefits for their country's economy arising from implementing the circular economy. Finally, some apply a broad definition of 'resources' to be used in closed cycles: raw materials, water, space, food and excavated soil (e.g. Flanders in Belgium).■

and Spain are on the verge of adopting such strategies or action plans, whereas several countries are developing them. Others embed the circular economy in climate policy or combinations of waste and resource policies, e.g. England in the United Kingdom and Wallonia in Belgium (EEA, forthcoming). The European Commission's Environmental Implementation Review (EC, 2019a) notes that several EU Member States 'should better implement circular economy principles' and 'further incentivise resource efficiency measures'.

Significant increases in resource efficiency that have occurred since 2007/2008 have been in part due to the way the economic crisis affected most economies and the resulting structural change (e.g. the sharp decline in construction). Furthermore, the picture is also affected by the nature of available indicators, which use a very aggregated measure of resource consumption.

It is not possible to conclusively evaluate the effect of policies for material use and resource efficiency, partly because policy objectives are formulated rather vaguely and in part due to the variety of driving factors at play (e.g. geography, climate, structure of the economy, energy mix, consumption patterns). Trends vary strongly across individual countries, driven by a complicated mix of underlying drivers. The main driver determining trends in resource use in recent years seems to be macroeconomic changes. Furthermore, given such a wide variety of factors at play it is difficult to demonstrate the causality of policy interventions.

However, the wave of policy measures stipulated in the 2015 circular economy action plan and follow-up measures (Section 9.2) can be expected to improve resource efficiency in the future. Moreover, policies on ensuring security of supply of raw materials, and in particular critical raw materials, started to increase the attention given to secondary raw materials. There is also growing emphasis on creating synergies with the low-carbon economy.

At the other end of the material resource use chain, generation of waste has stabilised at a high level (Section 9.3.3). While no binding EU targets exist, EU Member States had to adopt waste prevention programmes according to the Waste Framework Directive by 2013, and all EU Member States, as well as Iceland, Norway and Turkey, have such programmes (EEA, 2019). Recently, the revised Waste Framework Directive strengthened the requirements on waste prevention and obliges Member States to evaluate waste prevention measures. In addition, it introduces a reporting obligation for reuse and for food waste for the first time and mandates the European Commission to review the data reported with a view to setting waste prevention targets. Nevertheless, waste prevention remains a challenge in all EU Member States (EC, 2017a, 2019a).

Meanwhile, most waste prevention programmes started operating around 2013 or later, so the available data may not yet reflect the full effects of implementation. Knowledge on the effects of specific waste prevention measures is still limited and requires disentangling policy effects from economic and other factors. Such analysis is not available on a European level so far. The majority of policy instruments in the programmes concern information and awareness raising, which are generally considered weak policy instruments.

However, the overall economic policy goal of continued economic growth may conflict with the objective of waste prevention unless strong measures are

taken, for example moving towards less waste-intensive business models and extending the lifetime of products. This illustrates that waste generation is unlikely to be strongly reduced through waste policies alone. It needs to be addressed in a systemic way along the value chain, by fundamentally changing patterns of production and consumption. For example, preventing food waste needs to address the drivers of food waste in the whole food system (ECA, 2016; Ciccarese and Vulcano, 2017) (Chapter 16).

Waste management trends, as shown in Section 9.3.4, indicate that European waste management is moving towards more recycling, albeit very slowly. This development is certainly driven by EU waste policies, especially the binding targets. However, waste management targets relate to the weight of wastes, whereas it is their quality that determines their value as secondary raw materials in the circular economy.

The prospects of meeting specific waste management targets are mixed across Europe. Fourteen EU Member States are at risk of missing the 2020 50 % recycling target for certain waste fractions from households, set in the 2008 Waste Framework Directive (EC, 2018g; ETC/WMGE, 2018). Meeting the new targets on recycling and landfilling of municipal waste in combination with more stringent calculation methods for compliance, as well as the collection targets for batteries and WEEE, will require considerable additional efforts by most countries (Figure 9.7).

9.4.2 Benefits of moving towards a circular economy

Improving waste management contributed to mitigating the EU's greenhouse gas emissions (Chapters 7 and 12), mainly due to the Landfill Directive's technical requirements and the diversion of waste from landfill. However, replacing virgin materials with recycled ones in most cases leads to environmental benefits beyond the waste sector itself (OECD, 2019). For example, taking a life cycle approach, municipal waste management has already avoided more greenhouse gas emissions than it generated directly, and it is estimated that these avoided emissions (i.e. net environmental benefits) will increase steadily in the period 2015-2035 if the new targets are achieved (ETC/WMGE, 2019).

Waste and resource management provided about 3 million jobs in the EU in 2016.

Avoiding generating waste and decreasing the demand for virgin materials usually delivers higher environmental benefits than other options. It reduces both the need to treat the resulting waste and the pressures from extracting virgin resources and producing the products in the first place. For example, the production step is responsible for about 73-96 % of greenhouse gas emissions, acidification and eutrophication related to food waste in Europe, while food processing, distribution, consumption and food waste disposal, including composting, together account for the rest (Scherhaufer et al., 2018).

The waste management and resource management sectors provided about 3 million jobs in the EU in 2016 and employment has increased by 79 % since the year 2000. However, growth in employment in the sector slowed considerably after 2011 (Eurostat, 2019b).

Reaping the full potential benefits of enhancing resource efficiency and the use of waste as resources will require more attention to overcome a number of barriers, as illustrated in Section 9.3.1. More focus is needed on the longevity of products, the recyclability and uptake of recycled materials, preventing contamination with substances of concern, and improved waste collection and treatment efficiencies. Such barriers are often of a systemic nature and need action across policy domains. For example, internalising environmental impacts in the prices of materials, energy and products would create fairer markets for these circular solutions. Plastics are a good example to illustrate these aspects (EC, 2018a). Some shortcomings in EU waste policies are addressed in the revised waste directives adopted in 2018, but more coherence is needed especially between legislation on waste, products and chemicals (EC, 2018d).

There is still a long way to go to turn Europe into a truly 'circular economy where the value of products, materials and resources is maintained in the economy for as long as possible' (EC, 2015). The circular economy action plan of 2015 and its related initiatives, and several national circular economy strategies are positive steps in this direction. In order to reap the highest benefits most efficiently, focusing on areas of high resource use, high resource value and high environmental impact seems most appropriate. Nonetheless, 'making the circular economy a reality will however require long-term involvement at all levels, from Member States, regions and cities, to businesses and citizens' (EC, 2017c).