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CLOSING THE LOOP IN THE SLOVAK REPUBLIC

A ROADMAP TOWARDS CIRCULARITY FOR COMPETITIVENESS, ECO-INNOVATION AND SUSTAINABILITY

ANNEXES

OECD
BETTER POLICIES FOR BETTER LIVES

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MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC

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Abbreviations and acronyms

AF	Agri-food system
BIM	Building Information Modelling
CDW	Construction and demolition waste
CE	Circular economy
CO_2	Carbon dioxide
DRS	Deposit-Refund Scheme
EC	European Commission
ELV	End-of-Life Vehicle
EoL	End-of-life
EPR	Extended Producer Responsibility
EU	European Union
FLW	Food loss and waste
FPP	Food Waste Prevention Plan
FW	Food waste
GDP	Gross Domestic Product
GHG	Greenhouse gas
GPP	Green Public Procurement
IT	Information Technology
MS	Member State
MSP	Multi-stakeholder platform
NACE	Statistical Classification of Economic Activities in the European Community
NAP	National Action Plan
PAYT	Pay-As-You-Throw
PET	Polyethylene Eerephthalate
PPP	Purchasing Power Parity
PRO	Producer Responsibility Organisation
PVC	Polyvinyl Chloride
R&D	Research and development
RRP	Recovery and Resilience Plan
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprise
SR	Slovak Republic
UNFCCC	United Nations Framework Convention on Climate Change
VA	Voluntary agreement

VAT	Value added tax
WEEE	Waste electrical and electronic equipment
WFD	Waste Framework Directive
WMP	Waste Management Plan
WPP	Waste Prevention Programme
WRAP	Waste & Resources Action Programme

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Annex A. European Circular Economy-Related Regulatory Framework

Key European Union (EU) circular economy-related legislation and targets

Table A A.1. Key EU circular economy-related legislation, targets and obligations

Target	Timeframe	Legislation
The preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55%, 60% and 65% by weight, respectively. The Directive gives the possibility for the Slovak Republic to postpone the deadline for reaching these targets by 5 years, if the country reaches 50% by 2025.	By 2025, 2030, 2035	Waste Framework Directive
Separate collection of textiles and hazardous waste generated by households	By 01/01/2025	Waste Framework Directive
Separate collection or recycling at source of bio-waste	By 31/12/2023	Waste Framework Directive
A binding landfill target to reduce landfill to maximum of 10% of municipal waste. The Directive gives the possibility for the Slovak Republic to postpone the deadline for reaching this target by 5 years if the country reaches maximum 25% of municipal waste being landfilled by 2035 (in line with the landfill target in the Envirostrategy 2030).	By 2035	Landfill Directive
Restrictions on landfilling of all waste that is suitable for recycling or other material or energy recovery.	From 2030	Landfill Directive
A common EU target for recycling minimum of 65% by weight of all packaging waste (70% by 2030).	By 31/12/2025 (31/12/2030)	Packaging and packaging waste Directive
Minimum recycling targets for specific packaging materials: Paper and cardboard: 75% (85% by 2030); Ferrous metals: 70% (80% by 2030); Aluminium: 50% (60% by 2030); Glass: 70% (75% by 2030); Plastic: 50% (55% by 2030); Wood: 25% (30% by 2030) The Directive gives the possibility for the Slovak Republic to postpone the deadline for reaching these targets by 5 years if the derogation is limited to a maximum of 15 percentage points from a single target or divided between two targets. However, the recycling rate for a single target is not reduced below 30 % and the recycling rate for a single target for paper and cardboard, and glass is not reduced below 60%.	By 2025 (By 2030)	Packaging and packaging waste Directive
A 90% separate collection target for plastic bottles (77% by 2025)	By 2029	Single-Use Plastics Directive
Incorporate 25% of recycled plastic in the manufacture of PET bottles from 2025 and 30% in all plastic bottles as from 2030 The Directive also introduces a ban on certain single use plastic products for which an alternative exists (e.g. cutlery, plates, straws, cotton bud sticks).	By 2025 By 2030	Single-Use Plastics Directive
At least 55% reduction in greenhouse gas (GHG) emissions (from 1990 levels)	By 2030	European Climate Law
At least 32.5% improvement in energy efficiency (compared to projections of the expected energy use in 2030)	By 2030	Energy Efficiency Directive
At least 32% of total energy needs are covered by renewable energy	By 2030	Renewable Energy Directive
Minimum 95% of reuse and recovery by an average weight per vehicle and year, and minimum 85% recycling by an average weight per vehicle and year	By 2015	End-of-Life Vehicles Directive
Minimum collection rates of 45%	By 26/09/2016	Batteries Directive
Minimum annual collection rate of 65% of the average weight of electrical and electronic equipment placed on the market in the 3 preceding years in the MS concerned, or alternatively 85% of WEEE generated on the territory of that MS	From 2019	Waste from Electrical and Electronic Equipment Directive

Note: The table does not include a comprehensive list of sectoral climate and energy targets.

EU circular economy policy landscape for production and design

Key policies at the EU level

Initiatives for more efficient and circular production and design have been on the European policy agenda for several years.

To promote circular design and production, the EU has put in place regulations on eco-design and labelling. The **Eco-design Framework Directive** (Directive 2009/125/EC) regulates thirty-one product groups through product-specific implementing regulations. For instance, in 2019, ten eco-design implementing regulations were adopted by the European Commission, setting energy efficiency and circular economy related requirements (such as the reparability, recyclability, durability and water consumption of products). The revised **Energy Labelling Regulation** (Regulation (EU) 2017/1369) updates the energy efficiency labelling requirements for products to allow consumers to distinguish between energy efficient products. The **Ecolabel Regulation** (Regulation (EC) No 66/2010) sets a voluntary environmental labelling scheme and list requirements for products to obtain the EU ecolabel.

The other relevant EU legislation relates to individual product value chains. The new **Single Use Plastics Directive** (Directive (EU) 2019/904) aims to reduce certain plastic waste, by introducing a ban on certain single use plastic products for which alternatives exist (e.g. cutlery, plates, straws, cotton bud sticks). The EU legislation on chemicals regulates the chemical substances used in and restricted from products. The **REACH Regulation** (Regulation (EC) 1907/2006), in particular, aims at protecting human health and the environment by obliging companies to identify and manage risks related to the chemical substances they produce and sell. The **Fertilising Products Regulation** (Regulation (EU) 2019/1009) introduces harmonised rules for organic fertilisers manufactured from secondary raw materials, such as agricultural by-products and recovered bio-waste.

Furthermore, the new EU's **Circular Economy Action Plan** puts forward additional measures to strengthen circular production across the EU (European Commission, 2020[1]). To support design for durability, easier reuse, repair and recycling, as well as to strengthen the use of secondary raw materials and restrict the single use and premature obsolescence, the EU plans to develop a Sustainable Product Policy Framework. Some of the elements of this framework are currently under preparation, among others: a legislative proposal for a sustainable product policy initiative, legislative and non-legislative measures targeting the "right to repair", mandatory green public procurement criteria and targets in sectoral legislation, and industry-led industrial symbiosis reporting and certification (European Commission, 2020[2]).

In terms of key product value chains, the new EU Circular Economy Action Plan outlines a number of planned legislative proposals, with the aim to: improve product lifetimes of electronics and information and communication technologies (**Circular Electronic Initiative**), boost circular potential of batteries, substitute single use packaging and cutlery in food services and introduce mandatory requirements for recycled content of plastics, strengthen innovation in the textiles sector (**EU Strategy for Textiles**), and promote circularity principles for buildings (**Strategy for a Sustainably Built Environment**) (European Commission, 2020[1]).

Policies by some of the EU Member States

On top of the EU regulation, individual EU Member states have been putting measures and proposals in place to make their industrial production more circular. Some of the countries laid out circular production measures within their circular economy strategies and roadmaps. For instance, France has developed a specific roadmap for a "better production", through which it intends to promote upgrading and the differentiation of products through better environmental performance, to "produce better" with less non-renewable resources, and to incorporate more recycled raw materials (specifically for plastics) (Ministry

for an Ecological and Solidary Transition, 2018[3]). Production and product design are also included as focus areas within the Swedish strategy (Government Offices of Sweden, 2020[4]). Some of the proposed actions include promoting information about the content, origin and environmental impact of products and their recycling, promoting the development of standards that support resource efficient, circular and non-toxic product design, and developing economic instruments based on the polluter pays principle so that the environmental impact of products is internalised into their costs. Poland's strategy intends to facilitate the quantification of environmental impact of products by developing information and educational materials for calculating the impact of products and economic activities (Ministry of Economic Development, Labour and Technology, 2019[5]). It also intends to step up waste prevention through the strengthening of its EPR schemes. Several actions formulated within national strategies and roadmaps are yet to be implemented.

EU policy on circular construction

Numerous policies or plans with a direct or indirect impact on the circular economy in the construction sector exist at the EU level.

Cross-cutting policies

The following cross-cutting policies relevant to the circular economy in the construction sector at EU level have been identified:

- Circular economy is one of the focus areas of the **European Green Deal** and its new **EU Circular Economy Action Plan** (European Commission, 2020[1]), which foresees the development of a **Sustainable Built Environment Strategy** by 2022 (European Parliament, 2021[6]). Specific EU plans and policies guide various parts of the construction value chain in the building sector.
- At the design phase, the current EU circular economy approach for the construction sector is to enhance circular design, focusing on durability and adaptability as well as waste reduction and high-quality waste management.
- Under the **EU Recovery and Resilience Facility** (European Commission, 2021[7]), loans and grants have been made available to support reforms and investments undertaken by Member States to mitigate the economic and social impact of the Covid-19 pandemic while contributing to Europe's sustainable development. Flagship areas for investments and reforms include energy efficiency through renovation in buildings or re-/upskilling the local labour force.
- The first **EU Climate Law** (European Commission, 2021[8]) proposes a legally binding target of net zero greenhouse gas (GHG) emissions by 2050. This is supposed to be achieved by cutting emissions, investing in green technologies and protecting the natural environment. As emphasised within the European Green Deal, the circular economy has an essential role to play in reaching carbon neutrality, given a significant share of GHG emissions in the construction sector is attributed to material management activities (International Resource Panel, 2020[9]).

Policies targeting specific life cycle stages

Design

The European Commission has introduced the circular economy initiative **Principles for Buildings Design** (European Commission, 2020[10]) in order to enhance resource efficiency. Another European initiative relevant to the design of buildings, their components and materials is the **Sustainable Product Policy Initiative** (SPI). This includes a revision and extension of the Eco-design Directive, which also affects the construction sector as construction products are covered by this initiative. On 30 March 2022, the EC published a proposal for a **Regulation on Eco-design of Sustainable Products** extending eco-

design requirements to non-energy related products and to circular economy related requirements. The proposal also suggests the introduction of digital product passports (European Commission, 2022[11]).

Construction

The **Construction Products Regulation** (CPR) aims to achieve the proper functioning of the internal market for construction products, by means of introducing harmonised technical specifications of their performance in construction or use phases. On 30 March 2022, the EC published a proposal for the revision of the CPR, which introduces recycled content requirements for construction products as well as digital passports and empower the EC to establish mandatory GPP criteria for public construction works (European Commission, 2022[12]).

Use

Policies relevant for the use phase of buildings only target energy consumption. Policies directly related to the circular economy in the use phase are largely missing. At the same time, the circular economy has been recognised as one of the tools to reach carbon neutrality in national energy policies, such as in the Slovak **National Energy and Climate Plan** (Slovak Ministry of Economy, 2019[13]).

- The **Energy Efficiency Directive** (EED) establishes a set of binding measures to support the achievement of the energy efficiency targets by 2020. The new proposed revision of the EED considers circularity (for the global warming potential of life cycle emissions) in Articles 6 and 7.
- The **Energy Performance of Buildings Directive** (EPBD) complements the EED, and sets targets for all newly constructed buildings. It also sets minimum energy performance standards for renovated buildings, and mandates Member States to define clearly (in terms of energy consumption per built area) the energy consumption of near-zero energy buildings. These definitions are to be included in the long-term building renovation strategies.

End-of-life

For the end-of-life stage, there are two relevant EU policy and legal frameworks:

- The **Waste Framework Directive** is the EU's legal framework for treating and managing waste. Construction waste is one of the most important waste streams. The directive sets out a 70% target for non-hazardous construction and demolition waste (CDW) to be recycled, including backfilling, by 2020 (with exemptions for a few EU Member States).
- The **Landfill Directive** sets out operational requirements for landfill sites. It introduces the restriction on landfilling of materials that are suitable for recycling.

EU policy and legislation on food and bio-waste

Numerous policies and legislation exist at EU level with a direct or indirect impact on the circular economy in the food and bio-waste value chain. Key regulatory frameworks include the new **Circular Economy Action Plan**, the **European Green Deal**, the **Farm-to-Fork Strategy** and the corresponding directives and regulations, such as the revised **Waste Framework Directive** (WFD).

The relevant targets for the food and bio-waste value chain at the EU level include:

- The preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55% (by 2025), 60% (by 2030) and 65% (by 2035), respectively. The WFD gives the possibility for the Slovak Republic to postpone the deadline for reaching these targets by 5 years, if the country reaches 50% by 2025, Directive (EU) 2018/851 amending directive 2008/98/EC on waste (WFD);
- Separate collection or recycling at source of bio-waste (by 2023) (WFD);

- A binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2035. The Directive gives the possibility for the Slovak Republic to postpone the deadline for reaching this target by 5 years if the country reaches maximum 25% of municipal waste being landfilled by 2035, Directive (EU) 2018/850 amending Directive 1999/31/EC on the landfill of waste (Landfill Directive);
- Restrictions on landfilling of all waste that is suitable for recycling or other material or energy recovery (from 2030) (Landfill Directive);
- Commitment to halving per capita food waste at retail and consumer levels by 2030, contributing to the United Nations Sustainable Development Goal (SDG) 12.3 (Farm-to-Fork Strategy, EU Circular Economy Action Plan);
- Intended aim to propose legally binding food waste reduction targets in 2023 based on the reporting obligation on food waste data by each Member State to Eurostat by 2022 (Farm-to-Fork Strategy, EU Circular Economy Action Plan).

Earlier research (Vittuari et al., 2015[14]) (European Commission, 2020[15]) (Bos-Brouwers et al., 2020[17]) has created an overview of relevant EU policies and their positive, negative or neutral impact on food loss and food waste reduction. When assessing current regulatory frameworks and their effectiveness to address food and other bio-waste, the following differences need to be taken into consideration:

- Food waste and other bio-waste targeted and related policy areas (e.g. food waste prevention strategy vs. general food law);
- Differences that are impacting food and bio-waste directly and indirectly (e.g. measures related to measurement or awareness raising vs. Value Added Tax (VAT) on food donation and separate collection at source of municipal bio-waste);
- Differences that are related to the mandate of competent governmental bodies, and those related to private sector agreements and collaborations (e.g. cosmetic standards vs. investments in resource-efficient process technologies within the food industry).

The analysis of relevant EU policies and their impact on food and other bio-waste can be summarised as follows (into six key areas):

1. **Measurement of food waste**: the relatively new harmonised reporting requirements and methodological approach in combination with fragmented quantification efforts in the various Member States lead to data quality, validity and comparability issues, which negatively influence the evaluation of the progress made as well as the identification of targeted measures.
2. **EU policy on agriculture and fisheries**: is mainly focused on availability of sufficient food and supporting incomes within the primary sector. Amounts of losses are largely unknown as they are exempt from waste legislation, and therefore the policy negatively influences the identification of hotspot problems or targeted measures.
3. **Health & safety regulations**: regulations that safeguard the safety of foodstuff for human consumption supersede the prevention and reduction of food and other bio-waste, e.g. with regard to contamination (pesticides, contaminants, microbiological criteria), inspection, novel foods and phytosanitary issues. Where those regulations result in stricter than necessary standards and hygiene code requirements, as well as shorter available shelf life for consumers set by risk-averse food business operators, they lead to larger than necessary amounts of food and other bio-waste.
4. **Trade practices and standards**: regulations regarding import inspections, product liability, marketing standards and VAT (in relation to donation) may lead to stricter (private sector) standards than necessary, as well as to hindering the collaboration among food business operators (including charitable organisations and food banks).
5. **Waste legislation**: as all material resources are covered within this legislation, its measures are fragmented and potentially contradicting (e.g. bio-energy and packaging targets) to avoiding food and other bio-waste. Targets for food and other bio-waste reduction partially overlap (as bio-waste

partially also includes food waste, e.g. on household level), and measures to reduce landfill are focusing on increasing incineration and Energy from Waste, instead of higher value options and prevention. The lack of reliable and consistent data heavily affects policy consistency.

6. **Information on packaging**: albeit contributing to the right of consumers to safe food and accurate and reliable product information, they are sometimes confused as to the meaning of "use by" and "best before" dates. Also, food banks and other charitable organisations or social entrepreneurs using surplus food do not use food over the "best before" date, leading to the waste of food that is still safe.

Box A A.1. Date marking on food labels

According to Regulation (EU) No 1169/2011 on the provision of food information to consumers, it is required that most pre-packed food displays a date mark and accompanying wording that explains whether the date signals a threshold in the product's safety ("use by") or its quality ("best before"). The date mark is intended for use by consumers but also informs food chain operations, for example, retailers' stock management and food redistribution systems. Including a date of minimum durability or the "use by" date is mandatory in particular for pre-packed food products. Art. 24 of the Regulation indicates which type of date marking should be used when:

Article 24: Minimum durability date, 'use by' date and date of freezing

1. In the case of foods which, from a microbiological point of view, are highly perishable and are therefore likely to constitute an immediate danger to human health after a short period, the date of minimum durability shall be replaced by the 'use by' date. After the 'use by' date a food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002.

The indication that should be described on the packaging is included in Annex X:

Annex X Date of minimum durability, 'use by' date and date of freezing

The date of minimum durability shall be indicated as follows:

- (a) the date shall be preceded by the words:
  - 'Best before …' when the date includes an indication of the day ("Minimálna trvanlivosť do…")
  - 'Best before end …' in other cases ("Minimálna trvanlivosť do konca…")

The 'use by' date shall be indicated as follows:

- (a) it shall be preceded by the words 'use by '… ("Spotrebujte do ...")

Therefore, the removal of the "best-before" date is not an option under current EU legislation, nor the use of "use-by" date as an indication of minimum durability. After the expiry date of the "use-by" date, the food product is deemed unsafe to be consumed by humans, regardless of the quality of storage. There is also no evidence that the "best-before" date is being abolished across the EU.

Annex B. Analysis of National Circular Economy Roadmaps and Strategies across Selected EU Member States

Summary of the key insights for developing the circular economy roadmap for the Slovak Republic

This section outlines the high-level conclusions from the preceding comparative analysis of selected national circular economy strategies and roadmaps. The aim of this section is to summarise the lessons learned on the key building blocks of a strategic framework (vision, goals, links to other policies and strategies, interest groups involved, priority areas selection, targets, implementation measures, monitoring, evaluation and communication plans), and to inform the circular economy roadmap development in the Slovak Republic:

- **It is important to develop a clear vision for a transition.** The majority of Member States have presented highly ambitious ***visions*** for systemic change. All visions have in common that they aim at depicting a very concrete (rather than general) picture of the Member State's circular economy transition. However, there are differences in the ways in which Member States have formulated them. While some have opted for an explicit vision statement (e.g. becoming 100% circular and spearheading the circular economy at the global level), others have been more implicit about the future state of their circular economy (e.g. becoming a society fostering quality of life for all in keeping with the Sustainable Development Goals). Moreover, the level of ambition of the vision varies, ranging from some Member States aiming to become regional or even global leaders in the circular economy space, to others focusing on creating future-proof sustainable economies by improving material flows and stimulating innovation and export of new circular solutions. In addition to a vision at national level, Member States may also formulate one for each individually targeted priority area (e.g. the Netherlands envisages to use 100% renewable plastics without any harmful impact on the environment).
- **The roadmap should be tailored to the local context**. Circular economy strategy and roadmap documents tend to be drafted with a broad perspective in mind, reflecting the goals, ongoing actions and current policy paths embedded within the underlying domestic policy landscape. Although not every strategic framework document references the ***links to specific domestic policies and strategies*** explicitly, those countries that do so (e.g. Scotland, Slovenia and the Netherlands) tend to consider the links to all of the following: overarching country development strategies, specific sectoral strategies, environmental policies and programmes, waste management and raw material policies and plans, as well as broader enabling policies. Concerning EU-level regulation, Member States refer to both circular economy related guidelines (e.g. the EU Circular Economy Action Plan, and the most recent Circular Economy Package) and environment related regulation more broadly (e.g. European Waste Directive, Directive on Industrial Emissions, Eco-design Directive).
- **Shared ownership and understanding across stakeholder groups is crucial in the process of developing the roadmap**. The most inclusive strategies are those involving broad ***stakeholder***

groups, balanced partnerships, inter-ministerial coordination, and cross-sectoral cooperation, both during development and implementation phases. In most Member States, the strategy development is governed by one or more ministries, and steered by a diverse working group. The implementation is then carried out by stakeholders from individual focus areas, which tend to differ from the body responsible for the coordination of strategic development. It is a good practice for strategic development and its outcomes to be consulted with the broader public, through public consultations (e.g. regional in Slovenia, two-stage in France), individual meetings (structural interviews and stakeholder dialogues in Slovenia and Finland) and topical workshops (four topics of special relevance in France).

- **No clear guidance on the prioritisation approach emerges**. Substantial differences have also been identified in the ***prioritisation approach*** (i.e. closing loops in specific value chains versus focusing on approaches integrated along the value chain) (Figure A B.1) and in the ***selection of individual priority areas*** (i.e. attaining different levels of inclusiveness in terms of sectors/industries or systems included, and horizontal initiatives versus intervention tools) (Figure A B.2). The choice of the prioritisation approach seems to have implications well beyond the prioritisation of focus areas. This also affects the level of ambition, inclusiveness, and the speed of the paradigm change from a linear to a circular economy, and may therefore need to be considered at the initial stages of strategic development. In particular, the strategies integrated along the value chain (by France and Greece) tend to address the circular economy in its complexity, facilitate partnerships and mutual learning and aim at steering the public opinion towards the circular economic transition. On the contrary, strategies with limited sector focus (by Finland, the Netherlands, and Slovenia) tend to be less inclusive and somewhat more siloed, targeting stakeholders that are directly linked to the selected loops, and might show results more quickly. Finally, those strategies balancing the two approaches (Denmark and Scotland) are inclusive of broader material loops and large stakeholder base (Salvatori, Holstein and Böhme, 2019[18]). In terms of selecting individual priority areas, this may be either guided by strategic considerations or by the results of a quantitative analysis (such as in the Netherlands). The number of areas prioritised is typically contained to 4-6 focus areas.
- **Strategic goals set the narrative explaining the benefits of the chosen circular transition path**. The path to achieve the paradigm shift is operationalised by ***qualitative goals*** and quantitative targets. In fact, rather than an end in itself, the circular economy is a means to achieve higher-end goals, such as those spelled out in the United Nations SDGs, the Paris Climate Agreement, as well as positions by the European Commission, the G7 and the G8 (Weber and Stuchtey, 2019[19]; Salvatori, Holstein and Böhme, 2019[18]). At individual Member State level, differences exist in strategic goal setting, reflecting countries' individual approach to defining the concept of systems change, designing pathways to transitioning to a circular economy, and addressing specific challenges they are facing. More specifically, Member States may formulate goals along the lines of the benefits the circular economy presents to their economy (e.g. improved productivity, increased competitiveness, reduced dependence on imports of raw materials), and/or the environment (e.g. improving resilience, replacing non-renewable natural resources by renewables, reducing environmental footprint and controlling environmental impacts), and/or the society (e.g. creating well-being and promoting transfer to a service and sharing economy). Additionally, Member States taking a value chain perspective on the circular economy transition may also formulate process-oriented goals along the individual pillars of their strategic frameworks (e.g. production, consumption, waste management, and stakeholder involvement in France).
- **Quantitative targets set the level of ambition and provide a long-term perspective to stakeholders on the direction of travel**. The quantitative targets included in circular economy strategic frameworks largely build on targets readily used in related national and European strategy documents, policies and plans (Table A B.1). Their level of ambition varies – ranging from those in compliance with existing targets and obligations, to those going beyond these. Furthermore, they

can be formulated at national and/or sectoral level. In practice, most quantitative targets are related to environment, more specifically to resource productivity (e.g. boosting resource productivity by 40% based on the amount of materials, and by 15% based on their value in Denmark), reduction of use of primary raw materials (e.g. 50% reduction in the use of primary raw materials by 2030 in the Netherlands), waste reduction (e.g. food waste reduction target of 33% by 2025 in Scotland), and recycling (e.g. 100% plastics recycled by 2025 in France). Of the social and economic targets, quantitative targets are seldom and limited to the number of additional jobs created (15 900 new jobs in Greece and 300 000 in France), or, exceptionally, to circular business models (e.g. utilising surplus capacity by 50% of the population becoming active in the sharing economy in Denmark). The ***indicators*** to measure the progress towards specific targets tend to refer back to the EU's circular economy monitoring framework. However, several countries (Scotland, Slovenia, Finland, and the Netherlands) are considering designing a new set of indicators, which would more adequately capture the systemic effects of circularity levers (such as a sharing economy, industrial symbiosis, repair, and remanufacturing). Such indicators shall also contribute to better understanding circular economy choices and their alternative consequences. The prerequisite for the development of such indicators might be the initiation of new data collection going beyond already existing statistics.

- **Applying a mix of policy instruments is important to provide a coherent set of incentives across the targeted priority areas**. In terms of ***implementation***, countries use a mix of policy instruments across different priority areas and along different value chain stages. There is substantial heterogeneity across the different proposed instruments. These include both easier to implement information instruments (e.g. voluntary environmental labelling, analysis and digitalisation of public private data), voluntary approaches (e.g. voluntary agreements within key business sectors, voluntary commitments for recycled materials incorporated into products), education and research (e.g. establishment of education and training programmes, and of circular economy observatories, knowledge platforms and fora) and cooperation actions (e.g. public-private, cross-agency, inter-sectoral), as well as instruments which might require larger administrative effort for their implementation, such as economic incentives (e.g. removal of tax barriers for circular business models, introducing financial circular incentives, and financing tools) and regulatory instruments (e.g. introduction of deposit return schemes, ecological design of products, extended producer responsibility, product standards and certifications). Most Member States tend to set out the implementation measures at the level of individual priority areas (as opposed to the aggregate level), presenting a comprehensive list of measures clustered thematically along the value chain stages or along the targeted economic sectors. When it comes to demonstrating the actionability of the priority areas, it is a good practice to either single out private sector pilots and examples of good practices (as has been done in the Netherlands, France, Slovenia, Scotland), and/or to provide case studies of ongoing policies and specific government measures (in the Netherlands, France, Denmark). The Finnish strategy goes a step further and links policy actions at the level of priority areas with specific projects and individual pilots. Investing in the execution of proposed measures by such strategies and roadmaps has been identified as being key to their success (Laura and Riku, 2020[20]).
- **A communication plan developing ways to engage with the broader public may be integrated within the roadmap**. Strategy documents tend to inform sparingly about their ***evaluation plans***. Similarly, ***communication plans*** are seldom explicitly outlined in these. Exceptions are France and Scotland, which chose to explicitly include them as priority areas within their strategies.

Figure A B.1. Prioritisation approach across circular economy strategies of the selected EU Member States

	Sectors/ Industries	Systems	Horizontal initiatives	Value chain perspective
Finland		●	●	○
The Netherlands	●	●		○
Slovenia	●	●		○
Denmark	●	●	●	●
Scotland	●	●	●	●
France	○	○	○	●
Greece	○	○	○	●

Note: ● covered as specific priority area; ○ analysed implicitly within specific priority areas. Where left blank (the Netherlands and Slovenia), horizontal initiatives are included as intervention tools (rather than priority areas).
Source: Adapted from individual national circular economy strategy documents of respective countries.

Figure A B.2. Specific priority areas selected across circular economy strategies of the selected EU Member States

	SECTORS/INDUSTRIES								SYSTEMS				HORIZONTAL INITIATIVES									
	Plastics	(Re)Manufacturing	Buildings and construction	Consumer goods	Energy infrastructure, secondary fuels	Water	Waste management	Sustainable tourism	Forest-based value chain	Technical loops (all industries)	Mobility, transport, logistics	Food, drinks, bio-waste, biomass	Funding/subsidies, financial incentives, taxation	Export promotion, illegal trade	Public-private / international collaboration	Public procurement	Education, research, innovation	Eliminating regulation barriers / creating incentives, standards, eco-labelling, product policy	SMEs and business models	Data, digitalisation	Inter-ministerial initiatives	CE Indicators, communications
France	○	○	○	○	○		●		○	○	○	○	○	○		○	○	○	○	○	○	○
Finland							○		●	●	●	●	●	●	●	●	●	●		●	●	●
Denmark			●				●					●				○		○	●	●		
The Netherlands	●	●	●	●			○					●										
Slovenia		●	○					○	●		●	●										
Greece	○		○		○	○	●		○	○	○	○	○			○	○	○	○		○	○
Scotland		●	●		●		●					●					●					●

Note: ● covered as specific priority area; ○ analysed implicitly within specific priority areas. Where left blank for horizontal initiatives, these are included as intervention tools (rather than priority areas).
Source: Adapted from individual national circular economy strategy documents of respective countries.

Table A B.1. Targets across circular economy strategies of the selected EU Member States

Country	Targets
The Netherlands	Interim objective of 50% reduction in the use of primary raw materials by 2030; Examples of sector specific targets: • Achieving a 20% market share for bio-based chemicals and materials by 2020, and a market share of 30% by 2030; • Reducing the share of fossil resources in the Dutch economy to 70% by 2030; • Using 100% renewable (recycled and bio-based) plastics wherever such is technically feasible by 2050; • By 2020, capping the annual volume of household residual waste to 100 kg per capita; by 2025 to 30 kg per capita per year; • By 2022, halving the volume of residual waste for companies, organisations and governments that is comparable to household residual waste (compared to 2012).
Finland	No quantitative targets at the national level mentioned within the strategy document. It refers to either existent EU targets (e.g. cutting store and consumer food waste in half by 2030) or specific targets incorporated within individual pilots (e.g. 60% recycling rate for municipal bio-waste in 2022 through nutrient recycling).
Denmark	The strategy document is referring to the Advisory Board for Circular Economy Business community's targets for 2014-2030: • Boosting resource productivity by 40% based on amount of materials, and by 15% based on their value; • Boosting overall recycling to 80%, and reducing the amount of waste generated by 15%; • Utilising surplus capacity better, by 50% of the population becoming active in the sharing economy; • Boosting circular consumption by quadrupling overall turnover of eco-labelled products and services.
Slovenia	Targets adapted from the Slovenian Development Strategy 2030: • Material productivity: 3.5 PPP/kg; • Share of renewable energy in gross final energy consumption: 27%; • GDP per total greenhouse gas emissions: EU average in 2030.
France	• 30% reduction in resource consumption in relation to GDP between 2010 and 2030; • 50% reduction in amount of non-hazardous waste landfilled by 2025 (compared to 2010); • Aim towards 100% plastics recycled by 2025; • Avoid emission of 8 million additional tonnes of CO_2 each year thanks to plastic recycling; • Create up to 300 000 additional jobs, including new professions.
Scotland	Targets directly set by the Scottish Government (within Zero Waste Plan, and Safeguarding Scotland's Resources), or transposed those set by the EU: • Food waste reduction target of 33% by 2025; • Reducing waste arising by 7% against 2011 baseline of 13.2 million tonnes; • Recycling and preparing for re-use of 50% by weight of household waste and similar; • 60% recycling/composting and preparing for re-use of waste from household; • No more than 1.26 million tonnes of biodegradable municipal waste to be sent to landfill; • 70% recycling and reuse of construction and demolition waste; • Reducing waste arising by 15% against 2011 baseline of 13.2 million tonnes; • No more than 5% of all waste going to landfill; • 70% recycling/composting and preparing for re-use of all waste by 2025; • Reducing all food waste arising in Scotland and working with industry to reduce on-farm losses of edible produce.
Greece	Targets to be achieved by 2020 are taken over from Law on Recycling, existing waste legislation, and the actual National Circular Economy Action Plan: • Achieving a radical reduction of the per capita produced waste; • Increasing reuse and recycling of wastes, with a separate collection of recyclable waste and of bio-waste, to reach 50% of total municipal solid waste produced (from 25% where it stands today); • Reaching a 74% recovery and less than 30% disposal of total municipal solid waste produced (from the current disposal of 82%); • Creating around 15 900 new jobs and increasing the annual turnover of the waste management related businesses.

Source: Adapted from individual national circular economy strategy documents of respective countries.

Annex C. Stocktake of the Slovak Circular Economy Policy Landscape

Table A C.1. List of analysed policy documents

No.	Classification	Topic area	Title (original)	Title (English)	Author	Year	Timeframe
1	Core	Agenda 2030	Vízia a stratégia rozvoja Slovenska do roku 2030 (Slovensko 2030)	[Vision and sustainable development strategy of the Slovak Republic up to 2030]	MIRRI	2021	2030
2	Core	Environment	Zelensie Slovensko - Stratégia environmentálnej politiky Slovenskej republiky do 2030 (Envirostratégia 2030)	Greener Slovakia - Strategy of the Environmental Policy of the Slovak republic until 2030	Ministry of Environment	2019	2019-2030
3	Core	Raw materials	Aktualizácia surovinovej politiky Slovenskej republiky pre oblasť nerastných surovín	[Updated raw materials policy of the Slovak Republic]	Ministry of Economy	2004	long-, medium-(2005) and short-term (2004)
4	Core	Waste	Program odpadového hospodárstva Slovenskej republiky na roky 2021 – 2025	Waste Management Plan of the Slovak Republic for 2021-2025	Ministry of Environment	2021	2021-2025
5	Core	Waste	Program predchádzania vzniku odpadu SR na roky 2019 - 2025	[Waste prevention programme of the Slovak Republic for the period 2019 - 2025]	Ministry of Environment	2018	2019-2025
6	Core	Waste	Plán predchádzania plytvaniu potravinami	Food waste prevention plan	Ministry of Agriculture and Rural Development	2016	Not specified
7	Related	Agenda 2030	Návrh národných priorít implementácie Agendy 2030	[National priorities of the Agenda 2030 for sustainable development]	MIRRI	2018	2018-2030
8	Related	Agenda 2030	Národný investičný plán SR na roky 2018 – 2030 pilotná verzia	[National Investment Plan of the Slovak Republic for 2018 - 2030 pilot version]	MIRRI	2018 (to be updated)	2018-2030
9	Related	Agriculture	Akčný plán rozvoja pôdohospodárstva SR na roky 2014 – 2020	[Action plan for the development of agriculture in the Slovak Republic for the period 2014 - 2020]	Ministry of Agriculture and Rural Development	2014	2014-2020
10	Related	Agriculture	Koncepcia využitia poľnohospodárskej a lesníckej biomasy	[Concept for the use of agricultural and forestry biomass]	Ministry of Agriculture and Rural Development	2004	Not specified
11	Related	Digitalisation	Stratégia digitálnej transformácie Slovenska 2030	2030 Digital Transformation Strategy for Slovakia	MIRRI	2019	2019-2030
12	Related	Digitalisation	Akčný plán digitálnej transformácie Slovenska na roky 2019-2022	Action plan for the digital transformation of Slovakia for 2019-2022	MIRRI	2019	2019-2022
13	Related	Economy	Stratégia hospodárskej	[Economic policy strategy of	Ministry of	2018	2030

No.	Classification	Topic area	Title (original)	Title (English)	Author	Year	Timeframe
			politiky Slovenskej republiky do roku 2030	the Slovak Republic up to 2030]	Economy		
14	Related	Economy	Akčný plán k Stratégii hospodárskej politiky SR 2030	[Action plan for the Economic policy strategy of the Slovak Republic 2030]	Ministry of Economy	2019	2019-2021
15	Related	Energy & climate	Nízkouhlíková stratégia rozvoja Slovenskej republiky do roku 2030 s výhľadom do roku 2050	Low-Carbon Development Strategy of the Slovak Republic until 2030 with a view to 2050	Ministry of Environment	2020	2030, 2050
16	Related	Energy & climate	Integrovaný národný energetický a klimatický plán Slovenska do roku 2030	National Energy and Climate Plan up to 2030	Ministry of Economy	2019	2021-2030
17	Related	Energy & climate	Národný program znižovania emisií	National Emissions Reduction Programme	Ministry of Environment	2020	2020-2029 and beyond 2030
18	Related	Governance	Plan obnovy a odolnosti Slovenskej republiky	[Draft Recovery and Resilience Plan of the Slovak Republic]	Ministry of Finance	2021	2026
19	Related	Governance	Národný program reforiem Slovenskej republiky 2020	National Reform Programme	Ministry of Finance	2020	2020
20	Related	GPP	Národný akčný plán pre zelené verejné obstarávanie 2016-2020 (NAP GPP III)	National Action Plan on Green Public Procurement 2016-2020	Ministry of Environment	2016	2016-2020
21	Related	Industry	Akčný plán pre konkurencieschopný a udržateľný oceliarsky priemysel na Slovensku	[Action plan for a competitive and sustainable steel industry in the Slovak Republic]	Ministry of Economy	2014	2030
22	Related	Innovation	Podpora inovatívnych riešení v slovenských mestách	[Support for innovative solutions in Slovak cities]	Ministry of Economy	2017	no timeframe
23	Related	Innovation	Návrh štátnych programov výskumu a vývoja pre roky 2020 - 2024 s výhľadom do roku 2029	[Proposal for state programmes for R&D for the period 2020-2024 with an outlook to 2029]	Ministry of Education, Science, Research and Sport	2019 to be approved	2020-2029
24	Related	Innovation/ Industry	Koncepcia inteligentného priemyslu pre Slovensko	[Concept of smart industry for the Slovak Republic]	Ministry of Economy	2016	Not specified
25	Related	Innovation/ Industry	Akčný plán inteligentného priemyslu SR	[Action plan for smart industry for the Slovak Republic]	Ministry of Economy	2018	2018-2020
26	Related	Innovation/ Industry	Stratégia výskumu a inovácií pre inteligentnú špecializáciu (RIS3)	Research and Innovation Strategy for Smart Specialisation of the Slovak Republic	Ministry of Economy Ministry of Education, Science, Research and Sport	2013	2014-2020
27	Related	Transport	Strategický plán rozvoja dopravy SR do roku 2030	[Strategic plan for the development of transport in the Slovak Republic until 2030]	Ministry of Transport and Construction	2016	2030
28	Related	Water	Orientácia, zásady a priority vodohospodárskej politiky SR do roku 2027	Orientation, Principles and Priorities of the Slovak Republic Water Management Policy by 2027	Ministry of Environment	2015	2015-2027
29	Related	Water	Vodný plán Slovenska	Water Management Plan of	Ministry of	2015	2016-2021

No.	Classification	Topic area	Title (original)	Title (English)	Author	Year	Timeframe
			2016-2021	Slovakia 2016-2020	Environment		
30	Complementary	Consumption	Stratégia spotrebiteľskej politiky Slovenskej republiky na roky 2014 – 2020	[Consumer policy strategy of the Slovak Republic for the period 2014 - 2020]	Ministry of Economy	2014	2014-2020
31	Complementary	Education	Rezortna koncepcia environmentálnej výchovy, vzdelávania a osvety do roku 2025	[Concept of environmental education, training and awareness raising up to 2025]	Ministry of Environment	2015	2015-2025
32	Complementary	Energy & climate	Stratégia adaptácie Slovenskej republiky na zmenu klímy – aktualizácia	Strategy for the Adaptation of the Slovak Republic to Climate Change - Update	Ministry of Environment	2018	2018-2025
33	Complementary	Energy & climate	Akčný plán pre implementáciu Stratégie adaptácie SR na zmenu klímy	Action Plan for the implementation of the Strategy for the Adaptation of the Slovak Republic to Climate Change	Ministry of Environment	2021	2021-2027
34	Complementary	Governance	Akčný plán k Národnému programu reforiem	Action plan for the National Reform Programme 2020	Ministry of Finance	2020	2020
35	Complementary	Water	H2ODNOTA JE VODA - Akčný plán na riešenie dôsledkov sucha a nedostatku vody	[H2OVALUE IS WATER - An action plan to address the consequences of drought and water scarcity]	Ministry of Environment	2018	2018-2025

Note: [ ] brackets indicate the author's translation of the title of the policy document. MIRRI stands for the Ministry of Investments, Regional Development and Informatization.

Table A C.2. An overview of key qualitative goals

Policy document	Goals
Vision and Sustainable Development Strategy of Slovakia up to 2030 (Slovakia 2030)	Three integrated development programmes at the core of the strategy. Specific goals for each of them: 1. Protection and development of resources – this includes the development of cultural, human and natural resources. The goal related to natural resources encompasses, among others, increasing recycling rates of municipal waste, decreasing the rate of landfilling of waste, and decreasing soil erosion. 2. Sustainable use of resources – the aim of this programme is to transform the Slovak economy into a sustainable and competitive economy, driven by innovation and the efficient use of resources. This programme appears as the most relevant one to circular economy (CE), as the key to this transformation is increasing innovation and material intensity of the Slovak economy. However, this is only a small part of the programme. 3. Community development – the aim of the programme is regional development and the development of communities, social inclusiveness. The programme is not linked to the transition to a circular economy.
Greener Slovakia - Strategy of the Environmental Policy of the Slovak republic until 2030 (Envirostrategy 2030)	Overall areas tackled by the strategy: 1. Sustainable use and effective protection of natural resources (water, nature and landscape, land, forests, rock environment) 2. Climate change and air protection (climate change, floods, droughts and water scarcities, clean air) 3. Green economy (circular economy, energy, economic instruments, education and learning, better data) 4. Institutional framework CE related goals (not explicitly outlined): • Support of the CE (through green innovations, GPP, DRS, information tools, reuse and repair, voluntary agreements); • Gradual increase of landfill fees; • Introduction of PAYT; • Prevention of illegal dumping of solid waste based on the polluter pays principle; and • Prevention of the production of biodegradable and food waste.

Updated Raw Materials Policy of the Slovak Republic	The overall aim: to achieve a safe, reliable and efficient supply of all necessary raw materials at affordable prices, social acceptability and in line with the sustainable development and the national economic, social and environmental policies. Pillars of the raw materials policy: 1. Ensuring the raw material security of supply of the state; 2. Ensuring the competitiveness of the raw materials industry; 3. Sustainability. Specific objectives: regulation of the raw materials market, efficient use of domestic raw materials, coordination, sustainable management of raw materials, etc. Strategic raw materials: oil and gas (imported), coal, metals (imported), non-metallic minerals Regional: construction minerals (limited export possible).
Waste Management Plan of the Slovak Republic for 2021-2025	The main objective: to divert waste from landfills, in particular municipal waste by 2025. Objectives (and targets) for each waste stream: municipal waste, biodegradable waste, bioplastics, textile, packaging and non-packaging products, construction and demolition waste, tyres, ELV, batteries and accumulators, WEEE, waste oils, and hazardous waste. The majority of objectives are formulated as quantitative targets. Existing qualitative goals for the different waste streams: • Bioplastics: Preparation of materials for the creation of a functional waste management system for bioplastics. • Textiles: Creation of a functional waste management system in the Act on waste for textile waste as of 1 January 2025; increase of recycling and reuse of textile. • Batteries and accumulators: Adoption of a new regulatory framework for batteries and accumulators through relevant waste legislation. • Waste oils: Increase recycling and energy recovery of waste oils. • Hazardous waste: Increase the amount of recovered hazardous waste produced in the Slovak Republic.
Waste Prevention Programme of the Slovak Republic for the period 2019 - 2025	The main goal: to move from material recovery as the only priority in waste management in the Slovak Republic to the prevention of waste generation in accordance with the waste hierarchy. Specific targets/ goals for each of the 9 waste streams: mixed municipal waste, biodegradable waste, paper waste, plastics and packaging, bulky waste, food waste, C&D waste, hazardous waste, waste from the extraction industry.
Food Waste Prevention Plan	The main strategic objective: to reduce and prevent food losses and food waste. To achieve this goal, the plan specifies a number of sub-objectives: • Develop a uniform methodology to quantify the amount of food losses and wasted food along the food value chain; • Identify the causes of food losses and food waste and the possibilities to reduce or prevent such food waste/loss; • Increase societal awareness of the issue and change society's behaviour towards food consumption and waste. • Seek opportunities for cooperation between the food chain and public authorities.

Note: The list of specific goals for each overall goal is not comprehensive. Only circular economy related sub-objectives and goals are presented.
Source: Adapted from the six policy documents.

Table A C.3. An overview of key quantitative targets

Policy document	Quantitative targets
Vision and sustainable development strategy of Slovakia up to 2030 (Slovakia 2030)	Strategy includes targets for the different programme areas. CE relevant targets include: • Recycling and landfilling rates of municipal waste in line with the EU waste legislation; • Green Public Procurement (GPP) will cover at least 70% of the total value of all public procurements (national target); • Increase the land being used for organic farming to 16% (compared to the current long-standing share of 10%) (national target) (the EU ambition is 25% by 2030). No new targets, rather a collection of targets from national sectoral policies and legislation. Several CE related indicators are included in the monitoring framework of the strategy.
Greener Slovakia - Strategy of the Environmental Policy of the Slovak republic until 2030 (Envirostrategy 2030)	Strategy includes a number of EU and national targets: • Air pollution, GHG emissions, recycling targets - in line with the EU legislation (the target for landfilling of municipal waste is set at max 25% by 2035 instead of 10% (in line with the allowed postponing of the 10% target); • GPP will cover at least 70% of the total value of all public procurements; • Support for green innovation, science and research will reach a comparable level to the EU average. • Other targets include: % share of protected land, % share of organic farming, and good status of water.

Policy document	Quantitative targets
	A number of CE related indicators included: DMC/cap, GDP/DMC, Recycling rate of municipal waste, waste production per capita, the landfilling rate (excl. mineral waste) (based on Eurostat data).
Updated raw materials policy of the Slovak Republic	No targets.
Waste Management Plan of the Slovak Republic for 2021-2025	The Plan contains one main qualitative goal supported by a number of quantitative targets (per waste stream): • To increase the separate collection rate of municipal waste to 60% by 2025 (national target) and the recycling rate and the preparation for recovery to 55% by 2025 (EU target); • To increase the share of biodegradable municipal waste in mixed municipal waste to 25% by 2025 (national target); • To increase the preparing for re-use and recycling of construction waste, including backfilling operations, to 70% (national target based on EU 2020 target); • To achieve, by 31 December 2025, a recycling rate for waste tyres of at least 75% and an energy recovery rate of up to 24% of the total weight of tyres placed on the market. The possibility of other disposal methods for waste tyres was set at a maximum of 1% (national target). • To maintain the reuse of parts of ELVs and waste recovery from the treatment of ELVs to at least 95% and the reuse and recycling of ELVs to at least 85% (EU target). • From 2021, to achieve a minimum collection target of at least 65% of the average weight of electrical and electronic equipment placed on the market in the Slovak Republic in the three preceding years (EU target). Several indicators included for each waste stream.
Waste prevention programme of the Slovak Republic for the period 2019 - 2025	Targets for specific waste streams, e.g.: • Decrease the amount of municipal waste by 50% by 2025 compared to 2016; • Decrease the amount of biodegradable waste in municipal waste by 60% by 2025 compared to 2016. Indicators included: e.g. adoption of a new law on increased landfill fees, the number of information awareness campaigns, the number of ecolabel licence holders, the share of GPP, the number of Eco-Management and Audit Schemes (EMAS), etc.
Food Waste Prevention Plan	No targets. The Plan mentions the Sustainable Development Goal target on food waste reduction (50% reduction by 2030) but it is not the Plan's target.

Note: The list of all targets included in the six core policy documents is not comprehensive. Only circular economy related targets are presented.
Source: Adapted from the six policy documents.

Annex D. Measures Promoting Sustainable Consumption and Production with a Focus on Economic Instruments

Table A D.1. Overview of analysed policy instruments to improve circularity across the value chain

Value chain	Purpose	No	Instrument name	Type	Availability in the Slovak Republic
Production	Discouraging use of virgin and non-recyclable materials	1	Virgin material taxes	Explicit economic instrument	Not available, only charges on resources in the form of royalty payments for minerals extraction
		2	Plastics taxes (e.g. on non-recycled or single-use plastics)		Not available
		3	Reductions in VAT for repaired, refurbished, upcycled or second-hand products		Not available, only indirectly through VAT reduction for the activities of social enterprises
		4	Recycled content mandates	Economic/ regulatory/ voluntary instrument	Not available, only as direct regulation through the transition of the EU Single-Use Plastics Directive
	Linking product design to end-of-life disposal costs	5	Extended Producer Responsibility schemes		Available for e-waste, batteries and accumulators, packaging and packaging waste, end-of-life vehicles, tyres and certain products (in line with the EU legislation); no eco-modulation
		6	Green Public Procurement		Available and mandatory for four product groups for state-level entities. Additional mandatory application of GPP in effect from April 2022.
	Enhancing government support to business R&D and eco-innovation	7	R&D tax incentives	Explicit economic instrument	Available for R&D, not eco-innovation specifically
		8	Incentive subsidies for R&D and eco-innovation	Explicit economic incentive	Available through national and EU fund programmes
		9	Information and educational tools to build capacity	Information/ education tools	Available but not sufficiently to support SMEs
		10	Voluntary agreements	Voluntary instrument	Available but not specifically for eco-innovation
Consumption	Influencing consumer behaviour at the point of sale	11	Consumer product taxes, incl. advance disposal fees	Explicit economic instrument	Not available for CE purpose
		12	Eco-labels and certificates (e.g. for reuse or repaired products)	Information/ education tools	EU and national eco-label available, no quality certificate or other type of label
	Changing consumer behaviour at the product's end-of-life	13	Household waste charges, incl. PAYT	Explicit economic instrument	PAYT available but low uptake and often low incentive
		14	Deposit-refund schemes		Available for reusable beer glass bottles and single-use PET bottles and cans
		15	Information and educational tools	Information/ education tools	Available
Waste management	Incentives to move up the waste hierarchy	16	Landfill taxes	Explicit economic instrument	Available but not fully effective
		17	Incineration taxes		Not available
	Increasing reuse and recycling	18	Incentive subsidies for reuse and recycling		Available to some extent through national and EU grants

Discouraging the use of virgin and non-recyclable materials

Virgin material taxes

Table A D.2. Overview of taxes and levies on minerals in EEA countries, 2013

Country	Name of tax, charge or duty	Taxable object	Year of introduction	Tax rates
Bulgaria	Mining charge	Sand and gravel	1997	EUR 0.03-0.08/m³
Croatia	Extraction charge	Sand, gravel, crushed stone, limestone and clay	n/a	EUR 0.41/m³ (sand) EUR 0.55/m³ (gravel)
Cyprus	Quarrying charge	Materials extracted from quarries	Ca. 1998	EUR 0.26/tonne
Czech Republic	Payments for mineral extraction	aggregates	1993	Up to 10% of the market price for minerals
Denmark	Tax on raw materials	Stone, sand, gravel, peat, clay and limestone	1990	EUR 0.67/m³ (since 1990 fixed at DKK 5/m³
Estonia	Material extraction charge	Dolomite, granite, gravel, sand, limestone, clay, peat, phosphate rock and oil shale	1991	n/a
France	Tax on extracted minerals (granulates)	Minerals (granulates)	1999/2000	EUR 0.09/t (natural mineral grains) EUR 0.20/t (extracted minerals)
Latvia	Material extraction charge	Gravel, limestone and clay	1991	EUR 0.11/m³ (sand) EUR 0.13/m³ (dolomite) EUR 0.18/m³ (limestone) EUR 0.21/m³ (sand-gravel)
Lithuania	Mineral extraction charge	minerals	1991	EUR 0.14/m³ (sand) EUR 0.38/m³ (dolomite) EUR 0.50/m³ (limestone) EUR 0.17/m³ (gravel)
Sweden	Natural gravel tax	Gravel, sand, cobble and boulder	1996	1996: EUR 0.57/t 2006: EUR 1.41/t
United Kingdom	Aggregates levy	Sand, gravel and crushed rock	2002	2002: EUR 2.61/t 2010: EUR 2.30/t

Note: conversion factor of sand; gravel; crushed rock, =1.8 t/m³; and limestone, = 2.8 t/m³
Source: Bahn-Walkowiak and Steger (2015[21]) in International Resource Panel (2020[9])

Box A D.1. Economic instruments to optimise minerals extraction

Aggregates levy on sand, gravel and rock (the UK)

In 2002, the UK introduced an aggregates levy on rock, sand and gravel used as bulk fill in construction. Charged on quarry operators and other organisations that commercially exploit aggregates, this environmental tax is intended to:

- Reduce the environmental costs associated with quarrying operations (such as noise, dust, visual intrusion, loss of amenity and damage to biodiversity), and
- Reduce the demand for aggregates and encourage the use of alternative materials (such as secondary aggregate materials exempt from the levy or recycled aggregate materials).

The levy was introduced at a rate of EUR 2.35 (or GBP 1.60) per tonne (constituting around 20% of the average material price per tonne). The basis for the tax was informed by a contingent valuation study that estimated the total annual external costs of aggregates extraction in the region to be EUR 558 million. A proportion of the revenue raised has been used to correct market failures, namely training lorry drivers for more efficient and less disruptive transport of aggregates.

In addition to the levy, the UK has also implemented two associated policy measures (contrary to some EU Member States, which tend to implement the tax in isolation):

- Revenues raised from the aggregates levy are redistributed to business through a 0.1% cut in the employer's National Insurance Contributions. With this measure, the UK Government intends to shift taxation from the "good" to the "bad" (Seely, 2011[22]).
- A 10% share of the revenues raised from the aggregates levy are redistributed through an Aggregates Levy Sustainability Fund. This fund provides a source of funding to R&D projects designed to deliver local environmental benefits to areas subject to the environmental costs of aggregates extraction. The first objective of the fund is to reduce the demand for primary aggregates by promoting the greater use of recycled and secondary aggregates (EEA, 2008[23]; Seely, 2011[22]).

The introduction of the levy has contributed to an increase in the use of secondary aggregates. In 2020, the total UK sales amounted to 29%, which is the highest share of secondary aggregates in Europe (Highways, 2020[24]).

Lessons learned

According to an EEA study (2008[23]), the combination of a tax with other policy levers (e.g. permits, quality standards) can be more effective than a tax introduced in isolation. Moreover, important considerations should be made to assess the tax rate and its effectiveness. These include:

- Cross-price elasticity of demand: As the cost of aggregate materials is low in relation to overall construction costs, demand for aggregates is generally inelastic. Whether demand from the construction industry is met by recycled or primary aggregate materials influences the relative price between them.
- Tax distortions across country borders: A 'one size fits all' aggregate tax may lead to unintended effects (e.g. illegal trade in aggregate materials), as illustrated by the experience in Northern Ireland. This is particularly relevant where regional tax differentials exist. Environmental taxes and charges on primary aggregates implemented in other EU Member States

Other countries have also implemented aggregates taxes, including Denmark, Sweden, Belgium (Flanders) and Italy (on a regional level). Sweden has introduced a tax on natural gravel in 1996, with the purpose of promoting the use of crushed rock and recycled materials, in response to the increasingly limited supplies of virgin materials. In Denmark, the combination of virgin material taxes introduced in 1990 (on sand, gravel, stones, peat, clay and limestone) with waste taxes, drew the demand for recycled substitutes from only 12% of CDW to be recycled in 1985 to 94% in 2004 (European Commission, 2011[25]).

While in Denmark and Sweden the tax is levied on an ad quantum (physical) basis, the other countries apply ad valorem (monetary) taxes. Instead of implementing taxes, levies or duties, 11 other EU Member States (including the Czech Republic and France), have implemented charges on mining and extraction (EEA, 2008[23]).

Lessons learned from Sweden's gravel tax

An interesting feature of the Swedish gravel tax has been the decision to incrementally increase the gravel tax over time. This seems to have been effective at reinforcing the signal to producers and consumers on costs and the need to shift away from natural gravel use. The Ministry of Environment commented that companies would view the tax as an instrument that was likely to increase over time and so changed investment decisions. Such a 'signal effect' would have had a strong influence in changing company production plans. The gradual tax increase has also helped facilitate incremental restructuring across the aggregate industry.

Another lesson from Sweden is the way in which competition issues were considered prior to introducing the gravel tax. Although the tax supported the goal of maintaining natural gravel deposits in the southern part of Sweden (where natural gravel is scarce), it imposed costs in northern Sweden (where natural gravel is abundant). This might give the impression that the decision to introduce the gravel tax has not been a cost-effective option for the North and distorted the market. A solution may have been to use some of the revenue raised by the gravel tax to compensate those communities in the North that were most affected for equity and social purposes. Instead all of the revenue from the tax is incorporated into the central budget and used to finance general government spending programmes (EEA, 2008[23]).

The Slovak Republic has implemented resource fees for minerals extraction (Box A D.2). However, these are royalty payments associated with resource extraction collected for revenue and social redistribution purposes rather than virgin material taxes aimed at increasing the use of secondary raw materials and enhancing the environmental performance of companies (International Resource Panel, 2020[9]).

Virgin materials taxes are less well established interventions and are more challenging to implement but could have a significant impact. Empirical evidence from Denmark, Sweden and the United Kingdom suggests that the European aggregate taxes have contributed to the reduction of virgin materials use in these countries in spite of the relatively low price elasticity of aggregates (Söderholm, 2011[26]). However, these taxes often do not provide sufficient incentives for operators to improve their environmental performance and increase the supply of recycled materials (Söderholm, 2011[26]). The reason could be the difficulty to pass the full impact of the virgin materials tax down the supply chain to the users of the virgin material. Moreover, the experience shows that virgin materials taxes tend to be confined to commodities with relatively limited international trade due to the high transport costs relative to their value and the consideration of not disrupting the domestic industry by imposing higher material costs (OECD, 2021[27]).

The Slovak Republic could explore the option of introducing virgin material taxes on aggregates. This instrument proved to be effective in reducing the use of virgin construction minerals in a number of European countries and aggregates are commodities with limited international trade, hence domestic industry would not be disrupted. However, there is a concern in the Slovak Republic that the increased costs from the introduction of virgin material taxes in the country are likely to be passed on to the final consumer rather than being redirected towards the increased resource efficiency of primary materials. The literature also recommends implementing aggregates taxes in combination with additional policies to increase the demand for and supply of recycled materials (Söderholm, 2011[26]). This could be achieved in combination with introducing minimum recycled content requirements for specific construction products or green public procurement criteria for construction projects (see Chapter 6).

Box A D.2. Resource fees for minerals in the Slovak Republic

Resource fees for mineral prospecting or exploration

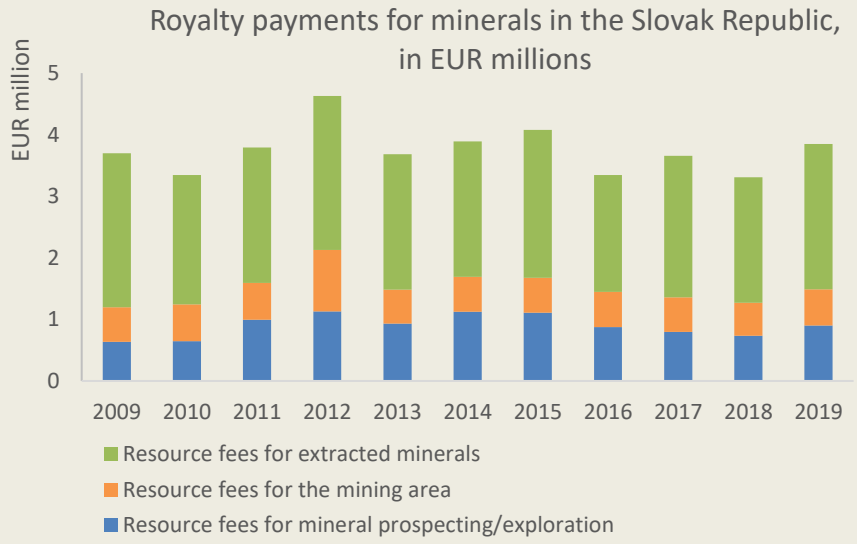
The fees are regulated by the Act No. 569/2007 Coll. on geological works (Geological Law), as amended by later regulations. The annual fees for the exploration area are as follows: 100€ per started km^2 for the first 4 years, 200€ per km^2 for the next 4 years, 350€ for additional 2 years, and 700€ thereafter (para 26(1) of the Geological law). The proceeds from the payments are earmarked for the Environmental Fund (50%); and for the municipalities on whose territory the exploration area is located (50%) (Paragraph 26(4) of the Geological Law).

Resource fees for the mining area

The fees are regulated by the Government Decree No. 50/2002 Coll. on payments for the mining area and for the extracted minerals, as amended by later regulations and by the Mining Law (Act No. 44/1988 Coll. para 32a). The annual fee for the mining area is 663.87 EUR per started km^2 of the mining area. 20% of the proceeds go to the State budget and 80% to the municipality on whose territory the mining area is located.

Resource fees for extracted minerals

The fees are regulated by the Government Decree No. 50/2002 Coll. on payments for the mining area and for the extracted minerals, as amended by later regulations and by the Mining Law (Act No. 44/1988 Coll. para 32a). Each organisation extracting minerals with a mining licence is obliged to pay royalties for the extracted minerals. The calculation of these royalties depends on the mining costs, total production costs, sales revenues and the tariff for the payment (0.1-10% depending on the mineral, max 20% in case of radioactive minerals)*. The calculation is performed on a quarterly basis. The proceeds from these payments go to the Environmental Fund. There are a few exemptions to the full payment of these fees.



Note: * According to the Amendment No. 401/2020 to the Government Decree No. 50/2002 Coll., the minimum tariff of 0.1% can be applied only to coal and lignite until the end of 2023.
Source: Adapted from data in the OECD PINE Database (n.d.[28])

Plastics taxes

The Slovak Republic is also not planning to implement a plastics tax in the near future to raise revenues for the new EU levy on non-recyclable plastics packaging, the latter being effective from January 2021 (Raábová, 2020[29]). Neither is the country planning to discourage the use of non-recyclable plastics through another economic instrument, such as eco-modulating fees for plastics and plastics packaging that Producer Responsibility Organisations (PROs) charge to firms producing or placing plastics on the Slovak market, for the time being.

The Slovak Republic could reconsider implementing a tax on virgin or non-recycled plastics or introduce another instrument to discourage the use of virgin or non-recyclable plastics in products. A tax on virgin or non-recycled plastics is a new instrument increasingly used by countries to curb plastics pollution. The EU levy on non-recycled plastic packaging waste of EUR 0.80 per kilogram was introduced in January 2021 for its Member States. Each Member State can choose how to finance the EU plastics waste levy. This is likely to lead to the introduction of a round of related taxes (OECD, 2022[30]) (see also Table A D.3). A tax on virgin plastic could stimulate the use of recycled plastics, or renewable and more durable alternatives. These measures can "push" recycling supply by increasing the quantity of material collected for recycling (OECD, 2018[31]). However, the plastic tax implementation could be complex and requires further assessment (OECD, 2018[31]).

Table A D.3. Recent developments in plastics taxes

Country	New legislation?	Description
Spain	Yes	A new tax on non-reusable plastic packaging and certain semi-finished products, likely effective from January 2022. Rate: EUR 0.45 per kilogram.
Italy	Yes	A new tax on single-use Plastic items and packaging and certain semi-finished products, likely effective from January 2022. Rate: EUR 0.45 per kilogram.
U.K.	Yes	Plastic packaging with less than 30% recycled plastic and imported plastic packaging, effective as of April 2022. Rate: GBP 200 per tonne of plastic packaging. An exception applies to users of less than 100 tonnes.
U.S.	Possibly	California is considering a tax on single-use plastic packaging and food ware sold in the state, at a maximum of USD 0.01 per item, to be introduced in 2022 under the California Recycling and plastic pollution reduction act of 2020 (Ballotpedia, 2021[32]; Legislative Analyst's Office, 2019[33]).
Poland	Possibly	The country announced that Poland will implement new legislation soon, most likely a new tax on single-use plastic packaging.
Sweden	Possibly	The country announced that Sweden will implement new legislation soon.
The Netherlands	Possibly	The country prepared a study on the impact of introducing a national tax on virgin plastic (CE Delft, 2021[34]).
Belgium	Unlikely	It is anticipated that the costs of this levy may be passed on to producers and users of plastics packaging, via EPR. These organisations would pay the levy to the Belgian Federal Government and would in turn pass it to their corporate members (such as packaging producers, users of packaging, and retailers), through an increase in the EPR fees paid by the members (EY, 2020[35]).
France	Unlikely	Probably through increased EPR fees. France already has a bonus-malus system for plastics packaging within the EPR scheme since 2019.
Luxembourg	No	No new legislation expected. The EU levy would be paid from the state budget.
Germany	No	No new legislation expected. The EU levy will not be passed on for the moment.
Slovak Republic	No	No new legislation expected. The EU levy would be paid from the state budget (Raábová, 2020[29]).
Czech Republic	No	No new legislation expected. The EU levy would be paid from the state budget (Envigroup, 2020[36]).

Source: Adapted from EY (2021[37]) and other sources as specified in the table.

Key design aspects of such a plastics tax include deciding on the scope of the tax, i.e. where in the value chain and on what products/materials the tax should be imposed, and the actor(s) who will bear the ultimate costs of the tax. For example, a tax can be envisaged for intermediate goods or materials (e.g. monomers

or resins), final single-use plastic products (applicable to consumers, producers or importers) or plastic waste (e.g. through pay-as-you-throw schemes) (Cornago, Börkey and Brown, 2021[38]). Depending on where the tax is imposed, there will be different behavioural, environmental and economic implications (these are discussed in Cornago, Börkey and Brown (2021[38])). Innovation will become increasingly important to businesses coping with the changes, as they will explore new ways to produce plastic, and thus avoid the levy (EY, 2021[39]).

Reductions in VAT for repaired, refurbished, upcycled or second-hand products

Countries also employ a diversity of tax benefits to stimulate upstream circular production strategies to use more recycled materials or upcycled and remanufactured products.

The Slovak Republic could extend the list of goods and services to which a reduced VAT applies to include repair services, the sale of refurbished, upcycled or second-hand products. For example, repair services are often very labour intensive small-scale activities involving local shops. A reduced VAT rate on repairs could increase the ability of local shops to offer repair and maintenance services (Milios, 2021[40]). Even though the EU Directive 2006/112/CE on a common system of value added tax regulates the EU internal market, the Directive gives Member States some discretion to set reduced tax rates for some activities. Several EU Member States have opted for reducing VAT for repairing activities (Box A D.3). Reduced VAT rates on repairs and reuse are also not expected to have negative implications for the functioning of the internal market as such products are often not traded (Copenhagen Economics, 2007[41]).

VAT reduction could also be applied to second hand goods. In France, the collection and sale of used goods carried out by social enterprises are exempt from VAT because their activities are linked to the employment of disadvantaged and disabled people. This is a charity-oriented initiative that, nevertheless, contributes to waste prevention (Reeuse, 2017[42]). However, to avoid the competitive impediment to the development of similar activities on a commercial basis, the VAT relief should apply to all operators on the market regardless of their commercial status.

Box A D.3. Examples of Value Added Tax reductions contributing to circular economy goals

VAT reductions for repair services across the EU Member States

VAT reductions for repair services have been introduced in Sweden, Ireland, Luxembourg, Malta, the Netherlands, Poland, Slovenia, Finland and recently also in the Czech Republic. In Sweden, since 2017, VAT was reduced from 25% to 12% for repair of bicycles, shoes, clothes and other textiles. In addition, 50% of the labour costs of repairing large appliances are deductible from the personal income tax up to a maximum of KR 25 000/year (EUR 2 385) or KR 50 000/year (EUR 4 770) for people above 65 years old (EEA, 2019[43]; Reeuse, 2017[42]). Since labour income taxes are high in Sweden this is a measure that has substantially altered the relative attractiveness of repair versus new replacement purchases. The reduced VAT rate of 10% for certain repair services (e.g. repair of footwear and leather products, repairs and adjustments of clothing and textile products) was introduced in the Czech Republic from 1 May 2020 (OECD, 2021[27]).

Recycled content mandates

Recycled content mandates typically take the form of a regulatory requirement for producers of a certain type of product to use a minimum percentage of recycled material in their newly produced product. This could be, for example, a requirement to use x% minimum recycled content in the production of plastic drinks bottles, or minimum requirements for recycled content in paper manufacture. Requirements for recycled content are relatively rare but are increasingly discussed in the context of plastics waste management (International Resource Panel, 2020[9]).

The EU targets on the minimum recycled content of PET bottles have been transposed into the Slovak legislation. The Slovak Republic also introduced a Deposit-Refund System (DRS) for single-use PET bottles (and cans) from January 2022 to help the country achieve the EU targets on PET bottles (see Box A D.9.).

The Slovak Republic could explore the option of introducing additional minimum recycled content mandates for plastics or other materials, such as construction materials. These policies aim to "pull" demand for secondary materials by setting a requirement or incentive for the composition of products or packaging. In turn, demand can help to instigate improved supply of secondary material as an input for regulated products (OECD, 2022[30]). Minimum recycled content requirements are less well established interventions and are more challenging to implement but they could have a significant impact. The minimum recycled content requirement could be imposed with legal force, as direct regulation, or it could be applied indirectly, for example through a voluntary agreement, in the context of an environmental tax, in the context of a system of EPR through eco-modulation or in the context of green public procurement. The EC proposed to implement minimum recycled content requirements as part of the proposed Regulation on Eco-design for Sustainable Products (European Commission, 2022[11]). Box A D.4. provides examples of international practices on how recycled content mandates were implemented within the different policy instruments.

Box A D.4. Examples of the application of minimum recycled content requirements

As direct regulation

The EU Single-Use Plastics Directive requires plastic bottles to be made of at least 25% recycled content by 2025 and 30% recycled content by 2030 (EU Single-Use Plastics Directive).

Through a Voluntary Agreement

The Netherlands launched the Dutch Plastic Pact (Plastic Pact NL) in 2019 to make single-use plastic products and packaging more sustainable and suitable for reuse. This Voluntary Agreement includes four targets, one of which requires single-use plastic products to contain at least 35% of recycled plastic (RIVM, 2020[44]).

Within the context of a tax

From 2022, the UK will apply a tax (GBP 200 per tonne) on plastic packaging with less than 30% recycled material (HM Revenue & Customs, 2020[45]).

In Italy, a series of fiscal incentives, mainly in the form of tax credits for enterprises, have been introduced to discourage the use of virgin materials and incentivise the use of recycled or compostable materials. These include the following provisions:

- Tax credits for enterprises that apply to the purchase of products made out of recycled plastics, packaging containing recycled paper, plastics or aluminium, as well as biodegradable packaging (introduced via the 2019 Budget Law). Tax credits would correspond to 36% of expenses incurred by enterprises, up to a maximum annual amount of EUR 20 000.
- Tax credits for enterprises that apply to the purchase of i) intermediary and final products composed (for at least 75%) of materials from the recycling of waste or of scrap materials, and ii) high-quality compost produced from the treatment of organic waste (introduced via Legislative Decree 34/2019). Tax credits correspond to 25% of expenses incurred, up to a maximum annual amount of €10 000.

In an EPR scheme through eco-modulation

EPR fees can be modulated in line with the share of recycled materials in the product to incentivise such design-for-environment. For example, products that verifiably meet thresholds for recycled content could receive a bonus resulting in a lowered fee. Some PROs have started to experiment with incentives to increase recycled content. For example, in France, a 50% fee reduction is provided for PE and PP packaging with at least 50% recycled content (CITEO, 2019[46]; Laubinger et al., 2021[47])**.**

Within a GPP system

The Japanese Act on Promoting Green Procurement and its related Basic Policy on Green Procurement specifies environmental criteria to be considered when purchasing goods and services by the government or by its administrative agencies (Ministry of the Environment Government of Japan, 2000[48]). The environmental criteria include, among other things, recycled content criteria for pulp and plastics used in the products designated for procurement. For example, the higher the recycled content share in an evaluated good, the higher the evaluation score for that good. For some of the goods, the policy requires minimum recycled content requirements. This is the case for example, for coated inkjet colour printer paper where at least 70% recycled pulp content is required, or for stationery products where items containing plastics contain at least 40% recycled plastics in weight of the total plastics and items containing paper contain at least 50% recycled pulp. GPP is mandatory for government agencies across a wide array of product categories.

In Italy, since 2016, all public entities are obliged to apply GPP criteria for products and services for which GPP criteria have been defined (Italian Public Contract Code). For some products, the presence of recycled content constitutes an award criterion that improves the evaluation score for the good or service. This is the case for instance of GPP criteria for textile products that reward the presence of recycled textile fibres or of by-products from industrial symbiosis processes as well as goods prepared for reuse and the presence of additional repair and maintenance services offered for the goods supplied (Ministerial Decree 30/06/21). Specific voluntary labelling and certification schemes enable companies to declare compliance with GPP criteria (both minimum and award criteria), such as the Remade in Italy environmental certification for recycled content. Moreover, minimum recycled content requirements constitute eligibility criteria to benefit from certain tax benefits measures targeted at enterprises.

Any design of the instrument in the Slovak Republic would need to consider the key challenges to the implementation of minimum recycled content requirements. Recycled content mandates face challenges when applied to more complex materials and products, with less well established recycling markets (Dalhammar, 2016[49]; Mayers, 2016[50]; Iida, 2011[51]). The literature suggests that the main (interrelated) issues are market competitiveness and compliance as well as the potential trade-off between environmental quality and product quality (Iida, 2011[51]). Moreover, recycled content mandates can impose high administrative costs on producers, in particular those with long, complex and multinational supply chain (International Resource Panel, 2020[9]). When setting minimum recycled content requirements, it is important to ensure that the demanded recycled materials are available on the market in sufficient quantity and quality. Otherwise, there could be supply risks leading to a decrease in quality of the products (Motúzová, 2021[52]). The Slovak Republic would need to take into account all these considerations when making the decision to implement a form of recycled content mandates.

Linking product design to end-of-life disposal costs

Extended Producer Responsibility schemes

An EPR scheme consists of several policy instruments that alone or in combination make producers responsible for their products at end-of-life. The vast majority (72%) of surveyed EPRs use take-back

requirements as their key policy instrument, followed by advance disposal fees (16%) and deposit-refund schemes (11%) (Kaffine and O'Reilly, 2013[53]). EPR schemes are well-established interventions with a potential significant impact. An EPR scheme can be applied to a large variety of products, the most important being electronics (35%), tyres (18%), packaging (17%) and vehicles/auto batteries (12%) (OECD, 2016[54]; Kaffine and O'Reilly, 2013[53]). For example, France has implemented 14 EPR schemes between 1992 and 2016, including products such as graphic papers, textiles, pharmaceuticals, furniture and dispersed hazardous waste in addition to the most commonly used products such as packaging, tyres, ELV, WEEE and batteries (OECD, 2016[54]).

The current EPR schemes in the Slovak Republic were set up in 2016. They are regulated by the Waste Act No. 79/2015 and by the Decree No. 373/2015 Coll. of the Ministry of Environment of the Slovak Republic on the Extended Producer Responsibility of Certain Products and on the Management of Certain Waste Streams. Since 2016, both pieces of legislation have gone through numerous amendments. Currently, PROs in the Slovak Republic exist for the following product groups: (1) electrical equipment, (2) batteries and accumulators, (3) packaging and certain other products, (4) vehicles, and (5) tyres. Slovak PROs operate in a competitive market where several PROs are authorised for each product group, who represent the majority of producers placing such products on the Slovak market. The Waste Act also includes a set of separate collection, recovery and recycling targets for the different products and materials covered by existing EPR schemes, which are primarily based on EU targets.

The data show that the Slovak EPR systems have been effective in reaching the relevant EU recycling and recovery targets as well as collection targets, and the country achieved or is likely to achieve the 2025 and 2030 targets (Ministry of Environment of the Slovak Republic and Slovak Environment Agency, 2020[55]). However, analyses and certain stakeholders raised concerns about the extent to which current EPR systems provide for a stable environment and to which extent the producers' financial contributions within the collective PRO systems reflect the materials' environmental impacts (Dráb, Engeľ and Krištofóry, 2020[56]; Rojko, 2021[57]; Hudec, 2020[58]).

Until January 2021, Slovak PROs charged very low, non-modulated fees per material to their clients, as a result of which certain Slovak municipalities were unable to finance separate collection of recyclables (Hudec, 2020[58]).[1] The competition among PROs also led to prices for materials, which did not reflect the material's environmental impacts (Dráb, Engeľ and Krištofóry, 2020[56]). The recent amendment to the Decree of the Ministry of Environment on EPR introduced a set of modulated minimum fees for batteries and accumulators, and for packaging and certain other products, effective from January 2021 (Table A D.4). These minimum fees differentiate per type of battery and accumulator (portable, vehicle and industrial battery or accumulator) and per type of packaging or other material/product (glass, plastics, paper, composite packaging and metal packaging). Such fees could be seen as basic modulated fees according to the OECD typology of fee modulation (Box A D.5.).

Table A D.4. EPR modulated fees in the Slovak Republic

Fees to determine the cost of separate collection and recovery of packaging waste and waste from certain other products

Item		Minimum rate (EUR/tonne)
Glass		100
Plastics		550
Paper	Paper and cardboard	120
	Newspapers and magazines	50

[1] The fees as set out in the Decree have been effective only as of January 2021 due to an opposition from manufacturers to change the old system of non-modulated fees per tonne of material.

Cardboard based composite packaging	550
Metal packaging	25

Note: The rates are valid from 1 January 2021 and exclude VAT.
Source: Annex No. 12a of the Decree no. 373/2015 Coll. of the Ministry of the Environment of the Slovak Republic on the Extended Producer Responsibility of Certain Products and on the Management of Certain Waste Streams.

Box A D.5. Modulation of PRO fees: basic vs advanced fee modulation

Modulation of PRO fees can take a number of forms, which has an impact on the extent to which fees reflect the waste management costs of a material or product. The OECD examined and analysed the different types of fee modulation within the context of EPR in its recent publication. The report identifies and assesses two basic categories of fee modulation:

- Basic EPR fee modulation – which applies rather simple averages per material (weight) or product type, based on measurable end-of-life cost differences; and
- Advanced EPR fee modulation – which applies more detailed criteria, such as recyclability or the presence of hazardous substances.

Level of Modulation	Methodology	Life cycle Stage	Modulation Type	Criteria examples	Issues or Considerations
Basic	Granularity (Allocation of approximated EoL costs)	End of Life (EoL is the focus)	"Basic"	Product Type, Weight, Source (post-consumer and post-industrial) used as a proxy for EoL costs	• Costs of design choices are not internalised by each producer; • Incentive to lightweight, even at expense of recyclability
Advanced	Granularity (Allocation of actual EoL costs, where possible)	End of Life	"Advanced EoL with Granularity"	Recyclability, Recycling Rate, Presence of Hazardous Substances, Consumer Awareness	• Additional complexity • Determining of exact EoL costs can be challenging • Potentially limited incentives for design change by producers
	Bonus/malus (Bonus/malus adjustments to basic fee)	End of Life	"Advanced EoL with Bonus/Malus"	Recyclability, Recycling Rate, Presence of Hazardous Substances, Consumer Awareness	• Arbitrariness: in some cases, fee adjustment is not tied to actual cost differences of the design change; • Additional complexity
		Life cycle (Aspects of all life cycle stages, beyond EoL, can determine fee modulation)	"Advanced Life cycle with Bonus/Malus"	Recycled Content, Product Lifespan	• Arbitrariness: in some cases, fee adjustment is not tied to actual cost differences of the design change; • Additional complexity

Source: Laubinger et al. (2021[47]).

The introduction of basic modulated fees should help firms and PROs in the Slovak Republic meet their EPR obligations and provide more financial stability to the system, in particular within the context of the newly introduced DRS system for PET bottles. The DRS for PET bottles is likely to shift some of the revenues from the sale of PET bottles for recycling from the existing PROs to the DRS operator, which might lead to financial difficulties to cross-subsidise the collection and treatment of non-recyclable materials if no fee modulation will be introduced.

The Slovak Republic needs to introduce mandatory eco-modulated fees within the country's collective EPR schemes to support design-for-environment goals of the designated products. The introduction of eco-modulated fees could consider the forthcoming EC guidance on EPR fee modulation, which should include a set of harmonised criteria to be applied across the EU. "Eco-modulation" of EPR fees reflects the characteristics of products that affect their end-of-life waste management costs, or even all aspects of product life cycle, where PROs charge higher fees for products containing toxic materials, or hard-to-recycle composite materials, for example, and lower fees for products which are easy to recycle or which contain high recycled content. In the OECD typology of fee modulation, this would refer to advanced fee modulation (Box A D.5.). The country's EPR system requires further changes to its financing structure to enhance the system's effectiveness and incentives for design-for-environment. This is in particular the case for EPRs dominated by collective PROs. Existing literature points towards a conclusion that a crucial element in determining the extent to which EPR incentivises design-for-environment is whether individual firms face costs of waste management that are directly-related to the particular characteristics of the products that they themselves have produced (Walls, 2006[59]). The evidence suggests that this is often not the case in collective PRO schemes. In a collective PRO, a crucial policy choice which underpins the effectiveness of EPR is the design of the fee governing the financial contributions of firms to the PRO. Firms will only face clear incentives to reduce end-of-life costs and improve the design of their products through, for example adopting high recycled content in their products, if the fees that they have to pay to the PRO are "eco-modulated" to reflect the environmental characteristics of products, such as recyclability or product lifespan (OECD, 2021[27]). Basic weight-based modulated fees (as those introduced by the Slovak Republic) do not tend to fulfil such design objectives as they could incentivise design of lighter products and packaging ("lightweighting") rather than design aimed at recyclability, reparability or reuse of products (Laubinger et al., 2021[47]).

Devising a structure of EPR fees which is appropriately modulated to reflect waste management cost differences is a challenging requirement to meet, particularly for complex products, but it is crucial for the ability of EPR to incentivise waste-reducing innovation.

The Slovak Waste Act was amended to transpose the revised EU Waste Framework Directive, including the addition of a provision to the Waste Act on eco-modulation of PRO fees towards their clients based on criteria such as durability, reparability, reusability, recyclability and the content of toxic substances. However, the obligation to implement eco-modulated fees into practice has been postponed to 2022 until the European Commission (EC) publishes a guidance on EPR fee modulation, including a harmonised set of criteria to be applied (Hudec, 2020[58]). According to the revised EU Waste Framework Directive, all EU Member States shall ensure that PROs operating in their national markets are charging eco-modulated fees, where possible, from January 2023. The EU Single-Use Plastics Directive also states that by 2030 all plastic packaging placed on the EU market is re-usable or easily recycled. The eco-modulation could be seen as a transition period within the context of the ban.

With regard to EC's plans to mandate the use of eco-modulated EPR fees, the Slovak Republic could already reflect on the different criteria and types of advanced modulated fees within the country's context. The recent OECD study on EPR fee modulation could provide a good starting point for such preparatory work (Laubinger et al., 2021[47]). Other relevant studies include the work of the Slovak Institute of Environmental Policy on EPR (2020[56]) or Hogg et al.'s (2020[60]) study to support the preparation of the EC's guidance, which discusses the rationale for granular EPR fees and proposes modulation criteria in different sectors. The OECD study summarises the key elements to take into account when setting up EPR fee modulation.

The Slovak Republic must also ensure that the competitive EPR systems are cost-effective and monitored. A particular problem appears to be the multiplicity of separate country-driven systems for the different product groups, with potential poor coordination between them, and lack of monitoring in performance and financing (Rojko, 2021[57]). This raises concerns about the stability of the systems. Consolidation of the multiple separate EPR schemes per product group together with regular monitoring

and an appropriate clearing mechanisms could help the Slovak public authorities to ensure transparency and equitable financing. Transparency is important to help public authorities audit the recycling and recovery performance of EPR operators, assess whether the system is really incentivising long-term waste-cost-reducing innovation and to ensure that the financing rules of the system are treating all firms equitably (OECD, 2021[27]).

Moreover, modulating EPR fees in competitive EPR systems, as is the case in the Slovak Republic, requires careful consideration. A nationwide, prescribed EPR fee schedule would establish a level playing field for PROs, but removes the possibility for PROs to compete in modulation methods. Also, prescribed fixed fee modulation risk that EPR fees divert from measurable differences in end-of-life costs. Instead, fee modulation could prescribe relative price changes (e.g. a 10% increase in fees for non-recyclable products, and a percentage bonus for products that meet criteria for "design-for-environment" [DfE]). Alternatively, a central authority could add a bonus or malus adjustment (e.g. a EUR 0.01 increase per kg of non-recyclable products) to the final EPR fee. A nationwide system for bonus and malus adjustments would allow PROs to still compete on the pre-adjusted EPR fees. For example, fee modulation along ecological criteria is required for the EPR for packaging in Germany despite the presence of multiple PROs. The independent central authority (Stiftung Zentrale Stelle Verpackungsregister), in agreement with the Federal Environment Agency (Umweltbundesamt), sets a minimum standard for packaging recyclability which is updated annually. PROs are required to modulate fees based on the minimum standard set by the central authority.

The Slovak Republic could also consider extending the EPR system to new product groups in the medium- to long-term. The country's EPR systems appear to be effective in reaching the EU and national recycling and recovery targets. This may make EPR a good policy tool for additional product groups, if the goal is to achieve higher recycling rates as well as more circular product design. For example, the EU Single-Use Plastics Directive will require Member Countries to implement EPR schemes for tobacco product filters by 2023 (the directive will also require EPR for balloons and sanitary wipes) and fishing gear by 2025 (EU Lex, 2019[61]). France introduced an EPR scheme for construction products and materials from the building sector in 2022 (Journal Officiel de la République Française, 2021[62]). Two conditions could provide a good rationale for expansion of EPR to certain product group (OECD, Forthcoming[63]):

- A product group exhibits relatively high cost of end-of-life management. This can be due to strict and costly requirements for the environmentally sound treatment of a specific end-of-life product or due to the large waste volume and high share in overall waste.
- There are opportunities for an EPR scheme to instigate changes in producer behaviour that lead to waste reduction, improved end-of-life handling, or impact reduction during other phases of a product's life cycle.

In particular, setting up an EPR scheme for textiles could be a policy instrument that could help the Slovak Republic comply with the EU obligation to separately collect and achieve a high recycling rate of textiles by 2025. The European Commission will propose harmonised EU EPR rules for textiles with eco-modulation of fees as part of the forthcoming revision of the Waste Framework Directive in 2023 (European Commission, 2022[64]) Currently, only France from the EU Member States has a functioning EPR for textiles (see Box A D.6.), and Sweden plans to implement such a system from 2022 (Ecotextile News, 2020[65]). However, the cost and benefit of introducing an EPR for textiles in the Slovak Republic requires further assessment.

Box A D.6. EPR for textiles and clothing

Several markets and regional organisations are considering whether to adopt EPR measures for textiles. At EU level, the European Commission is treating the textiles sector as a priority industry under the new Circular Economy Action Plan. Under discussion is also an EPR policy approach, which would use an EU Directive to mandate that Member States introduce national legislation (McKenzie, 2020[66]). At the national level, Sweden plans to introduce an EPR for textiles from 2022 and England plans to review and consult on an EPR for textiles. Several markets and regional organisations are considering whether to adopt EPR measures for textiles. At EU level, the European Commission is treating the textiles sector as a priority industry under the new Circular Economy Action Plan. Under discussion is also an EPR policy approach, which would use an EU Directive to mandate that Member States introduce national legislation (McKenzie, 2020[66]). At the national level, Sweden plans to introduce an EPR for textiles from 2022 and England plans to review and consult on an EPR for textiles.

EPR for textiles and clothing in France

The EPR scheme for textiles was introduced in 2007 under Article L-541-10-3 of the Code de l'Environnement. This placed obligations on firms in the textiles and clothing sector in France to ensure a given standard of recovery and recycling. Forms could achieve this directly, through their own actions, or by contributing to an accredited PRO. In practice a single non-profit PRO, Eco-TLC (Eco-organisme du textiles, du linge et de la chaussure), has emerged as the sole vehicle for collective action in this sector. It was initiated in 2008 by a consortium of some 30 large retailers, manufacturers, wholesalers and industry organisations. It currently has around 4,200 members making financial contributions to discharge their EPR liability. These include manufacturers, importers and distributors, responsible in total for around 625,000 tonnes of sales in 2018 (Eco-TLC, 2019[67]).

Member contributions are based on the previous year's sales of items in four size categories of clothing, and two categories of footwear. The contribution for a clothing item of average size was about EUR 0.8 cents in 2016 (Bukhari, Carrasco-Gallego and Ponce-Cueto, 2018[68]). Reduced contribution rates ("eco-modulation") apply to producers of hard-wearing and sustainable products, and to producers that can demonstrate a content of recycled fibres in their production. However the application of these reduced rates appears limited to less than 1% of total output (Eco-TLC, 2019[67]), apparently because the benefit of the reduced rates is insufficient to warrant the audit documentation that must be supplied (Bukhari, Carrasco-Gallego and Ponce-Cueto, 2018[68]).

Eco-TLC provides financial support for sorting and recycling facilities owned by private operators, including the non-profit Le Relais and Emmaüs organisations. Subject to meeting various performance and traceability requirements, a rate of EUR 65 per tonne is paid for items sent for reuse and recycling, and EUR 20 per tonne for items sent for energy recovery. Higher rates are paid to operators hiring disadvantaged workers (Bukhari, Carrasco-Gallego and Ponce-Cueto, 2018[68]). These subsidy payments account for about two thirds of the approx. EUR 17 million revenues from member contributions, and much of the remainder is devoted to consumer awareness campaigns and to funding innovative demonstration projects and research (Eco-TLC, 2019[67]).

Some 240,000 tonnes of clothing was collected and processed through the system in 2018, equivalent to about 38% of clothing sales during the same period. Of the total collected, about 59% is re-used. Nearly all of the remainder is used for recycling (in particular, processed into insulation materials) and energy recovery, and less than 1% is discarded in landfill (Eco-TLC, 2019[67]). Only about one tenth of the reused items are sold locally, and the remainder is exported to other countries, particularly in Africa.

Source: OECD (2021[27]; Forthcoming[63])

Green public procurement (GPP)

GPP schemes are well-established interventions with a potential significant impact and which are supported by a number of practical guidelines and tools (in particular at EU level). The evidence shows that all OECD countries have developed strategies or policies to support GPP and around 70% of OECD countries are measuring results of their GPP policies and strategies (OECD, n.d.[69]). By using the purchasing power of governments, GPP can be a major driving force towards the circular economy, innovation and other sustainability goals, including the potential to expand the size of the market for remanufactured or recycled products.

The Slovak Republic has had a GPP system in place since 2007, when the first National Action Plan (NAP) on GPP was approved. The latest, and third, NAP on GPP was for the period 2016-2020. Until 2020, the GPP system in the Slovak Republic belonged to voluntary environmental policy instruments. Nevertheless, the NAP GPP III for the period 2016-2020 contained concrete obligations for the state to pursue green public procurement. The NAP GPP III included a target to achieve a 50% share of GPP contracts out of the total public procurement for specific 12 product groups by 2020 (Ministry of Environment of the Slovak Republic, 2016[70]). The Envirostrategy to 2030 extended this target to all procured products and services and increased it to 70% (in volume and value of contracts) by 2030 (Ministry of Environment of the Slovak Republic, 2019[71]). The NAP GPP III advocated for the mandatory application of specific environmental characteristics for three product groups – 'Copy and graphic paper', 'Office IT equipment/computers and monitors' and 'Vehicles and transport services'. The Slovak Government approved the mandatory application of relevant environmental criteria in the procurement of these three product groups by ministries and other key public bodies on national level in July 2020 in its Government Resolution No. 92/2020 (2020[72]). Such a mandatory application of GPP criteria by state-level administration bodies was extended to 'Cleaning products and services' in February 2021 by a Government Resolution No. 80/2021 (2021[73]). Nevertheless, the Slovak ministries can still exercise a large discretion as to which criteria they choose to apply when evaluating the offers. This has been also demonstrated in a recent OECD review of the public procurement practices in the Slovak Republic, which showed that the vast majority of public procurement procedures and procurement volume was still based on applying strict economic efficiency criteria, i.e. awarding public contracts based on the lowest price criteria (2021[74]).

The new amendment to the Public Procurement Act No. 343/2015 Coll. (Amendment No. 395/2021 Coll.) taking effect in April 2022 is a first step towards the inclusion of environmental considerations in public procurement in the Slovak Republic. The amendment requires that state-level entities include environmental aspects in public procurement (as a separate requirement to fulfil the contract or as an award criterion) in at least 6% of annual contracts, while other public entities, procuring at least 10 contracts per year above a certain value, can reach these 6% annually in combination with contracts including social aspects (i.e. the 6% can be reached by contracts with environmental or social considerations).

The Slovak Republic could gradually strengthen the use of GPP criteria in awarding contracts for all public entities and extend their mandatory application by state-level entities to additional product groups in the short-term, for example when procuring food and catering services. A monitoring report of the NAP GPP III for the year 2020 concluded that while the 50% target by 2020 was not achieved, the GPP share of public procurement contracts increased from 3.6% in 2019 to 32% in 2020 (in volume) for the procurement of 12 product groups covered by NAP GPP III (Ministry of Environment of the Slovak Republic, 2021[75]). Public procurement of copy and graphic paper achieved the best performance as 68% (in volume) of contracts in 2020 procured by state-level bodies were GPP contracts (or 64% in volume of contracts overall) (Ministry of Environment of the Slovak Republic, 2021[75]). The Slovak Ministry of Environment is in consultation with a number of expert groups to discuss the option of making GPP mandatory for certain additional product groups as well as how to support a wider implementation of GPP through soft measures (e.g. education and information awareness tools) (Odpady-Portal, 2021[76]). Gradually increasing the mandatory use of GPP criteria and extending them to additional product groups in the Slovak Republic would be a timely regulatory intervention, as the European

Commission proposed on 30 March 2022 a Regulation on Eco-design for Sustainable Products, which empowers the EC to establish mandatory GPP criteria for products covered by this regulation and phase-in mandatory reporting on GPP (European Commission, 2022[11]). As an example, since 2016 Italy applies mandatory minimum environment criteria to be used by all public entities for, among others, public lighting, energy services, furniture, paper products, electric and electronic equipment, the supply and rental of textiles (including medical devices and personal protective equipment), municipal waste management and construction works (the Italian Public Contract Code).

Moreover, relying on environmental criteria (in particular those related to circular economy principles) in addition to financial criteria when awarding public contracts could stimulate the use of circular product practices and the supply of products that are more circular. Within the Slovak context, a gradual introduction and application of such award criteria would give companies the necessary time to adjust to compete on "green" criteria rather than solely on price, which has been the practice until now. The recent amendment (No. 395/2021) of the Public Procurement Act goes in the good direction but in the medium-to long-term the legislation mandating GPP will need to maintain sufficient degree of flexibility for both the public entities as well as bidders to allow for stronger incentives for bidders to compete on green criteria (rather than to compete only on the prescribed minimum requirements set by law). The legislative initiatives could be supported by a catalogue of national good practices to showcase the benefits of GPP to potential bidders.

EU studies show that the uptake of GPP strongly correlates to the existence or absence of an eco-label scheme and that eco-labels play an important role in implementing GPP solutions (OECD, 2015[77]). The practice in other countries shows that GPP can be implemented on a voluntary basis (i.e. it is not mandated by law) and still achieve a good performance while some other countries have leaned towards requiring all public entities to apply minimum GPP criteria for products and services for which GPP criteria have been defined (e.g. Italy). The European Commission has developed a set of sector specific life cycle costing calculation tools, which could be used more widely by Slovak public procurers to evaluate the cost of the product/service during its entire lifetime rather than consider the purchase price only. However, informal discussions with contracting authorities have shown that the language barrier is an obstacle to making greater use of these tools, as these tools are currently available only in English. The Slovak Republic may also wish to consider developing a tailored methodology to help assess the quality of bids on criteria other than price, as the Dutch Department of Public Works of the Ministry of Infrastructure and Water Management has done for procured infrastructure projects (OECD, 2014[78]). To mainstream greener production processes in companies, the Slovak Republic could even consider restricting selection criteria for public procurement of certain products and services to companies with demonstrated commitments to greener production. An example of such a practice is the United Kingdom's consideration of carbon reduction plans in the procurement of major government contracts with a contract value above GBP 5 million per year. This requirement asks bidding suppliers to include their carbon reduction plans as a selection criterion (UK Government, 2021[79]). While this may exclude some suppliers of such services from bidding, the financial incentive appears to be large enough for companies to adopt such plans. The downside of such a requirement is the need for sufficient internal capacity on the side of public entities to be able to monitor such commitments by companies.

The country could also consider the option of introducing minimum recycled content requirements within GPP for additional products and materials, such as for paper and plastics for office supplies, furniture or construction products in the medium to long-term. Within the context of the work on recycled content requirements, the Slovak Republic may consider implementing minimum recycled content requirements in its GPP regulatory framework first for specific products, such as for example for construction products (as required in the Slovak Recovery and Resilience Plan).[2] The European

[2] Recycled content of pulp is already one of the environmental characteristics to be looked at when procuring office paper in the Slovak Republic.

Commission will also propose the introduction of mandatory recycled content requirements for products, including construction products as part of the proposed Regulation on Eco-design for Sustainable Products (European Commission, 2022[11]), which could be used as reference material in this regard. If the Slovak Republic wishes to go beyond the announced EU initiatives, the country may look at the example of Japan, which introduced minimum recycled content requirements in its GPP legal framework for paper and plastics used in procured stationery products, office furniture and equipment but also which applied additional circularity criteria, such as the minimum rates of dismantle-possibility for office furniture, the minimum share of plant-based plastics used in procured products or additional design for environmental criteria (Ministry of the Environment Government of Japan, 2000[48]) (see also Box A D.4.). There are also cases in Italy where public authorities have used the presence of recycled content in a textile product as an award criterion.

Enhancing business R&D and eco-innovation

The Slovak Republic will need to reform the research, development and innovation regulatory environment in the country as barriers to innovation go beyond eco-innovation. R&D and innovation is a clear national priority targeted by several key strategic documents and supported by national and European funding instruments. The country review reports by the European Commission (Eco-innovation Observatory, 2020[80]; European Commission, 2019[81]) and the OECD (Ministry of Environment of the Slovak Republic, 2018[82]; OECD, 2021[83]) also highlight the numerous barriers to greater R&D and innovation in the country, including eco-innovation.

The Slovak Republic ranked as 23rd on the 2019 Eco-Innovation Scoreboard with a score of 62, below the EU average of 100. This means that the Slovak Republic's relative position remains unchanged but its score decreased from 68 to 62, showing that it is lagging in terms of its European peers (Eco-innovation Observatory, 2019[84]). Its relatively low score is due to both low R&D investment and a fragmented eco-innovation policy framework (European Commission, 2019[81]). Within the Eco-innovation index, the Slovak Republic is still a below average performer for material productivity-related innovation. Some of the obstacles to stronger eco-innovation are low public awareness translating to weak demand for such products and services, low private sector investment, low public funding for business R&D spending, and mismatch in tertiary skill levels (European Commission, 2019[81]). These obstacles may not only hinder the emergence of stronger eco-innovation trends but could also be a source of relative slowdown leading to decrease.

Economic and financial incentives

The key economic instruments to support R&D in green technologies and eco-innovation are tax benefits. R&D tax benefits may take the form of a tax reduction or a tax relief for specific R&D activities. For example, companies working on innovative projects in the UK have different types of R&D reliefs available to them depending on their size or the type of contract (i.e. whether the company is a subcontractor or the lead contractor) (Government UK, 2020[85]). It offers a specific R&D relief for SMEs, which can deduct an additional 130% of their eligible costs from their yearly profit margins in addition to the regular 100% deduction, in total equalling to 230% deduction. SMEs can also claim a tax credit of up to 14.5% of the surrenderable loss[3] if the company is loss making. Large companies can claim an R&D expenditure credit up to 13% from 1 April 2020. In the Netherlands, several tax incentive schemes for innovation and R&D exist. As an example, there are two tax incentive schemes for investing in environmentally friendly technology. The MIA scheme – Environmental investment deduction scheme – allows an entrepreneur to deduct up to 36% of the investment costs for an environmentally friendly investment on top of the regular

[3] Surrenderable loss in this sense means that the company can surrender its losses to receive a cash benefit equal to 14.5% of surrenderable loss. This means the company cannot carry such loss forward and offset it against profits made in the future.

investment tax deduction, and a Vamil scheme – Arbitrary depreciation of environmental investments schemes – allows the entrepreneur to decide when to write off 75% of the investment costs. The latter provides an advantage with regard to liquidity and interest (Netherlands Enterprise Agency, n.d.[86]; OECD, 2021[27]).

There is currently no dedicated economic instrument to support eco-innovation in the Slovak Republic besides an R&D tax support instrument and subsidies available from the European Structural and Investment Funds (ESIF). The R&D tax allowance and tax relief hybrid instrument allows Slovak firms to receive tax benefits for their R&D expenditures related to machinery and equipment, and buildings and land. The instrument is regulated by the Income Tax Act No. 595/2003 and Act No. 185/2009 on R&D incentives. The OECD described and assessed this instrument in its R&D tax incentive compendium (2021[87]). Even though the Slovak R&D tax support instrument is relatively generous, where the R&D tax allowance was increased from a rate of 150% possible deduction of eligible R&D expenditures from the corporate income tax base in 2019 to 200% in 2020 and the scope of the instrument was extended to additional recipients, the Slovak Republic is among the countries with the lowest level of government support to business R&D as a percentage of GDP, at a rate of 0.04% of GDP in 2018 (OECD, 2021[87]). This is so even among its Visegrad 4 peers (OECD, 2021[88]). To put the number in context, an EU average rate of government support to R&D was equivalent to 0.17% of GDP, and countries, such as France achieved a rate of 0.4% of GDP (OECD, 2021[88]). However, the Slovak Republic remains one of the least successful applicants of the Horizon 2020 Programme (Eco-innovation Observatory, 2020[80]).

The funding support to business R&D in the Slovak Republic is largely dependent on subsidies, namely on national and EU funding programmes, such as from ESIF. The national programmes include grant programmes of the Slovak Research and Development Agency, the Environmental Fund, the Green Education Fund or the Science Grant Agency of the Ministry of Education, Science, Research and Sport. Companies can further apply for grants from the European Structural and Investments, Horizon Europe or LIFE Programme, which support transnational collaboration on a wide range of R&D, demonstration or other innovation related projects, including innovation related to the circular economy. For an overview of existing public funding instruments for eco-innovation, see the country profile report prepared for the EU Eco-innovation Observatory (2020[80]).

The Slovak Republic could enhance public funding for business R&D and eco-innovation in multiple ways. The country could introduce a dedicated fiscal instrument to support investments in environmental technologies. For example, the Netherlands introduced two tax incentive schemes for investing in environmentally friendly technologies which allow entrepreneurs to deduct additional investment costs on top of the regular investment tax reduction or to decide when to write off a part of the investment costs, which brings liquidity and interest benefits.

Since private sector innovation is also lagging, both by large companies as well as SMEs (OECD, 2017[89])**, the Slovak Republic could make a better use of collaborative R&D grants schemes where funding from public sources is linked to projects where business and researchers from academia collaborate**. An example of such a scheme is the Collaborative R&D grant in Canada (Natural Sciences and Engineering Research Council of Canada, 2020[90]). Evaluations suggest that collaborative grants do have a positive impact on encouraging firms to cooperate with public research institutions (Cunningham and Gök, 2016[91]). Such a collaborative R&D grant scheme would have to have a dedicated circular economy strategic area to specifically support projects in this area.

Moreover, the Slovak Republic could explore the possibility of setting up a dedicated Circular Economy innovation fund offering grants or loans, which would support start-up activities in the area of the circular economy. External financing required for risky innovation projects is lacking, leading to little start-up activity in the country (OECD, 2019[92]). For example, Scotland has set up a Circular Economy Investment Fund offering a grant support to SMEs and NGOs for innovative circular economy projects (Zero Waste Scotland, n.d.[93]), which is also linked to a business support service instrument (see

the next sub-section). There are several other examples of innovation funding instruments across the EU Member States, ranging from specific "From waste to resource" funding in the Netherlands (VANG programme) to regional programmes aimed at accelerating the development of innovative start-ups, such as the Brussels Greenlab.brussels. For examples, see Doranova et al. (2016[94]). Another good example is the RE: Source innovation programme in Sweden, where the government appointed two agencies to invest in a strategic innovation programme which focuses on developing circular economy and resource efficiency innovations (RE: SOURCE, n.d.[95]). It brings together companies, universities and authorities to collaborate in strategically important areas, such as this one. This programme provides specific funding for projects under this programme and five platforms to develop solutions for its priority areas.

Capacity building – information and educational tools

Information instruments to improve knowledge on eco-innovation in particular targeted to SMEs exist to some extent, for example the Circular Slovakia Platform, but more needs to be done in this area. Other soft measures include business support services and innovation hubs, such as those offered by the Slovak Business Agency.

Strengthening business support services and innovation hubs could help increase the share of SMEs accessing public funding support instruments, and as a result help SMEs to innovate. A recent eco-innovation country profile review of the Slovak Republic identified the absence of non-financial support mechanisms for SMEs as a key barrier to eco-innovation in the country (Eco-innovation Observatory, 2020[80]). A similar bottleneck has been identified by a recent OECD review of the use of European funds to promote research and innovation in the Slovak Republic (2021[83]). In this regard, the country could explore the example of Scotland which set up a Circular Economy Business Support Service to SMEs across all sectors, including advice on technologies and innovative CE business models. This one-on-one service is supported by the European Regional Development Fund. Once the service is completed, businesses may be eligible for funding via the Circular Economy Development Grant or the Circular Economy Investment Fund for projects nearing commercialisation (Zero Waste Scotland, 2020[96]). Another examples of such a business support programme is the Circular Business Challenge provided by the Rabobank in the Netherlands, where companies and entrepreneurs are offered practical workshops and other support, including financial support to develop innovations and new business models (Rabobank, n.d.[97]).

Beyond the need for a stronger policy framework, **strong research and innovation must also stem from a robust educational system, especially tertiary education**. However, the Slovak Republic lags behind its peers due to a relatively low quality of tertiary education (OECD, 2017[89]). This is further hampered by a system where research funding does not distinguish between high and low quality of research, resulting in high publication rates but low citations (OECD, 2019[92]). In addition, the lack of strong education and training has spill over effects on the digital skillsets of low-skill workers. This has possible future repercussions with regard to their employability in the medium-term where automation may replace some of the more routine jobs (OECD, 2019[92]).

Cooperation through voluntary agreements

Voluntary agreements negotiated between the industry and the government can also serve as an incentive to innovate. This is the case when certain practices or standards are agreed and the industry needs to adopt new practices, products or business models to reach these standards. Currently, such voluntary agreements do not seem to exist in the Slovak Republic. An example of successful cooperation in innovation between the government, companies and other stakeholders are the Green Deals in the Netherlands (Green Deal, n.d.[98]). These are mutual agreements between the Dutch government and other parties (companies, civil society organisations and other public authorities) defining the innovative initiative and the actions involved for all stakeholders as clearly as possible, including quantitative aims. The government then commits itself to remove obstacles for concrete sustainable projects by modifying regulations. Several of the hundreds of Green Deals signed involved projects related to innovation in the

circular economy, but mostly with regard to recycling. A similar Green Deal could be explored for the circular economy in the Slovak Republic.

Engaging consumers and households in circular consumption patterns

Influencing consumer decisions at the point of sale

Consumer product taxes

Appropriate product taxes levied on disposable or non-recyclable products, or on products that have high disposal costs can also provide economic incentives for consumers to purchase products that are more circular if passed forward to consumers in higher product prices (Convery, McDonnell and Ferreira, 2007[99]; OECD, 2015[100]; European Commission, 2008[101]). If set at an appropriate level, these taxes can induce changes in consumer purchasing behaviour away from disposable products towards more durable alternatives, or away from products with high disposal costs to those that are more easily recycled. Product taxes could also act as advance disposal fees, reflecting the cost of the end-of-life treatment of the designated products. In addition, they are likely to incentivise businesses to bring to the market more sustainable products, as these would not be taxed. Product taxes which aim at enhancing circular economy objectives have been widely applied to single-use plastic bags, single-use packaging, fertilisers, mineral oils or tyres (OECD, 2021[27]). An OECD report provides some examples of consumer product taxes relevant to the circular economy (2015[100]).

The Slovak Republic has introduced a number of product taxes (excises), most relevant to the circular economy being the product tax on mineral oils. Currently, there is no specific product tax on disposable or hard-to-recycle products. The Waste Act transposes the EU's Single-Use Plastics Directive, as a result of which the country bans the placement of certain single-use plastic products on the market. Consumers are also charged for the use of light plastic bags, however, these charges are not product taxes.

The Slovak Republic could consider in the long-term potential use of additional product taxes (excises) to act as advance disposal fees for products with high end-of-life costs or products that are hard-to-recycle, which are not covered by other incentive schemes (for example EPR or DRS). While a survey of EPR instruments, including advance disposal fees, found that advance disposal fees have a wide range of product applications in many countries (Kaffine and O'Reilly, 2013[53]), most other EU Member States have made only limited use of product taxes, most of which were applied to single-use plastics, packaging, tyres, batteries or household electronics. As currently, most of these products are either regulated through EPR or are/will be banned from the market, there is no need to impose additional product taxes on such products, if the existing systems work effectively at financing their end-of-life treatment. However, if, for example, EPR is ineffective because it is under-resourced, a tax or charge on the most polluting products covered by an EPR system could be a route to ensuring more adequate and stable financing for the EPR regime (OECD, 2021[27]).

Possibly, such a product tax could be considered in the long-run for some hard-to-recycle products, which are currently not regulated but which are expected to be in the future. Such examples include, for instance, clothing made of certain composite fibres or non-recycled plastic fibres (discussed in the UK), or chewing gum, disposable diapers and kitchenware (as in place in Korea in the form of an advance disposal fee) (OECD, 2016[54]). Such advance disposal fee for non-recyclable products can restore incentives to design products that can be recycled in the future or internalise costs for small waste streams for which setting up a take-back scheme would induce excessive administrative costs (OECD, 2016[54]). However, evidence base for product taxes applied to the less typical products is limited as countries tend to turn to alternative measures, such as for example EPR schemes. Before deciding to implement new product taxes, the Slovak Republic will need to assess which instrument would be best to use to internalise the end-of-life treatment costs of such products (e.g. EPR or a product tax).

Eco-labels and other information relevant to consumers at the point of sale

Eco-labelling offers consumers a more reliable framework to base their decisions on when purchasing sustainable and environmentally-friendly products. The EU has developed a common voluntary environmental label (Eco-label) for all companies operating across the EU Member States. The EU Eco-label certifies that certain categories of products and services are characterised by a reduced environmental impact during the entire product life cycle. Companies operating in the Slovak Republic can apply for both the EU Eco-label as well as the national "Environmentally friendly product" eco-label. The statistics on the number of products with such a label in the Slovak Republic show a decreasing trend in the use of such labels over time (Enviroportal, n.d.[102]).

Quality standards for products also provide consumers information on the products that they buy. Introducing quality standards for reused products (furniture, toys, bicycles and even industrial equipment, but in particular electronics) could boost the market for second-hand, refurbished and remanufactured consumer goods. An example of such a quality standard is the Scottish Revolve Reuse Quality Standard (Box A D.7.). A recent study for the European Commission found out that increasing the confidence of consumers about the quality and safety of reused products, and improving information about durability and reparability at the point of sale through labels, information or educational campaigns was key to shift consumer preferences towards products that are more circular (LE Europe et al., 2018[103]).

The Slovak Republic could strengthen its efforts in this area to foster demand for products that are circular. This could be done through continued efforts in targeted awareness raising campaigns and capacity building as well as through considerations to adopt a quality standard for reused or refurbished products in the long-term.

Box A D.7. Revolve Reuse Quality Standard in Scotland

Since 2011, the National Responsible Agency Zero Waste Scotland is conducting a programme for increasing customer confidence in reused products (2020[104]). The Revolve Reuse Quality Standard, an externally validated tool, was designed and piloted in 2011 for Scottish reuse businesses to increase the purchasing of reused goods. According to UK statistics (Zero Waste Scotland, 2020[104]), the confidence in quality and safety of reused products is a barrier to reuse, as only 27% of the national population purchase in second-hand shops, even if 77% declare the willingness of doing so. The introduction of this quality standard is both increasing consumers' confidence and helping the accredited businesses to increase their turnover by selling second-hand products. Businesses that sell reused products and want to be certified are tested by using those standards related to quality of goods, shopping experience and trust. In 2018 there were 122 accredited stores across Scotland. In a sample of 10 stores, revenue has increased by just under £45 000 since 2011 (Moir, 2018[105]). As well as increasing the purchase of second-hand over new products and supporting second-hand stores to reach a wider audience and sell more, another important objective of this initiative is opening a discussion around legislation, perception and barriers for the reuse of goods.

Changing consumer behaviour at the product's end-of-life

Household waste charges, including PAYT charges

Countries have introduced charges for the collection and disposal of household waste, which could be set as a flat fee, for example, per person per year, irrespective of the amount of waste produced, or as a fee based on the volume or weight of waste collected, i.e. Pay-As-You-Throw (PAYT) based charges. Different types of PAYT exist across countries and municipalities, which charge either directly, through individual measurement and billing (weight-based), or indirectly, through charges for bags, stickers, tokens or by

differentiating the charge by container size and the frequency of collection (volume-based). Several studies have analysed household waste charges, and conclude that PAYT based charges are more effective instruments in inducing households to better sort their waste and increase municipal waste recycling rates compared to conventional flat rate financed household waste collection charges (OECD, 2006[106]; Hogg, Sherrington and Vergunst, 2011[107]; Fullerton and Kinnaman, 1996[108]; EEA, 2016[109]). This should, in turn, create incentives for producers to design and market products with lower end-of-life costs, or else risk losing sales to competitors (BIO IS et al., 2012[110]; Dinan, 1993[111]). Table A D.5. provides an overview of examples of good international practices for PAYT based charges.

Table A D.5. Examples of implemented PAYT based charges from other countries

PAYT scheme	Examples	Description
Volume and frequency based scheme	Slovak Republic	These schemes charge based on the size of the bin and the frequency of emptying the bin. Can be subscription based or based upon the number of emptying of the bin. The incentive is twofold: reducing the frequency as well as bin size.
Frequency-based schemes	Locally used in Germany, the Netherlands, Belgium, Slovak Republic	Households either subscribe for a particular frequency of bins collection, or have their bins tagged or with electronic chips to record when bins are emptied (more expensive alternative). Implications for the cost of the system as the cost is more linked to frequency of collection rather than to weight. Households may also incline to stomp their bins (Hogg, Sherrington and Vergunst, 2011[107]). An example of PAYT scheme in densely populated areas are chamber systems with smart containers operated by personal ID cards introduced in Schwerin (Germany). Here, an individual billing system was set up, defined as a flat rate plus a variable fee depending on the number of uses of the residual waste containers. Overall, the residual waste in the area with this chamber system was reduced by almost 90%, from 40 to 4 litres per inhabitant per week (Stadt Schwerin, 2000[112]).
Bin volume-based schemes	USA, Germany (Berlin), Czech Republic	Households typically choose the size of their bins at the beginning of a particular year and are charged accordingly. Need of a good range of bin sizes. An important decision is whether to allow changes to the bin sizes and if so, how often (implications for the cost of the system). Seems the use of this system is on the decline. Only a marginal incentive to change consumer behaviour (Hogg, Sherrington and Vergunst, 2011[107]). Berlin (Germany) introduced pay-per-bin charges with different collection fees applied to the different bins: EUR 55.45/year for 60 litres residual waste bin; EUR 25.06/year for 60 litres bio-waste bin; recycling bins being free of charge; and an extra cost charged for additional "grey sacks" for residual waste (European Commission, 2014[113]).
Sack-based schemes	Belgium (Flanders, Brussels), Italy (Bergamo, Milano, Seveso)	Essentially a volume based scheme but an incentive to reduce waste is higher as there is a higher flexibility in changing volumes than in a "fixed" volume-based bin schemes. Households can either buy specific bags or tags/ stickers, which must be attached to the sacks. Good to differentiate sack sizes (Hogg, Sherrington and Vergunst, 2011[107]). In Belgium Pay-as-You-Throw is a central pillar of the policy portfolio to incentivise citizens to sort their waste. Flanders, one of the three regions in Belgium, mandates the municipalities to set the variable price for mixed waste collection between EUR 0.11 and 0.33 per kg, i.e. for a single bag of residual waste of 10 kg, the cost could go up to EUR 3.3. The Flemish regional PAYT system also relies on the differential pricing of mixed municipal waste, recyclables and bio-waste, with higher rates for mixed waste than bio-waste (OECD, 2006[106]). In less densely populated areas such schemes have been set up as pay-per-bag charges in Bergamo (Italy). These function based on compulsory purchasing of special bags for residual waste using a smart card associated to each household. Over time, they helped increasing the separate collection levels in the province of Bergamo to 57% (up from 42.5%) (Provincia di Bergamo, 2020[114]).
Weight-based schemes	South Korea (nation-wide scheme), Sweden (Bjuv) Luxembourg (Koerich and Kopstal); Ireland (nation-wide)	The bins are usually equipped with a transponder which is read by software as the bin is loaded. The bin is weighted. This creates strong incentives. Collection inefficiencies of small quantities collected on a frequent basis. Often this scheme consists of a fixed fee and a variable weight-based fee (Hogg, Sherrington and Vergunst, 2011[107]). Municipalities in Luxembourg varied charges based on the weight of the waste collected and volume of the mixed waste container used, while dry recyclables were collected for free, implementing a differential cost between recycling and disposing of waste. The Irish government ended flat rate fees for household waste collection and introduced weight-based (e.g. a weight allowance or per lift) charge (Government of Ireland, 2021[115]).
Bin volume, frequency and		Such a scheme becomes possible with technology development and digitalisation. It creates an incentive by choosing the size of the bin, the frequency of emptying as well as weight. This system might be costly to implement (Hogg, Sherrington and Vergunst, 2011[107]).

weight-based schemes		
Mixed schemes consisting of a flat fee and a variable PAYT based fee	Italy (Parma and Contarina)	In Parma, the fee is composed of two main elements: a fixed part based on the number of household members and the square meters of the household, and a variable part that essentially depends on residual waste generation (accounted in terms of number of set-outs) and home composting. The fixed part already covers a minimum number of collections of residual waste per household, which is intended to cover the fixed costs of managing the system and concurrently to prevent dumping and littering. Additional removals are charged (EUR 0.7 per bag, EUR 1.4 per bucket and EUR 4.2 per wheeled bin). In terms of positive incentives, households get a 12% reduction in their fee if they do home composting. Households making use of nappies are not charged for the extra removals (Zero Waste Europe, 2018[116]). Similarly, in Contarina, the fee is composed of a flat and a variable fee. The variable fee penalises the number of times the non-recyclable dry waste bin is emptied and provides a bonus for those households doing home-composting which see a reduction of 30% on the variable fee (Zero Waste Europe, 2018[117]).

Source: Adapted from the literature specified in the table.

The impact of introducing PAYT based charges on mixed municipal waste production has been shown positive but with a varying degree of magnitude, ranging from 21 to 70% (Slučiaková, 2021[118]; Huang, Halstead and Saunders, 2011[119]; Wright, Halstead and Huang, 2018[120]). For example, an analysis of municipal waste management across European countries has shown that all European countries with recycling rates above 45% (in 2015) implemented a form of PAYT based charges, while most countries with recycling rates below 20% do not use such charges (EEA, 2016[109]).

Slovak municipalities have the choice of implementing a flat based household charge or a PAYT based charge for their residents. The local waste charges are regulated by the Waste Act No. 79/2015 Coll. and by the Act No. 582/2004 on Local Taxes and Local Charges for Municipal Waste and Small Construction Waste (Table A D.6). The proceeds from the charges are earmarked as revenues for municipalities to finance collection, transport and treatment of municipal waste and of small construction waste. The calculation of the local waste charges includes the costs for the collection of mixed municipal waste, biodegradable municipal waste and small construction waste from households, for the separate collection of municipal waste streams, which are not covered by an EPR scheme[4], and for incorrectly sorted waste within the framework of an EPR scheme. The local waste charges are set on the basis of actual costs for the collection, transport and treatment of municipal waste and of small construction waste. In 2019, EUR 157 million were collected in total through household waste charges (OECD, n.d.[28]).

Table A D.6. Household charges for municipal waste in the Slovak Republic

Type	Rates and description
Flat-based charge	Between EUR 0.0066 - 0.1095 per person per calendar day
PAYT-based charge	Between EUR 0.0033 - 0.0531 per litre or dm^3 of municipal waste, including small construction waste, if the municipality has not set up a PAYT scheme for small construction waste; or between EUR 0.0066 - 0.1659 per kg of municipal waste or small construction waste otherwise
	Between EUR 0.015 - 0.078 per kg of small construction waste under a PAYT system. The charge under the PAYT scheme is calculated as the product of the frequency of the collection, rate and volume of the bin

Source: Act No. 582/2004 on Local Taxes and Local Charges for Municipal Waste and Small Construction Waste of the Slovak Republic

Households covered by a PAYT scheme can determine the frequency of waste collection as well as the size of the bin (the municipality must offer at least three alternative bin sizes). This is a so-called volume and frequency based scheme (see Table A D.5.). In municipalities without a PAYT scheme, an individual

[4] The costs for the separate collection of municipal waste streams, which fall under the EPR schemes, are borne by the producer of the relevant products covered by such schemes or by a PRO, and are not included in the calculation of local waste charges.

can demand introduction of such a system if the municipal waste the individual generates is measurable and if such waste can be stored in a safe place until it is collected. A municipality can also introduce a PAYT scheme for small construction waste from households.

The Slovak Republic should aim at expanding the coverage of well-designed PAYT schemes to increase waste sorting. This could be done, for example, by making PAYT mandatory for certain regions or country-wide, or by introducing additional incentives, which would drive more municipalities to adopt PAYT on a voluntary basis. The choice of the most convenient type of PAYT scheme would be left to the decision by municipalities. The available evidence in the Slovak Republic indicates that there is a large potential to expand the coverage of PAYT schemes across the country, however, the introduction of such schemes needs to be carefully planned. In 2018, only around 13% of the Slovak population, equivalent to less than 5.8% of Slovak municipalities, used such an instrument (Slučiaková, 2021[118]).

The literature points to a number of policy options to expand the coverage of PAYT schemes:

- Mandating PAYT (i.e. removing the non-PAYT charging option from the legislation). For example, South Korea and Ireland implemented a nation-wide PAYT scheme. In other countries, PAYT tends to be implemented regionally (Belgium) or locally (OECD, 2006[106]). Ireland has been phasing out flat fee charging structures since the end of September 2017 for customers whose current flat fee contracts end (Competition and Consumer Protection Commission of Ireland, 2018[121]). Monitoring of Irish household collection charges during the phasing out process showed that 47 different types of charging plans were operating in June 2018.
- Making disposing of unsorted waste so costly that municipalities would have the incentive to sort. For this the key is an effective landfill tax (OECD, 2021[27]).
- Making sorting waste attractive financially that municipalities would want to sort. This could include a landfill tax discount rate or an incentive subsidy for sorting waste, such as the ones introduced in the Slovak Republic[5] and the Czech Republic within the country's landfill tax reform. However, such a financial incentive must be high enough to induce changes in behaviour of municipalities. Other options to provide financial incentives to municipalities to sort more include decreasing the waste management cost of recyclables by strengthening markets for secondary raw materials, and imposing an incineration tax or landfill and incineration bans for recyclables. For example, Flanders has introduced landfill and incineration bans for recyclables in the past.
- Establishing a financial penalty on municipalities that operate a non-PAYT regime. Such an economic instrument could be effective in inducing change, so long as the penalty was sufficiently high (OECD, 2021[27]).

In particular, options 2 and 3 appear as most relevant and feasible within the context of the Slovak Republic but according to some of the consulted stakeholders, the transition to a PAYT system in the Slovak Republic needs to start with complementary measures aimed at educating households to sort their waste better and at changing the existing waste infrastructure to meet the requirements of PAYT schemes and a convenient separate collection system for different waste streams. Without these pre-conditions in place, some of the consulted stakeholders fear the introduction of PAYT might lead to the creation of illegal waste dumps and to negative attitudes towards PAYT due to potential increase in household waste charges. The key aim of a PAYT scheme is to get more household waste sorted and increase recycling rates, with the ultimate benefit of reduced household waste charges for mixed municipal waste (as these are reflected in the household waste charges). Almost 50% of municipal waste in the Slovak Republic is mixed waste, a

[5] The recent landfill tax reform in the Slovak Republic in effect from 2019 also introduced incentive subsidies for municipalities, which sort better in addition to higher landfill tax rates. If the subsidy is high enough, it should incentivise more municipalities to adopt measures to increase household waste sorting, one of which is the adoption of PAYT based charges.

majority of which ends up in landfills. In principle, the Slovak municipalities have few incentives to change current practices as the landfill tax remains relatively low compared to rates in other EU Member States, even after the landfill tax reform in 2018, and they are allowed to levy a relatively low fixed charge for waste collection. An additional landfill tax increase, beyond 2021, as well as changes to the design of the landfill tax, could provide further incentives for municipalities to introduce a PAYT scheme, and in turn induce households to sort and reduce their waste to benefit from lower waste charges.[6]

Some municipalities might be also reluctant to implement additional waste management practices leading to higher proportions of recyclables, as this might put additional economic strain on their budgets. This was the case in the Czech Republic as the secondary raw material markets were not yet functioning well, which was reflected by a low demand for recyclables and high waste management prices (OECD, 2021[27]). Hence, initiatives aimed at increasing the rates of separate collection of recyclables, such as PAYT, must go hand in hand with strengthening the demand for recycled materials (OECD, 2021[27]).

Moreover, the Slovak Republic needs to move beyond the most popular volume and frequency subscription based schemes as these do not always provide sufficient incentives to sort waste. For these schemes to be effective, the container size needs to be small enough for the amount of current levels of mixed waste and households need to face a range of subscription options for containers of different sizes and collection frequencies, where PAYT based charges are rising exponentially with the size of containers and more frequent collection of waste (OECD, 2021[27]). Nevertheless, this might still prove to be insufficient for households residing in densely populated multi-family apartment buildings, where the incentives for individual waste reduction are diluted.[7] While a more widespread introduction of additional container infrastructure that would "lock and allow access" to a set of containers only to the multi-apartment building's residents would be seen as a significant move forward[8], the sack- or weight-based schemes might be more appropriate in these areas to reach the desired effects. In such densely populated areas, the use of bags, stickers, tags or electronic chips to record when bins are emptied has also shown to increase sorting compared to a volume and frequency based subscription (though the available scientific evidence is old, see for example Hogg, Sherrington and Vergunst (2011[107])). An empirical analysis of the Slovak PAYT schemes demonstrated that a tag based system, which is the second most popular PAYT scheme in the Slovak Republic, could reduce the mixed municipal waste by around 31% compared to a flat-fee system, while a container and frequency based subscription system could achieve a reduction of 11% (Slučiaková, 2021[118]).

The choice of the most suitable type of PAYT scheme needs to consider the implementation costs of such a scheme and the subsequent potential increase in waste management costs. This might trigger resistance from municipalities and citizens. While volume and frequency based schemes (including sack-based schemes) tend to be less expensive to set up and operate than weight-based schemes, the weight-based schemes appear to be more effective in reducing the amount of household waste (Hogg, Sherrington and Vergunst, 2011[107]; OECD, 2006[106]). Both the sack-based and weight-based schemes offer the advantage of flexibility for consumers to change the amount of charged waste. In volume and frequency based schemes, in particular those based on annual subscriptions, such choice to change the amount of the charged waste depends on if, and how often, the volume and frequency can be changed (Hogg, Sherrington and Vergunst, 2011[107]). A hybrid system of individual billing based on a flat fee plus a variable charge could be also promoted as has been done in a number of foreign municipalities (e.g. Parma in Italy,

[6] The landfill tax rates for industrial and construction waste were increased beyond 2021 after this report was drafted.

[7] For example in Petržalka district of Bratislava, an apartment block of buildings (which could include up to almost 100 households) shares the same set of containers (locked, with access only to the residents of the apartment block) under the currently implemented volume and frequency based scheme.

[8] Opinion provided by the Ministry of Environment of the Slovak Republic as currently such a container infrastructure is installed only in around 20% of multi-family apartment buildings in the Slovak Republic (a very rough estimate).

Table A D.5). The scientific literature does not provide sufficient evidence on the costs and benefits (in monetary terms) of the different types of PAYT schemes and often falls back on old data (1990s and 2000s). The experience from countries that have a long-history with PAYT based schemes (e.g. Flanders and the Netherlands) indicates that a successful PAYT system takes time to implement, and relies on a supporting regulatory framework (landfill/incineration taxes and bans), financial support (for municipalities), continuous education and awareness raising of citizens and a good enforcement framework with fines (to deter illegal waste dumping) (ACR+, 2014[122]; Hogg, Sherrington and Vergunst, 2011[107]; OECD, 2006[106]). Box A D.8. illustrates how sack-based, and later weight-based PAYT schemes were introduced in some municipalities in the Flanders region in Belgium (densely populated region). The region started with the implementation of a few pilot projects, continued with heavy investments into information and awareness raising campaigns to motivate citizens to sort waste, and once sorting was an accepted practice, the sack-based system was gradually introduced for mixed municipal waste (and later for separately collected waste). Over time, Flemish municipalities started to voluntarily replace sack-based schemes by weight-based schemes (ACR+, 2014[122]).

Box A D.8. From pay-per-bag to pay-per-kg for residual household waste in Flanders

Flanders has implemented PAYT based charges for all municipal solid waste on a regional level since around 1995. The main rationale was to induce the households to sort their waste better at source and to cover the rising cost for the collection and treatment of the municipal waste (ACR+, 2014[122]).

Certain Flemish municipalities (around 23%) have gradually voluntarily transitioned from the default price-per-bag pricing systems to more sophisticated weight-based pricing schemes. The results of a quantitative analysis (taking into account the data between 2005 and 2010) indicate that introducing weight-based PAYT schemes has an initial significant and substantial downward impact on the amount of residual municipal waste per capita. However, the findings indicate that this impact levels off in the years after introduction (De Jaeger and Eyckmans, 2015[123]).

The more sophisticated weight-based PAYT schemes imply that households are charged for each kilogram of waste that they put on the curbside. In Flanders, each household receives a standardised waste bin marked with an identification chip. The weight of the bin before and after emptying is recorded and measured, and households are charged later for the actual amount of waste that they disposed of. The weight-based schemes have been introduced by first municipalities already in 1998 (De Jaeger and Eyckmans, 2015[123]).

The identified key success factors of implementing PAYT in Flanders are (ACR+, 2014[122]):

- *Clear legal framework* – including mandatory separate collection schemes for the municipal waste, firm regulation, removing legal obstacles.
- *Financial support* – there is a need to financially support the municipalities to make a switch from a flat-based charging to PAYT, as PAYT involves initial costs of setting up such systems (e.g. micro-chipped bins, weighbridges, etc.). Over the years, since the 1990s, more than EUR 50 million were used as subsidies for the municipalities.
- *Supporting policy measures* – such as landfill and incineration taxes and bans, which make recycling more financially attractive.
- *Information and awareness raising campaigns* – to inform the citizens and educate them about the principles and benefits of PAYT.
- *Continuous and active dialogue with the municipalities*.

Shifting towards more effective forms of PAYT in the Slovak Republic, in particular in densely populated areas, must be supported by educating and informing municipalities about the different PAYT options and

by supporting effective awareness raising campaigns directed at citizens to sort their waste (the need for such campaigns has been raised by some of the consulted stakeholders as well). Evidence also shows that the effectiveness of PAYT based charges could be enhanced by implementing them together with a door-to-door separate collection of certain categories of recyclables, in particular of kitchen bio-waste, paper and glass (OECD, 2021[27]) and by making separate collection of recyclables convenient for households (as was the case in the Netherlands, see OECD (2006[106])). A door-to-door collection of kitchen bio-waste in family houses is already in place in the Slovak Republic and there appears to be a large network of collection points for recyclables in general. Promoting the use of the sack-based schemes (where households purchase specific bags for their waste) appears to be a more economically viable option to implement by municipalities at a larger scale within the Slovak context than weight-based schemes, while still having an important positive impact on household waste reduction.[9] However, as mentioned above, concerns were raised with regard to potential issues of littering (of trash bags in front of residences) in the Slovak Republic if sack-based schemes were implemented and increased illegal dumping of waste in general. To mitigate this issue, the country would need to put in place an effective monitoring and fining system. The level of illegal waste disposal appears to also depend on the convenience of sorting recyclables (OECD, 2006[106]). To mitigate the increased waste management costs for municipalities from the implementation of PAYT based schemes, one option appears to be to take advantage of economies of scale. This might be in the form of building consortia of municipalities jointly operating waste collection and management facilities (OECD, 2021[27]).

Deposit-refund systems

Governments across the world have introduced legislation mandating the use of DRS, mostly for beverage packaging. A DRS could be considered as a form of EPR if the producer pays for the system (but DRS can also be funded by government provision) and is generally implemented to increase the quantity and the quality of the separate collection of specific products following mandatory take-back obligations (but can be implemented voluntarily by industry if this leads to profit-making). However, it can also exist outside of an EPR scheme.[10] High rates of return for re-use or recycling can be achieved because the refund provides consumers with an economic incentive to return items through appropriate channels rather than discarding them in general waste (Bohm, 1981[124]; Walls, 2011[125]; European Parliament, 2011[126]). The legislation often specifies the amounts to be charged as a deposit on each such product sold. The main drawback of the system is its high implementation cost, which makes it economically unviable to implement for a large range of products. As such, the DRS system has been so far typically used for specific products or materials, for which high sorting and recovery rates are needed (e.g. packaging materials for beverages).

The Slovak Republic has an existing DRS for reusable beverage packaging, which is regulated by the Decree no. 373/2015 Coll. of the Ministry of the Environment of the Slovak Republic on the EPR of Certain Products and on the Management of Certain Waste Streams. The decree sets the following minimum amounts for deposits: (a) EUR 0.13 for each reusable packaging for beverages up to 2 litres except of packaging falling under (b); (b) EUR 0.27 per reusable glass packaging for beer with other than crown cap; (c) EUR 40 for other reusable packaging for beverages (e.g. a barrel). Currently, this system is functioning primarily for beer glass bottles, with a deposit of EUR 0.13 per bottle.

[9] Evidence from the Netherlands suggests that the weight- and sack-based schemes perform far better than the frequency and volume based schemes. The sack-based schemes seem to be the best option as their effects are comparable to those of weight-based systems, while their administrative costs are much lower (Dijkgraaf and Gradus, 2004[237]).

[10] For example, the bottle DRS in Hawaii (U.S.) is operated by the Department of Health but additional policies are not used in combination with an EPR approach (OECD, Forthcoming[128]).

Recently, the Slovak Republic has introduced a DRS for single use PET bottles and cans to meet the targets of the EU Single-Use Plastics Directive (Box A D.9.). This system is regulated by the Act No. 302/2019 Coll. on the Deposit Refund System for single use packaging for beverages. The Act entered into force on 1 December 2019. However, the DRS system has been functional only from 1 January 2022. The scheme covers only single use plastic packaging for bottles (PET bottles) and metal packaging (cans). The system is mandatory for the producers as well as retailers of the relevant packaging materials. However, not all retailers are obliged to set up relevant infrastructure to collect empty bottles and cans and to reimburse the deposit to consumers (for example, this is obligatory only for retailers selling such beverages on an area larger than 300m^2).

Box A D.9. DRS for single-use PET bottles and cans in the Slovak Republic

The Act No. 302/2019 Coll. on the Deposit Refund System for single use packaging for beverages sets a number of separate collection targets:

- **Plastic bottles** - minimum 60% of single-use plastic packaging placed on the market in a given year by weight should be separately collected by the end of 2022; 77% by the end of 2024 (this target is in line with the target set by the EU Single Use Plastics Directive); and 90% from 2027 onwards (the Directive sets this target from 2029 only).
- **Metal cans** – there is no target set for 2024; minimum 70% of cans must be separately collected by the end of 2025; and 90% by the end of 2029. There is no such target on the EU level.

Decree No. 347/2019 Coll. of the Ministry of Environment of the Slovak Republic implementing certain provisions of the Act on DRS for single use packaging for beverages sets the level of deposit and the scope of single-use packaging to which the DRS applies. The deposit must be minimum EUR 0.12 per plastic bottle and minimum EUR 0.10 per can. Based on evidence from other countries with already implemented DRS schemes, these levels of deposit are expected to lead to a collection rate higher than 90%, which is an increase from the current 62% collection rate for PET bottles (Dráb and Slučiaková, 2018[127]).

The new Slovak DRS for PET bottles and cans is set up in the form of a central system, often implemented in Scandinavian countries. Such a central system is composed of unions and associations of manufacturers. The role of the administrator of such a system is to coordinate and approve of the activities, and to finance the system. The system is financed by manufacturers through an administrative fee for each plastic bottle and can. Additional costs incurred by retailers are financed by a handling fee (Dráb and Slučiaková, 2018[127]). The selected DRS clearing organisation has set the level of deposit at EUR 0.15 per plastic bottle and per can.

While there is currently no need to introduce DRS for additional products in the Slovak Republic, the country may consider expanding DRS alongside an existing EPR for additional products in the long-run, if an EPR scheme fails to achieve certain recycling rates. Evidence shows that DRS generally achieve high collection rates, which may in turn increase recycling rates and help achieve targets on specific materials and products. This could further provide design-for-environment incentives in the upstream part of the value chain. It is likely that obligations from increasingly ambitious targets for recycling, recycled content, and litter prevention or clean-up in the coming decades will require a combination of EPR policies, including a DRS (OECD, Forthcoming[128]). However, a potential new DRS in the Slovak Republic will need to generate net benefits.

Information and educational tools

Consumer behaviour can also be influenced by a mix of soft instruments. Information (awareness raising) and education (capacity building) of citizens and consumers play an important role in the transition to a

circular economy. These instruments can be implemented at different stages of the product value chain to encourage the consumption of ecological products, to promote waste prevention and to inform on waste collection and sorting.

Education plays an important role in raising awareness about the benefits of the circular economy. Interactive learning at day cares teaches how to sort waste correctly, while at primary and secondary schools children learn about materials and business activities (Silvennoinen and Pajunen, 2019[129]). Capacity building at higher, vocational and lifelong levels equips students with knowledge and skills to apply circular thinking in future careers (Ellen MacArthur Foundation, 2020[130]). Mainstreaming the circular economy at all levels of education is therefore important for a systemic change in consumers' behaviour.

Awareness raising through information sharing is another crucial area for influencing consumers' choices. Information campaigns and other awareness raising tools help engage with consumers and keep them informed about product characteristics, their maintenance and end of life management. Examples of awareness raising tools for waste prevention include: promoting local consumption and the choice of seasonal products (Associazione Nazionale Le Donne dell'Ortofrutta, 2020[131]), awareness raising about the benefits of composting (Leicestershire Waste Partnership, 2021[132]), and providing guidance on how to reduce food waste (US EPA, 2016[133]; US EPA, 2020[134]) (Zachraň jídlo, n.d.[135]), to name a few. Information campaigns can also promote capacity building to support new business models for the sharing, reuse, repair and refurbishing of products (for concrete examples refer to Box A D.10.). Public awareness about waste collection and sorting can be fostered through targeted campaigns (OECD, 2019[136]) and publications providing information about household waste composition and available waste treatment options across individual regions (ZeroWaste France, 2016[136]). Working with producer responsibility organisations (PROs) can also play an important role in raising public awareness on sorting packaging waste and recycling (EKO-KOM, 2018[138]; OECD, 2019[136]).

Box A D.10. Examples of capacity building activities to extend products' lifespan

Repair Café's

The 'Repaired better than new' initiative introduced in the Metropolitan Area of Barcelona marks more than 10 years of successful operation (AMB - Metropolitan Area of Barcelona, 2020[139]). It offers citizens with access to advisory services and workshops, where they can learn how to repair their own goods with the support of training, personal, tools and spaces. In 2014, there were more than 4 500 users who took advantage of such services, while more than 3 000 people attended the self-repair workshops. Before the repair, each delivered object is weighed to evaluate the amount of waste avoided. In 2014 alone, it was estimated that 12 tonnes of products were delivered into the centre, with an average success rate of repair of 74%. The annual budget for the service is 255 100 euros.

The non-profit organisation Repair Café International Foundation provides professional support to local groups to start their own repair café in the Netherlands and abroad (2018[140]). By January 2020, 2 000 local cafés have been established. Each repair café is a free meeting place where people can find tools, materials, and expert volunteers to repair their broken items. They also offer repair workshops. In 2018, the average repair success rate was 65% (60% for coffee machines, 47% for laptops, 45% for irons and above 90% for clothing and bicycles) (Repair Café, 2018[140]). A voluntary one-off fee of 49 EUR is charged to local groups for receiving advice on finding a suitable location, local repair experts and tools and securing further funding. The projects must be run on a voluntary and non-commercial basis. More than 40% of them have been predominantly funded by citizens. Only 12% of funding is coming from public institutions and government.

In the Slovak Republic, the Slovak Environment Agency is the principal coordinator of environmental awareness, training and education programmes at both national and regional levels (2021[141]). It organises

educational and information events targeting pre-school, primary and secondary students, professionals in environmental education, as well as employees of state administration and the public. Some of the circular economy related educational programmes for students focus on plastics, waste prevention, fast fashion, ecolabels and environmental footprint, provide educational and methodological material for teachers and schools (EWOBOX – the environmental education online platform), as well as awareness raising material for the public about waste management (Slovak Environment Agency, 2021[142]). The Slovak Environment Agency also manages the Green Education Fund, which supports the realisation of projects focused on environmental education, training programmes, and awareness raising events by non-governmental non-profit organisations (Slovak Environment Agency, n.d.[143]). Educational activities implemented by other stakeholders include interactive education about the circular economy at primary and secondary schools within the Interreg V-A Slovakia-Hungary Cooperation Programme (Kruh obehového hospodárstva, 2019[144]), as well as lectures for the public and workshops for municipalities and businesses about waste prevention and sorting organised by INCIEN (2021[145]). **In addition to these individual offerings of educational activities, the Slovak Republic could benefit from strengthening the support of educational programmes through a more systematic mainstreaming of the circular economy. To do so, it could develop circular economy modules for different levels of the educational system (including pre-school, primary, secondary and higher education as well as vocational training).**

The Slovak Environment Agency is also responsible for overseeing the preparation of promotional material and the implementation of campaigns and awareness raising events, workshops and conferences. There are not many implemented information instruments specifically targeting circular consumption. Some awareness raising campaigns for households focusing on better waste sorting are provided by the initiative "triedime.sk", delivering leaflets with waste collection schedules and information material by municipalities about food waste prevention and reduction, the use of biological waste in gardens and home composting, and publishing "circular maps" indicating the location of composting sites, rental and repair shops across larger cities in the Slovak Republic (ENVI - PAK, 2021[145]; Mesto Michalovce, 2021[146]; INCIEN, 2021[147]). The new Waste Prevention Program for 2019-2025 foresees a number of information and educational activities targeting waste prevention across individual waste streams, including household, bio, food, plastic and construction and demolition waste. Some examples include the creation of an information online platform for waste prevention and sharing relevant good practice examples, awareness raising campaigns supporting household and community composting, and food and packaging waste prevention, as well as information support for setting up re-use centres and libraries of things (Ministry of Environment of the Slovak Republic, 2018[150]). **Besides strengthening the support for information campaigns, awareness raising programmes and guidelines to citizens on how to prevent and sort waste, the Slovak Republic could also focus on engaging consumers more in repair and reuse of products and the promotion of repair initiatives and sharing schemes.**

Other soft instruments to induce change in consumer behaviour towards waste sorting and increase the quality of recyclables include system nudges. These are discussed in more detail in Box A D.11.

Box A D.11. The role of nudges

System nudges represent an additional type of instruments that can help can alter consumers' behaviour.

'Green nudges' have been implemented to improve waste sorting rates and quality of recyclables by reducing the impurities. Evidence shows that free access to waste bags or bins and reduced distance to recycling sites has increased participation rates of households in waste separate collection (Cornel, 2018[151]). Providing free bins for recycling, replacing black with transparent waste bags, introducing higher collection frequencies for recyclables and reducing the size of the lids on bio-waste street

containers are other examples of system nudges that have been effective in changing the recycling behaviour of users and decreasing impurities of separately collected waste fractions (European Commission, 2016[152]) (Ajuntament de Barcelona, 2014[154]) (Vismara, 2014[155]).

'Information nudges' are another example of guiding consumers towards more sustainable decisions. For instance, providing personalised information through a citizens' App about households' waste reduction and source separation practices has been found to increase separate collection rates. This measure is also known as Know-As-You-Throw (Giavini, 2017[156]).

Improving waste management practices, reuse and recycling

Incentives to move up the waste hierarchy

Landfill taxes

Many countries levy landfill taxes to reflect the environmental costs associated with landfill use. In the EU27, 23 EU Member States have implemented a landfill tax, as well as Switzerland and the UK, varying from EUR 5 per tonne (in Lithuania) to more than EUR 100 per tonne (Belgium), while four EU Member States do not have a landfill tax currently in place (Cyprus, Germany, Croatia and Malta) (CEWEP, 2021[157]). These taxes are typically charged on the weight or volume of waste delivered to landfill sites, or on the authorised landfill capacity. Besides the landfill tax, a non-tax gate fee can be charged for the management of waste by landfill operators, increasing the cost of waste disposal to landfill even further. Like other economic instruments, to the extent that the tax is passed on to landfill users and operators, it will increase the cost of waste disposal to landfill compared with alternatives, and encourage a shift to alternative disposal routes such as recycling (Bartelings and et al., 2005[158]).

The Slovak Republic used to impose very low landfill tax rates on landfill users, including several exemptions to the payment of this tax. For example, municipalities in whose territory the landfill site operated were exempted from the tax (similarly as in the case of the Czech Republic in the past). The country has substantially reformed the landfill taxes in 2018, both by gradually and substantially increasing the landfill tax rate for certain waste streams and by establishing that each landfill user depositing waste to landfill pays the tax. A system of incentive subsidies has been integrated into the landfill tax reform, where, for example, municipalities achieving a certain level of sorting or recovering of all separately collected household kitchen bio-waste in a facility designated for this purpose can receive subsidies paid from the landfill tax proceeds that can be used for activities which are in line with the goals set out in the Waste Prevention Programme and the Waste Management Plan of Slovakia (see Box A D.12.).

Box A D.12. Current landfill tax system in the Slovak Republic

As of 28 November 2018, the new Act No. 329/2018 Coll. on Landfill Taxes establishes that each person or entity depositing waste to landfill shall pay a landfill tax, even if the landfill site is located on their territory. It is the municipality that pays for the municipal waste to be landfilled on behalf of households. The current landfill tax does not apply to waste if it is to be used for construction works, sanitary works, reconstruction works and backfilling purposes. The Government Decree No. 330/2018 Coll. sets the value of landfill taxes for the different waste streams and the distribution of the revenues from these taxes (this decree was amended in April 2022 to significantly increase the landfill tax rates for CDW and industrial waste, in effect from July 2022) (Table A D.7). To landfill mixed municipal waste and bulky waste, the landfill tax is calculated based on the share of sorted municipal waste. The landfill tax for other waste is calculated based on the landfill tax applied to such waste and to its volume.

The municipality is obliged to publish the sorting rate of its municipal waste (kg separately collected wastes/ kg total municipal waste). The proceeds from the landfill tax are earmarked for the Environmental Fund, unlike previously, where the proceeds went directly to the municipalities in whose territory the landfill was located. The Slovak Environmental Fund will redistribute the proceeds to:

1. Municipalities in whose territory the landfills are located or through whose territory the roads to the landfill pass (as a form of compensation) – in 2021 this was equivalent to EUR 5 per tonne of disposed non-hazardous waste and EUR 33 per tonne of disposed hazardous waste for municipalities with a landfill site.

The remaining tax proceeds are split as follows:

2. Municipalities, which sort their municipal waste above a certain threshold (this could be seen as an incentive subsidy to sort better): 60% of the tax proceeds from landfilling municipal waste after the deduction of the contribution paid to the municipalities under point 1);
3. Municipalities, which implemented a separate collection for biodegradable kitchen waste from households, and which recover all of this waste in a facility set up for this purpose (a form of incentive subsidy for food waste reduction): 15% of the tax proceeds from landfilling municipal waste + 15% of revenues from landfilling industrial waste after the deduction of contribution to municipalities in point 1);
4. Waste management operators: 25% of the tax proceeds from landfilling municipal waste + 40% of the proceeds from landfilling industrial waste after the deduction of contribution to municipalities under point 1); and
5. Entities, which demonstrate a lower production of waste in their production processes: 45% of the proceeds from landfilling industrial waste after the deduction of contribution to municipalities under point 1).

According to the Act No. 587/2004 Coll. on the Environmental Fund, which regulates the use of the revenues from the landfill tax, subsides from such revenues can be used for activities, which are in line with the goals set out in the Waste Prevention Programme and the Waste Management Plan of Slovakia.

Table A D.7. Landfill tax rates in the Slovak Republic from 2019

Landfill tax rate, EUR per tonne

Item	Type of waste	2019 (EUR/tonne)	2020 (EUR/tonne)	2021 (EUR/tonne)	2022 (EUR/tonne)*	2023 (EUR/tonne)*	2024 and beyond (EUR/tonne)*
Mixed municipal waste and bulky waste (sorting rate of municipal waste x (%))							
1	x ≤ 10	17	26	33			
2	10 < x ≤ 20	12	24	30			
3	20 < x ≤ 30	10	22	27			
4	30 < x ≤ 40	8	13	22			
5	40 < x ≤ 50	7	12	18			
6	50 < x ≤ 60	7	11	15			
7	x > 60	7	8	11			
Other type of municipal waste							
8	Small construction waste	7	7	8			
9	Soil	3	5	7			
10	Other type of waste	17	18	19			
11	Hazardous waste	35	38	40			

Industrial waste							
12	Excavated soil – inert waste	3	5	7	8	10	15
13	Excavated soil – non-hazardous waste	7	7	7	8	10	15
14	Construction waste	7	7	8	25	30	35
15	Other inert waste	0.66	0.66	0.66	0.66	0.66	0.66
16	Other inert waste, non-hazardous	7	7	7	7	7	7
17	Other industrial waste excl. no. 18	7	7	7	7	7	7
18	Other industrial waste	30	30	30	30	30	30
19	Industrial waste, hazardous	35	38	40	40	40	40

Note: * In April 2022, the Slovak Republic proposed an amendment to the Government Decree No. 330/2018 gradually increasing the landfill tax rates for construction and demolition rates. The amendment came into effect from 1 July 2022.
Source: Annex 1 and Annex 2 of the Government Decree No. 330/2018

However, the Slovak Republic could further enhance the effectiveness of the system to decrease landfill rates and increase recycling in the short-term through implementing changes to the landfill tax and through introducing significant supporting measures. For example, Slovak municipalities in whose territory the landfill is based or through whose territory the road infrastructure to landfill leads, still receive a subsidy from the landfill tax proceeds as compensation payment. In 2020 and 2021, municipalities with a landfill site received a compensation of EUR 5 per tonne of disposed non-hazardous waste and EUR 33 per tonne of disposed hazardous waste, while in 2022 and beyond, this will slightly decrease to EUR 4 per tonne and EUR 30 per tonne, respectively. In 2019, around 68% of the total proceeds from the landfill tax equivalent to around EUR 14 million (out of total EUR 20.7 million) were redistributed back to these municipalities.[11] In 2020, around 50% of the total proceeds from the landfill tax, equivalent to around EUR 13.5 million, were redistributed back to municipalities in whose territory the landfill operates or the road infrastructure passes.[12] This leaves very little revenue to redistribute among municipalities in the form of incentive subsidies for better sorting or better treatment of kitchen bio-waste. While this may be seen as giving appropriate compensation to the communities living near a landfill site, it also decreases the cost of landfill for these municipalities and weakens the incentive effect of the landfill tax. Decreasing or removing the proceeds from the landfill tax to municipalities could be further strengthened (see Box A D.13 for an example of how the Czech Republic plans to address this issue). This would also increase the proportion of the proceeds available for incentive subsidies for better sorting and better waste management and treatment, even though the current thresholds could be increased beyond what is obliged by law. In addition, the compensation also acts to increase the willingness of municipalities to accept landfill operations, and hence increases the aggregate landfill capacity.

Box A D.13. New system of landfill taxes in the Czech Republic

Main changes to the Czech landfill fees beyond 2020

The new Czech Waste Act No. 541/2020 Coll. substantially increased the landfill fee for recyclable and recoverable waste (up to threefold by 2030 compared to the current rates). It has also introduced substantial changes with regard to the structure of the landfill fee system and the incentives it provides.

[11] Based on the Envirofund data provided by the Slovak Ministry of Environment. In 2019, a total of 2.7 million tonnes of waste was landfilled, out of which around 1 million tonnes of municipal and small construction waste, and around 1.7 million tonnes of industrial waste, equivalent to around EUR 9.2 million and EUR 11.5 million, respectively.

[12] In 2020, around EUR 27.6 million were collected from the landfill tax for depositing around 3 million tonnes of waste, out of which around 1.3 million tonnes of municipal and small construction waste with a total of around EUR 16 million.

From the original two landfill rates (associated with the basic and risk components, respectively), the new Waste Act splits the rates for the basic component into two categories: recyclable/recoverable waste and residual waste. In addition to these two components and the hazardous waste component, there is a technological waste component introduced for waste that is currently stored freely in an open landscape. The aim of this component is to motivate producers of this waste to store it in a safe environment (i.e. landfill) rather than in an open space.

The table below shows the evolution of landfill rates over time. From 2030 onwards, there will be a ban on landfilling recoverable/recyclable waste, in line with the EU waste legislation.

	Landfill rates for different components (in CZK/tonne) in Year									
Component of the landfill fee	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 onwards
Recoverable waste	800	900	1000	1250	1500	1600	1700	1800	1850	1850
Residual waste	500	500	500	500	500	600	600	700	700	800
Hazardous waste	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Selected technological waste*	45	45	45	45	45	45	45	45	45	45

Besides the landfill rates, the design of the instrument also changed with regard to the way proceeds are split between the two beneficiaries (municipalities and the State Environmental Fund). The table below shows the evolution of this split from 2021 to 2030 and beyond.

	The split of proceeds from landfill fees for each component (in % share for the municipality on whose territory the landfill site is located/ share for the State Environmental Fund									
Component/ Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 onwards
Recoverable waste	60/40	50/50	45/55	36/64	28/72	26/74	24/76	22/78	20/80	20/80
Residual waste	80/20	75/25	75/25	75/25	75/25	60/40	60/40	50/50	50/50	40/60
Hazardous waste	50/50	50/50	50/50	50/50	50/50	50/50	50/50	50/50	50/50	50/50
Selected technological waste	100/0	100/0	100/0	100/0	100/0	100/0	100/0	100/0	100/0	100/0

This shows that the revised instrument goes in the direction of decreasing the revenues payable to the municipalities on whose territory the landfill site operates, and as such diverts incentives from landfilling to more sorting, at least theoretically, compared to the previous design of landfill fees. However, this is the case only for the recyclable/recoverable part of waste to be landfilled, as there will be a ban on landfilling this waste from 2030.

Source: Waste Act No. 541/2020 Coll.

Moreover, the gradual increase in landfill tax rates for municipal waste is currently capped in the legislation to the rates for 2021 (the landfill tax rates for CDW and industrial waste were increased after this report was drafted, in effect from July 2022). Gradually increasing the landfill tax rates beyond 2021 would, on the one hand, raise additional tax revenues, and on the other hand, provide an even stronger incentive effect. An OECD study based on Slovak micro data estimated that an increase of the average landfill tax from EUR 7 to EUR 42 per tonne would decrease the landfill rate from 66% to 52% between 2016 and 2023 (2017[159]). The increased landfill tax rates for 2019 to 2021 are still relatively low compared to other EU Member States (Table A D.8). While the extent of the non-tax gate fee in the Slovak Republic is unclear (estimates point to the total cost of landfilling, including the tax and non-tax gate fees to be around EUR 60-70 per tonne of waste), an additional rise in landfill tax rates would be also justified if the non-tax gate fee did not provide a financial disincentive for landfill operation.

Table A D.8. Examples of landfill tax rates in selected EU Member States

Country	Landfill tax in EUR/tonne of waste	Landfill bans	Landfill rate of waste excluding major mineral wastes 2018
Poland	EUR 46/tonne	Since 1.1.2013, ban on biodegradable waste collected separately. Since 1.1.2016, ban on combustible waste with > 5 % TOC, >8% LOI, Calorific value > 6MJ/kg	27%
Hungary	In 2021, EUR 19.35/tonne	Since 2002 on untreated waste. Since 2003 on hazardous waste streams including waste tyres, shredded rubber and partially organic wastes.	40%
Slovenia	Non-hazardous waste: EUR 11/t Hazardous waste: EUR 22/t	Since 2011, ban on calorific value > 6 MJ/kg of dry matter, TOC > 5% (18% by weight), AT4 > 10mg O2 / g dry matter. This ban also includes mixed municipal waste and separately collected waste.	4%
Austria	Since 2012: landfills for construction or inert waste and soil excavation: EUR 9.20 per tonne; residual waste landfills: EUR 20.60 per tonne; and mass or hazardous waste landfills, including output from MBT: EUR 29.80 per tonne. Untreated MSW that is stored or exported for disposal in a lower standard landfill is taxed at EUR 87 per tonne (Eunomia, 2016[160]). Residues from incineration and co-incineration plants are exempted from landfill tax.	Bans waste with TOC > 5% with exceptions for: mechanical-biological treatment waste with a calorific value > 6600 kJ/kg dry substance; mechanically treated waste with a calorific value > 6600 kJ/kg dry substance and TOC > 8%	12% (provisional)
France	EUR 152 /tonne in 'non-authorized' landfills; EUR 37 /t in 'authorized' landfills with 75% energy recovery from captured biogas; EUR 47 /t in 'authorized' bioreactor landfill cells with biogas recovery; EUR 54/t in other 'authorized' landfills	Ban on untreated waste since 2002. Ban on source separated waste collected for recycling. Ban on waste from municipalities which do not have source separation schemes.	23%

Note: TOC = total organic carbon; LOI = loss on ignition; MBT = mechanical biological treatment. Landfill rate of waste excluding major mineral wastes in the Slovak Republic was 40% in 2018.
Source: Adapted from CEWEP (2021[157]) unless otherwise stated. Landfill rates are from Eurostat (2021[161]).

Other improvements of the system relate to removing some of the exceptions to the landfill tax and to implementing supporting measures, such as incineration taxes (see the next section) and ensuring enforcement and monitoring to minimise illegal waste disposal (on illegal disposal of CDW, see Chapter 5) as well as enhanced cooperation between municipalities on municipal waste management. Since the Slovak Republic has a high number of municipalities (around 3 000) responsible for municipal waste management, there is fragmentation, inefficiencies and a lack of economy of scale in waste collection and treatment (European Commission, 2019[81]). Small municipalities also face constraints in terms of infrastructure for separate collection, lack of funding and technical capacity in waste management. As recommended by the EC in 2018, possible actions to strengthen cooperation between Slovak municipalities include the setting up of a national forum to engage government institutions, municipalities and relevant stakeholders in municipal waste management. Moreover, a national system of technical support could be established, providing guidelines on specific areas of separate waste collection and peer-to-peer networks for the sharing of best practices (European Commission, 2018[162]). International best practices on increasing inter-municipality cooperation in municipal waste management include examples from countries such as Japan, Poland and Norway, where municipalities collaborated in joint contracting of waste collection and transport services to achieve economies of scale. Other countries, such as Slovenia, adopted a different approach by legally allowing municipal waste to be managed on a wider scale than municipality-level (OECD, 2019[136]).

Several countries have also implemented landfill bans (see CEWEP (2021[157])). The Slovak Republic is planning to introduce landfill restrictions and bans in line with the EU waste legislation.

Incineration taxes

To ensure that high landfill taxes do not divert disposal of waste to incineration rather than to recycling, some countries levy incineration taxes with a similar motivation to landfill taxes. If both landfill and incineration involve external costs, taxing only one disposal route will encourage excessive diversion to the other (Sahlin et al., 2007[163]). The price of landfill and incineration for combustible waste in a number of countries and regions can be seen in Table A D.9.

Table A D.9. Comparison of the price of landfill and incineration for combustible waste, various years 2012-14

	Landfill (€/tonne)			Incineration (€/tonne)			After-tax cost differential
	Cost	Tax	Total	Cost	Tax	Total	(incineration as % of landfill)
France	65	16	81	117	4	121	149
Catalonia (Spain)	34	12	46	50	9	59	128
Netherlands	20	17	37	71	13	84	227
England (UK)	26	101	127	109	0	109	86
Austria	70	87	157	125	8	133	85
Sweden	114	54	168	59	0	59	35
Wallonia (Belgium)	70	76	146	70	10	80	55

Source: Adapted from ADEME (2017[164]) available from OECD (2021[27]).

The Slovak Republic could introduce incineration taxes in the medium- to long-term to safeguard against the potential undesirable rise in incineration replacing landfilling. While the country currently has a low incineration rate, foreseen landfill restrictions might drive waste operators towards investing in incineration capacity in the future. Such a tax has been also suggested in a recent OECD report analysing the Slovak environmental fiscal policies (2020[165]). An incineration tax may include an energy tax on the use of fossil fuels or a tax on fossil CO_2 emissions from the incineration of waste, as was the case in Sweden (Sahlin et al., 2007[163]).

Annex E. Circular Economy in the Construction Sector

Circular economy strategies in buildings along their life cycle

Table A E.1. Circular economy strategies by life cycle stage

Life cycle phase	Circular economy strategy
Extraction	Prioritise the production of other types of cement as a substitute for ordinary cement
	Avoid toxic and hazardous substances in building materials and components
	Increase the share of recycled and recovered input materials to produce construction materials
	Reduce the dependence on critical raw materials
Design	Design for Disassembly/Reassembly
	Design for flexibility and adaptability, e.g. through application of BIM and open source design
	Reduce the use of material at design stage (reducing overspecification)
	Use high-quality, durable and long-performance materials and components that are easy to maintain and upgrade
	Prepare a disassemble and a dismantling plan, e.g. developed through BIM and made accessible through a Digital Product Passport.
	Design houses and their components in a way that their final energy consumption is as low as possible (Passive House)
Construction	Reduce amount of materials used, especially those that are scarce/critical
	Maximise amount of recovered and recycled construction materials and products
	Use of modular and prefabricated buildings and their components, e.g. enabled through 3D printing and additive manufacturing
	Maximise the amount of alternative and renewable materials – e.g. use timber as the structural material in buildings instead of mineral materials
	Reuse building materials/components
Use	Building and its users consume minimal water and energy, e.g. through more efficient use patterns and sensor technology
	Apply internal circular resource cycles, e.g. grey water systems
	Increase the share of renewables in the use- and building-related energy demand (in case of surplus energy, store it or sell it to the grid)
	Do frequent maintenance checks, enabled through predictive maintenance, and repair immediately if necessary
	Prolong building's lifetime through small renovations and retrofits
	Optimise the space in buildings
	Increase the occupancy rate by sharing spaces, multi-use concepts or renting out the space if unutilised
	Extending life and value retention of the existing interior, furniture and relevant facilities through e.g. leasing concepts, such as LED
End-of-life	Take building materials and components apart (disassemble and deconstruct) to that they can serve an input material for a new product or building
	Recycle building materials
New lifetime	Extend buildings' lifetime by renovating rather than demolishing and rebuilding
	Reuse or repurpose building materials and components

Note: This is not an exhaustive list of strategies. Not all listed strategies are addressed in the chapter.
Source: Adapted from Circle Economy, DGBC, Metabolic (2021[166]) and Ramboll, Fraunhofer ISI and Ecologic Institute (2020[167]).

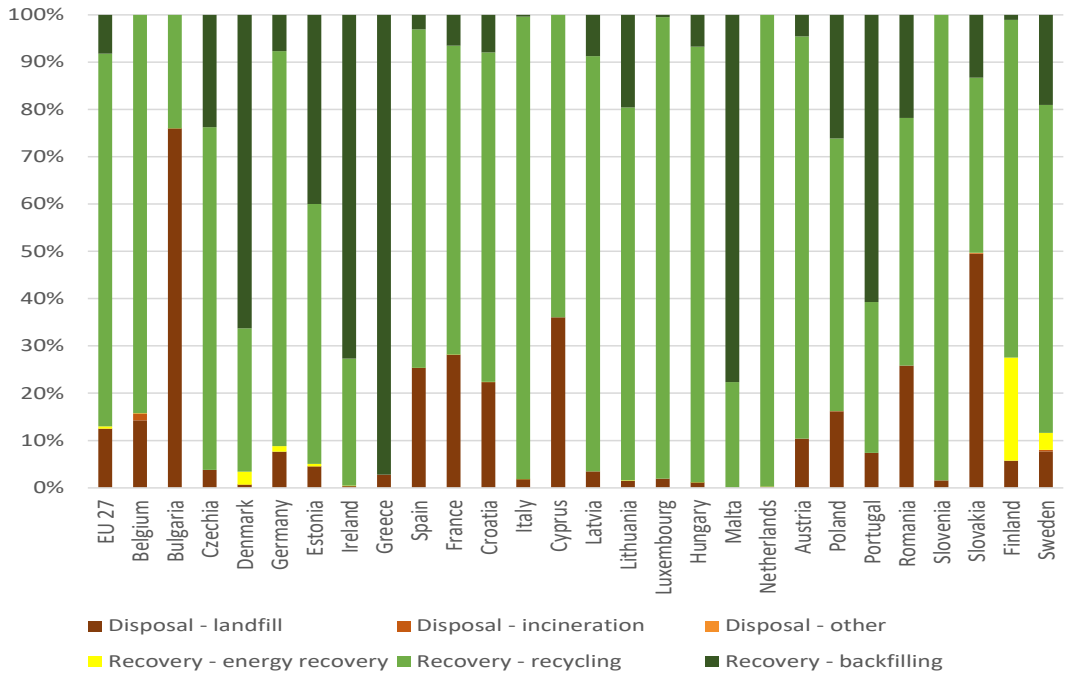
Construction data in the Slovak Republic

Table A E.2. Construction production by SK NACE Rev.2

Million EUR, at current prices	2017	2018	2019	Share - 2019
Construction of buildings	**1 883.37**	**1 694.06**	**1 841.09**	**37%**
Construction of residential buildings	372.48	368.97	461.12	9%
Construction of non-residential buildings	1 179.00	1 134.00	1 126.27	23%
Construction of residential and non-residential buildings n.e.c.	329.11	191.09	247.62	5%
Civil engineering	**1 922.46**	**2 260.83**	**1 872.00**	**38%**
Construction of roads and motorways	1 174.59	1 536.02	1 135.76	23%
Construction of railways and underground railways	119.18	130.67	134.06	3%
Construction of bridges and tunnels	192.78	174.87	183.76	4%
Construction of utility projects for fluids	136.73	131.73	132.83	3%
Construction of utility projects for electricity and telecommunications	175.95	147.79	113.60	2%
Construction of other civil engineering projects	123.24	139.75	171.99	3%
Specialised construction activities	**1 050.89**	**1 161.50**	**1 209.28**	**25%**
Demolition	7.11	6.25	8.92	0%
Site preparation	34.62	60.00	75.45	2%
Electrical, plumbing and other construction installation activities	400.31	437.51	483.36	10%
Building completion and finishing	207.34	226.97	241.34	5%
Other specialised construction activities	371.40	422.03	397.43	8%
Total	**4 856.73**	**5 116.38**	**4 922.36**	

Source: Statistical Office of the Slovak Republic (2020[168])

Figure A E.1. Treatment of mineral waste from construction and demolition in EU countries, 2018



Source: Eurostat (2021[169])

Slovak policy and legal frameworks relevant to the construction sector

Box A E.1. Circular economy ambitions in the Slovak construction sector

Short-term goals

The Slovak government has prioritised building renovation and construction waste in its reform efforts. This dual prioritisation is a product of its strategy to scale up renovations of public buildings as part of the Slovak Resilience and Recovery Plan (RRP). To align renovations with circular economy principles for the end-of-life buildings phase, the short term-priority of the Slovak RRP is to reform the treatment of the construction waste. The RRP includes the following measures:

- Introducing mandatory selective demolition, including a system of inspection, before and after demolition for constructions and demolitions. Stipulating the obligation to establish a waste-sorting site, then systematically enforcing this obligation.
- Introducing legislation determining the quality standards for recycled construction and demolition waste.
- Introducing mandatory green public procurement when contracting construction work in public administration. Ensuring the mandatory use of recycled materials meeting the required building standards as substitutes for natural resources, under the framework of publicly funded construction activities, if technically and economically feasible. Construction works financed from public resources (especially the construction of roads and infrastructure) utilising repurposed construction and demolition waste, construction materials and products of waste recovery processes (material or energy) provided that they meet functional and technical requirements, or construction products produced from construction and demolition waste or by-products.
- Simplifying the rules for using processed construction and demolition waste and recycled materials from such waste for backfilling, while maintaining high standards of environmental protection and public health.
- Prioritising the recycling of construction waste over its utilisation in backfilling.
- Updating legislation for the use of uncontaminated excavated soils and other naturally occurring materials in connection to the end-of-waste criteria for excavated soils and the forthcoming legislation on backfilling.
- Analysing the possibilities of the reuse of construction waste from demolition and renovation work.
- Increasing the circularity potential in the area of construction waste and the construction sector in general, leading to a higher recycling rate and construction waste prevention.
- Ensuring that at least 70% (measured by weight) of non-hazardous construction and demolition waste (excluding naturally occurring materials defined by the EWC category 17 05 04) created in construction is processed for reuse or recycling, or by other waste recovery methods using waste as a replacement for other materials, including backfilling.
- Requiring at least 70% wood products used in renovation of structures, cladding and surfaces will consist of reused or recycled materials, or will be sourced from sustainable forests certified by third-party audits performed by accredited certification bodies, e.g. FSC/PEFC norms or equivalents.
- Improving data collection systems in the construction sector.

Long-term ambitions

The relevant Slovak authorities would like to build on the momentum of the construction reform as outlined in the Slovak RRP and pursue the vision for the Circular Economy Roadmap to embrace the following principles in the long-term:

- Decreasing the use of primary resources. Using renewable and sustainable material resources while preserving primary natural resources and limiting environmental harm connected to the extraction of primary resources.
- Limiting the use of plastics in construction.
- Increasing material efficiency in construction and increasing the lifespan of building, implementing measures increasing lifespan of existing buildings and creating new benchmarks for forthcoming construction projects.
- Improving buildings use.
- Enhancing aspects of construction waste management, including enhancing reuse and recycling of construction waste. Construction waste reforms will complement the envisaged building renovation activities.

Source: Ministry of Finance of the Slovak Republic (2021[170]) and the Ministry of Environment of the Slovak Republic.

Gap analysis and policy recommendations for the construction sector policy

Cross-cutting measures

Box A E.2. Challenges with monitoring CDW flows in the Slovak Republic

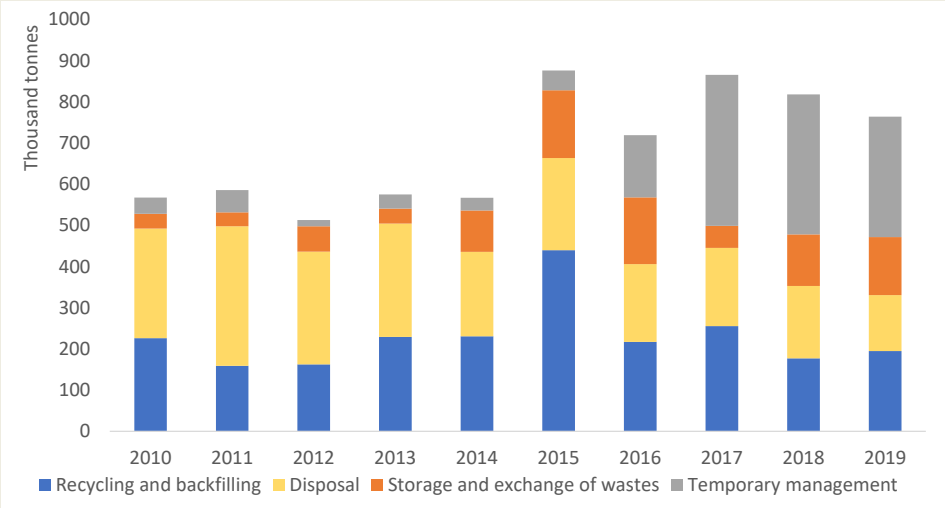
Statistics on CDW production can range from 333 000 tonnes to 784 000 tonnes in 2019

Based on the data provided by the Slovak Ministry of Environment, the production of CDW* can range from 333 000 tonnes to 784 000 tonnes in 2019. This depends on whether the statistics include temporary waste operations (i.e. collection, handing over to the trader or to the intermediary) of more than 300 000 tonnes. Another 140 000 tonnes of waste were reported as treatment operations storage (R12)** and exchange of wastes (R13)*** for submission to recycling. For the latter wastes, information on the final destination is missing. Figure A E.2 shows that the amount of waste reported as temporarily managed increased significantly since 2015 due to the change of reporting methodology for waste.

The unknown final destination of CDW leads to unknown real recovery and recycling rate of CDW

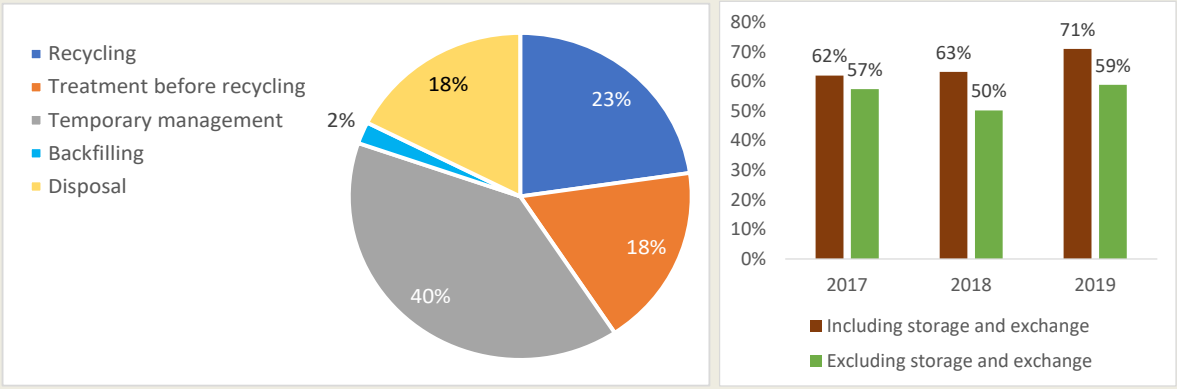
It is also difficult to estimate recovery and recycling rates of CDW. To calculate the 2019 CDW recovery rate, the Slovak Ministry of Environment wanted to assume the same “recovery-disposal ratio” for waste that is temporarily managed as for waste for which the final management is known. In addition, they wanted to assume that all waste reported as stored (code R13) and exchanged (code R12) ended in recycling (as final destination). This would result in a CDW recovery rate of 71% in 2019, compared to the officially reported 51% in 2018 (Figure A E.3). However, the reported data on CDW production and recovery rates for Eurostat did not include data on temporary management, storage and exchange in previous years, which was in line with the Eurostat methodology (Eurostat, 2022[171]). This resulted in lower reported CDW production and recovery rates compared to previous years (before 2015).

Figure A E.2. CDW generation and management in the Slovak Republic



Source: Adapted from data provided by the Ministry of Environment of the Slovak Republic.

Figure A E.3. CDW management in 2019 and CDW recovery rates during 2017-2019



Source: Adapted from data provided by the Ministry of Environment and from Eurostat.
Note: * CDW refers to the waste category 'Mineral waste from construction and demolition' (EWC-Stat 12.1 as used for Eurostat reporting).
** R12 - Exchange of wastes for submission to any of the operations numbered R1 to R11 as defined in Directive 2008/98/EC.
*** R13 - Storage of wastes pending any of the operations numbered R1 to R12 (excluding temporary storage, pending collection, on the site where it is produced).

Box A E.3. The Dutch infrastructure digital approach to the circular economy

Rijkswaterstaat is part of the Dutch Ministry of Infrastructure and Water Management responsible for the design, construction, management and maintenance of the main infrastructure facilities in the Netherlands. The maintenance of over 6000 assets like bridges, sluices, viaducts, and aqueducts, and over 3000 km of national road infrastructure, cannot be achieved without having access to detailed information about these assets. Notably, data and information on how assets perform, which materials

or components they are made of, how the individual elements are connected, and which repair and maintenance they have undergone during their life time, are crucial for the potential future reuse of embedded materials. While in the past such informational aspect has not been taken into account, during the past years Rijkswaterstaat embarked on an explicit ambition of becoming a data driven organisation (Rijkswaterstaat, 2019[173]).

Some of the data-driven initiatives of Rijkswaterstaat include the initiation of discussions about the digital construction sector through the establishment of a public-private discussion platform (see Box A E.4), the piloting of the Dutch start-up Excess Materials Exchange (Excess Materials Exchange, 2019[174]), which aims to develop a cross sectoral "dating site for secondary materials" based on blockchain technology, and supporting the establishment of an online materials library by another Dutch start-up Madaster, which aims to simplify the reuse of materials and become the central register of materials use in the construction sector (Madaster, n.d.[175]).

Box A E.4. Examples of good practices in strengthening collaboration

Green Deals for innovation in circular activities (the Netherlands)

Green Deals in the Netherlands are an example of successful collaboration in innovation between government, companies and other stakeholders addressing cross-cutting issues. These "deals" represent mutual agreements defining specific initiatives and actions for all stakeholders, including quantitative targets. The government then commits to remove obstacles for concrete sustainable projects by modifying regulations. Several hundreds of such "deals" involved projects related to innovation in the circular economy, most frequently related to recycling (Green Deal, n.d.[98]).

Public-private discussion platform for digital circular construction (the Netherlands)

The Netherlands has started undertaking the first steps towards a digital circular construction sector. Through the establishment of a public-private discussion platform, Rijkswaterstaat, jointly with the National Real Estate company and the National Standardisation body, aimed to create a consensus about the concept of a Circular Building sector (PLATFORM CB'23, n.d.[176]). Over a hundred stakeholders have been engaged in discussions on a number of topics, including how to measure circularity and what type of information the material passports standards would need to contain. The guides on "Core method for measuring circularity in the construction sector" and "Passports for the construction sector" have been drawn up as a result of those discussions. The discussion has now shifted to how this information and data exchange should be organised in practice (DigiDealGO, n.d.[177]).

Government programme for applied research and experimental development (the Czech Republic)

The Technology Agency of the Czech Republic runs a number of national R&D support programmes, including programmes EPSILON and BETA2 for applied Research, Development and Innovation, TREND for new products, production processes and services, and ZETA for cooperation between academia and industry (Technology Agency of the Czech Republic, n.d.[178]). The now closed Funding programme for applied research and experimental development EPSILON financed the project on "TH 04010143 - 3D printer for buildings and prefabricated components for construction 4.0". This project resulted in the development of the largest 3D printer in the country, which was designed to print buildings. The project was a collaboration between the Faculty of Mechanical Engineering and the Faculty of Civil Engineering of the Czech Technical University in Prague and the company Strojírny Podzimek a Podzimek a Synové. Its aim was not only the development of a 3D printer, but also the

mastering of processing and controlling the properties of the printing material. The project also included the design of a test printer. It was developed for initial experiments with suitable 3D printing material (Stavitel, 2022[179]).

Extraction, design and construction phases

Box A E.5. Quality Scheme for recycling CDW (the Netherlands)

Recycling of CDW in the Netherlands started in the 1980's when the country developed its Waste Hierarchy. The implementation of this policy consisted of landfill bans (on materials that can be treated or recycled with best available techniques) and recycling targets. A national plan was developed for CDW by all stakeholders, assigning tasks and responsibilities to each stakeholder. A specific task for the recycling industry was the development of quality assurance schemes.

Recycling started by relatively simple crushing of inert CDW into recycled aggregates. These were used for various applications, including what now is seen as backfilling. Crushing of inert CDW has been the prime activity for many years. As the landfilling of mixed CDW was also prohibited, new plants for sorting of this material were started. These plants recover materials such as wood, metals, plastics and inert materials. The residual fraction is partially used to produce a secondary fuel.

The quality of recycled aggregates improved over the years. Processes improved and so did quality control. For many years now, recycled aggregates are prescribed by the Ministry of Transport purely based on its outstanding technical characteristics. The environmental quality is fully assured through certification schemes* that include the mandatory requirements of the Soil Quality Decree. Increasingly, recycled aggregates are also used in the production of concrete. Recycling of asphalt has gone through a similar process. Nowadays, almost all asphalt is recycled into new asphalt. Wood recycling is also frequent, although a main alternative outlet for wood is still biomass for power generation (energy recovery).

Recycling of several other materials has proven to be more difficult. These materials constitute smaller fractions of CDW and recycling of these fractions usually requires more input. Other materials, which are being recycled progressively are:

- *Flat glass:* A collection scheme exists for flat glass initiated by the glass industry and the glass can be delivered to collection points for free. PVC windows: A collection scheme exists for PVC windows, and also these can be delivered for free to collection points.
- *Gypsum:* A few years ago, an agreement was made between government and industry to make the Netherlands a leader of the recycling of gypsum. Gypsum is kept separate mainly in order to not affect the quality of recycling of inert CDW.
- *PVC pipes:* One recycler has developed a recycling process for PVC pipes. PVC is micronised in order to meet the requirements for use in new PVC pipes.
- *Roofing material:* Bitumen roofing material can be recovered and processed, and used partly in new roofing constructions and partly in asphalt.

Note: * (1) NL-Bsb certificate as required by the Soil Quality Decree that covers environmental quality of end products to be used in or as soil and (2) BRL 2506 certificate as a voluntary means that covers all (other) quality aspects not addressed by CE making and NL-Bsb. It guarantees that the end products fulfil all requirements for use (Fédération Internationale du Recyclage, n.d.[180]).
Source: Fédération Internationale du Recyclage (n.d.[180]).

Box A E.6. Lessons learned - obstacles of upcycling and reuse

The study "Circular Economy and Regeneration of Building Stock: Policy Improvements, Stakeholder Networks and Life Cycle Tools" (Giorgi, Lavagna and Campioli, 2019[181]) identifies the obstacles of upcycling and reuse of CDW. The reason that prevents the activation of a sustainable circular practice at the building level is the lack of expert operators able to disassemble, and of space to store the materials to be reused. These gaps lead to high costs in human labour and difficulties in logistics. However, the main obstacle concerns the legislative framework and responsibility. Nowadays, the legislative framework does not enable the certification of the quality and durability of a reused material, because there is a lack of data and knowledge on the history of the material itself. As a result, even if it is possible to use reused or recycled materials, designers and constructor companies prefer to use new ones only, because they are responsible for the material quality used to build a building.

Box A E.7. Examples of GPP practices and tools applied in construction

The use of GPP in renovation in Flanders

Circular Flanders was established in 2017 with the goal of achieving the transition to a circular economy by 2050. The Government of Flanders has made the circular economy one of its top goals, and the OVAM (Flanders' Public Waste Agency) has been named the project's initiator. Circular Flanders and the Government of the Region of Flanders launched the Green Deal for Circular Procurement (GDCP) in June 2017 with the help of a number of partners. Over the course of two years, more than 150 organisations committed to circular purchasing or assisting circular procurement programs. They presently include sample cases, circular providers, papers, tools, and information for each product group on their online platform (Aankopen Vlaanderen Circulair, 2022[182]).

For example, in 2017, the Agency for Facility Operations issued a tender for the design and construction of the refurbishment of the World Trade Centre's towers. The facility's sustainability components, as well as the procurement procedure's standards, were defined and measured using the Government of Flanders' GRO sustainability tool, which is used for all construction projects regardless of scale. The minimum requirements of the tender (technical specifications) were determined using GRO, while the award criteria (50% based on total costs and 45% on quality, of which 20% were circular use of materials, energy and maintenance) focused on circularity elements (European Commission, 2021[183]).

Introducing recycled content requirements within GPP

Japan has a well-established framework for GPP, including a mandatory application of GPP criteria for government agencies across a wide array of product categories (UNEP, 2017[184]). Under the Act on Promoting Green Procurement, government agencies need to apply GPP criteria for public works, which includes construction works (Ministry of the Environment Government of Japan, 2000[48]). The relevant GPP criteria for some of the construction products include:

- Use of recycled heated asphalt compound or asphalt compound with steel slag as asphalt compound.
- Use eco-cement as cement for concrete structures and concrete products that do not require high strength. Eco-cement is defined as cement that uses ashes resulting from incineration of

city waste, and the like, as the main ingredient. This cement contains no less than 500kg in dry weight of such waste material per 1 tonne of final product.

- Use recycled unplasticised polyvinyl chloride pipes for sewage or vent as plumbing material.
- Use fly-ash cement whose raw material contains more than 10% fly-ash as blended cement.
- Use pavement material, which contains 20% or more of recycled material by weight (e.g. steel slag, building material waste, paper sludge, stone chips, etc.).
- Use ceramic tiles, which contain 20% or more of recycled material by weight (e.g. plastic waste, building material waste, waste rubber, and quarry or kiln waste).

The Green Purchasing Network, a non-profit organisation with 2 400 member organisations from businesses and local governments, supports the Ministry of Environment in Japan as the main government agency managing GPP. This organisation helps with the implementation and promotion of GPP, particularly in the areas of training and awareness raising (UNEP, 2017[184]). In Japan (as well as in China), eco-labelling criteria are widely used as the basis for green public procurement.

GPP tools to facilitate the evaluation of environmental award criteria in the Netherlands

The Department of Public Works of the Ministry of Infrastructure and Water Management (RWS) uses the Most Economically Advantageous Tender (MEAT) methodology ensuring the evaluation of specific quality aspects. To assess the sustainability of tender submissions, the RWS assigns a value according to the effort made by the bidder to improve quality focusing on CO_2 emission reduction (using a CO_2 performance ladder certification system) and environmental impact mitigation (through the "DuboCalc" software, a life cycle analysis (LCA) based tool to calculate the sustainability of materials). Tenderers can use both tools to calculate the precise quality value of their bids. The more effort the bidder makes to improve the quality of the bid, the higher the monetised value that is deducted from the quoted offer price. In this way, the bids that score highest in sustainability have higher chances of winning the tender.

The CO_2 performance ladder certificate – which is not compulsory at Invitation To Tender (ITT) stage as long as it is provided within one year of signing the contract – obliges the tenderer to comply with a set CO_2 reduction target. Holders of the certificate have their submission price reduced by a value proportional to the CO_2 emissions reduction effort. If the actual quality does not comply with the set target, then a sanction follows that is 1.5 times the calculated price for quality value. In practice, the maximum environmental value added is often 10-20% of the awarded tender. However, before including environmental quality as a distinguishing factor in the tender process, the RWS initially always investigates whether sustainability or environmental quality will be sufficiently distinctive when proposals are submitted (OECD, 2015[77]).

Use of digital tools in public construction works in Italy

Following EU Directive 2014/24 that introduces the possibility of using digital methods and tools, such as Building Information Modelling (BIM) in public procurement of construction works, Art.23.1 of the new Law regulating public procurement (Codice degli Appalti of 2016) specifies the gradual introduction of BIM as evaluation parameter for award criteria. BIM allows for several benefits in the management of construction works, gaining total control along the entire life cycle of the process. The digitalisation of public procurement processes facilitates the reduction of construction costs, time, and polluting emissions. The mandatory use of BIM is introduced gradually, starting from works over EUR 100 million value in 2019 until total coverage of public construction works in 2025.

Cooperation through green thematic buyers' groups in Finland

A network-based competence centre for sustainable and innovative public procurement (KEINO) supports the development of sustainable and innovative procurement in Finland through the facilitation of buyers' groups. Each participating organisation is responsible for its own procurement but cooperates

with other procurement experts to focus on common challenges, developing joint criteria and tools, and organising market dialogues. The groups also collect existing best practices from Finland and abroad. Each buyers' group work is facilitated by an expert from KEINO, which is funded by the Finnish Ministry of Economic Affairs and Employment. In 2021, there are groups focusing on low-carbon construction, clean vehicles and transport, and zero-emissions construction sites, among others. Despite the fact that the buyers' groups do not currently focus on circular public procurement, they provide an ideal setting for brainstorming on how circular economy components may be included into future procurements (Interreg Europe, 2022[185]).

Box A E.8. Piloting circular design

One of the barriers to the circular economy transition in the construction sector is the lack of experience. Small-scale pilot projects might help capturing initial learnings and new skills.

Building Information Modelling

BIM is at the core of the digital transformation in the construction industry, providing multidisciplinary data to create digital representations of buildings' characteristics. It is an open cloud for integrated design, modelling, and planning, facilitating a transparent flow of information between stakeholders and collaboration throughout the project phases. Besides lowering the costs and increasing the speed of delivery, BIM also allows for efficiency gains and lower emissions and waste.

The European BIM market is predicted to reach EUR 2.1 billion in 2023 (European Construction Sector Observatory, 2019[186]). The growth is driven by integrated urban development trends (e.g. smart cities, green buildings and increase in renovation projects) and government policies (i.e. adoption of BIM in public procurement).

Material passports (digital building passports)

Material passports enable utilising buildings as material banks, by providing detailed documentation of materials, components and products within their structures (including information on their origin, supplier, current condition, and environmental impact). Moreover, digital datasets allow auditing material health and environmental impact, and provide information on adaptability and recyclability in the planning and design phases as well as during remodelling and deconstruction of buildings. They also enhance the recovery of materials to maximise their reuse potential (BAMB, n.d.[187]; Block, Schouten and Dasnois, 2020[188]). Beyond identifying components, material passports also contribute to gain a better understanding of the value of buildings. For example, a study for the Amsterdam Metropolitan Area calculated that the 2.6 million tonnes of building materials released yearly through renovation and demolition in Amsterdam have a value of EUR 688 million (Block, Schouten and Dasnois, 2020[188]).

Modular and reversible designs

A modular construction is a prefabricated building designed in the factory and transported to the building site for assembly, the layout of which can be easily adjusted to current and future needs (Saint Gobain, 2021[189]). A modular pilot scheme of eco energy efficient houses was implemented in the non-commercially viable sites of West Midlands in the UK. The houses were completed offsite within a controlled factory. They exceeded building regulations with greater cost-effectiveness and speed of delivery, well in line with the government's ambitions for greener and more energy efficient houses. The sustainability benefits of the project included waste reductions (by up to 80%) and CO_2 reductions (by

50%) when compared to traditional site construction, as well as a high EPC rating (A+ generating just 2 tonnes of CO_2 annually, compared to a UK average of 6 tonnes), and reduction in residents' fuel costs through solar panels with battery backup (by 20%) (Constructing Excellence, 2020[190]).

A reversible construction is a building designed to serve several uses throughout its lifetime. The universal design, achieved through large surfaces with open spaces and wood or metal frames with light inner lining, allows for easy dismantling, redeployment and reuse without the need for demolishing (Saint Gobain, 2021[189]). A pilot project for an educational transformable wooden building was launched as part of the Regional Programme for the Circular Economy in Belgium. The aim was to acquire insights, knowledge and skills on building reversibility and transformability, reclaimed materials, as well as resource and energy efficiency. The building was developed by an interdisciplinary Brussels training centre. Built by trainees, the building has been assembled and disassembled on a yearly basis, with changing functions including as an office, a shop, and an acoustic laboratory (BAMB, n.d.[191]).

End-of-waste phase and reuse and recycling

Box A E.9. Landfill taxes for inert and construction waste

A number of countries have implemented landfill taxes for inert and construction waste. Figure A E.4 provides an overview of these taxes from the past decade. Although somewhat outdated (most of the countries increased their landfilling taxes since, with Lithuania, Switzerland and UK reaching EUR 30.41 per tonne, EUR 4.3/tonne, and GBP 3.10/tonne of inert waste from 2020), it provides an insight into different magnitudes of such taxes across countries. More recent data confirms these differences, with landfilling costs spanning from EUR 5 to more than EUR 100 per tonne of waste (CEWEP, 2021[157]).

Figure A E.4. Overview of the landfill tax for inert waste, including CDW, for selected countries

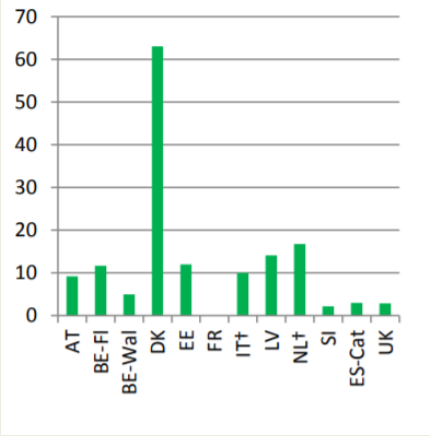


Table 6.3 Landfill taxes for different Member States

Member State	Tax €/t of waste	Brief description
Austria	8	Excavated materials and inert construction waste
	18	Inert residues
Belgium (Flanders Region)	0.32–7.73	Waste from mining and mineral industries and to recycling and soil sanitation residues
	10.83	Inert waste and inert asbestos
Czech Republic	15.85	Disposal of non-hazardous waste in landfill
Denmark	50.31	Landfilling tax
	28.4	Landfilling of residual waste (slag and fly ash)
Finland	30	Waste left at public landfill sites. Fly ash excluded
France	7.5–18.29	For non-hazardous and hazardous waste. Inert waste not taxed
Germany	–	No taxation
Italy	1.03–10.33	Industrial waste from mining extractive building and metalworking sector activities
Netherlands	13.98	Non-combustible waste. C&DW are banned from landfill since April 2000
Spain	3–10	C&DW
UK	3.36	Ceramic and concrete materials, furnace slags and ash
	43.06	Active waste

Source: Böhmer, 2008; EC *et al.*, 2009.

Source: European Commission (2012[192]) and Pacheco-Torgal et al. (2013[193]).

As an example of the effectiveness of the landfill tax, Denmark is among the countries that were early adopters of such taxes. It also has one of the highest tax rates across the EU. Implemented in 1987, and progressively increased since then, the average gate fee for landfilling has been EUR 44 per tonne, while the actual landfill tax was laid at EUR 63 per tonne (RECO Baltic 21 Tech project, 2012[191]). This

tax has served as a tool to assign an economic value to the damages caused by landfills that can be added to the landfill costs. The increase in overall landfill costs encourage consumers and businesses to produce less waste. Denmark has an overall CDW recovery rate of 97% (2018) (Eurostat, 2022[195]). The landfill tax, accompanied by subsidies for cleaner technology and recycling projects, the establishment of local government sorting schemes, virgin material taxes, regulations on the use of waste material in construction, and rules on selective demolition for bricks and concrete, led to a remarkable increase in recycling of CDW (COVEC, 2012[196]). However, part of the recycling behaviour can be explained by attitude factors, rather than the cost of waste disposal.

Box A E.10. End-of-waste criteria for CDW used as aggregates

Definitions

According to Article 6 of the Waste Framework Directive (WFD), "waste which has undergone a recycling or other recovery operation is considered to have ceased to be waste if it complies with the following conditions:

- The substance or object is to be used for specific purposes;
- A market or demand exists for such a material;
- The substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and
- The use of the substance or object will not lead to overall adverse environmental or human health impacts."

Alternatively, a material may cease to be waste if Article 5 of the WFD applies: "Member States shall take appropriate measures to ensure that a substance or object resulting from a production process the primary aim of which is not the production of that substance or object is considered not to be waste, but to be a by-product" if certain conditions are met.

Depending on the local regulation, individual countries have adopted a very specific terminology for End-of-waste (EoW) criteria and are targeting different types and compositions of CDW. For instance, recycled aggregates may be classified according to their *weight* (i.e. particle density more or less than 2000 kg/m^3), *size* (from fine through coarse to all-in), or *composition* (based on the weight percentage of each component, such as concrete, glass, ceramic, plaster).

Uses and restrictions

The uses and restrictions for the secondary raw materials recovered from CDW vary across countries. In function of the degree of environmental protection these include *bound applications* with negligible potential release of components to the environment (such as structural and non-structural concrete) and *unbound applications* (such as base and sub-base layers under parking lots and filling material in noise reduction barriers).

The restrictions to the uses usually apply to protected areas, areas liable to flooding, as well as close protection perimeters of drinking water sources. Moreover, limitations may be imposed on recycled aggregates produced from CDW originating from locations with potentially contaminating activities, or industrial ruins that may have suffered soil-polluting activities. Some countries have developed legislation establishing specific environmental conditions for recycled aggregates to be used (in relation

to leaching references and various attenuation factors). Less frequently, countries impose a check on the limiting values to organic or inorganic compounds.

Technical standards

Countries tend to establish different technical standards for the application of recycled materials from CDW. These include different specifications for *geometric*, *physical* and *chemical requirements*, as well as *durability*.

Source: Adapted from Tecnalia (2021[197]) and European Commission (2020[198]).

Box A E.11. Waste identification, source separation and collection (France)

The French regulation for construction and building projects specifies how to identify waste from demolition and refurbishment of buildings. The buildings concerned are those with a surface area of more than 1 000 m^2 for each space that has been exposed to hazardous substances. The works addresses the reconstruction and/or demolition of a major part of the structure of the building. The contracting entity has to carry out the identification before applying for the demolition permit or before accepting estimates for contracting.

The identification lists the nature, the amount and the location of material and waste and their means of management – notably those that are reused on site, recovered or eliminated. The list is provided to anyone involved in the demolition works.

At the end of the works, the contracting authority writes an assessment of works indicating the nature and the amount of material actually reused on site and that of waste that is recovered or eliminated. The contracting entity sends the form to the French Environment and Energy Management Agency, which presents a yearly report to the Ministry in charge of construction (French Government, 2012[199]).

Waste identification can be enabled through digital tools. Examples are a Digital Product Passport that hold information about the materials used in construction products or even whole buildings, such as Madaster (Madaster, n.d.[200]), or the use of BIMs that could support the estimation of CDW (Pellegrini et al., 2020[201]).

Box A E.12. EPR law for CDW in France

As of January 1, 2022, all producers, importers, and retailers of construction products and materials in France must ensure the free recovery and treatment of the resulting sorted waste. However, they may only do so through one or more eco-organisations and in collaboration with local authorities. Article 1 of Decree no. 2021-1941 relating to the fight against waste and the circular economy specifies the materials covered by the EPR scheme (all products and materials intended to be permanently incorporated in a building, with the exception of those used only for the duration of construction works) and those that are excluded (excavated earth, industrial tools and technical equipment, basic nuclear installations, and funerary monuments) (Journal Officiel de la République Française, 2021[62]). Article 1

further sets the criteria for waste sorting and collection, and the obligations of eco-organisations in terms of organisation and geographic coverage of waste collection.

The marketers of construction products and materials will be required to be organised within streams to ensure the free recovery of sorted waste, including windows, carpets, or concrete. France is also intending to install new professional waste collection centres, where sorted materials by professionals will be taken back for free (Ministere de la transition ecologique, 2020[202]; Journal Officiel de la République Française, 2021[62]).

Methodological approach to assess investment needs

Administrative costs

Introducing **mandatory selective demolition** requires investment costs for the establishment of a system of audits, which would require preparing training materials and conducting training sessions for auditors. The PARADE project, supported by the EIT Raw Materials under Horizon2020, developed life-long education material including best practices for pre-demolition waste audits (PARADE, n.d.[203]). This project involved several members, including one Slovak university, and resulted in materials, such as lecture slides in Slovak, which may be further developed and used in training for auditors. Based on available international data, the costs of organising training sessions and preparing training materials amount to EUR 50 000 per training. However, if studies were conducted by national experts, prices could be 20% lower given the purchasing power parity (PPP) of the Slovak Republic compared to the EU average level.

Examining the potential to **revise zoning codes** is associated with awareness raising initiatives (possibly in the form of a training), with local municipalities being the target audience. Based on the review of waste management, construction, and environment related training in the Slovak Republic, and assuming that these would also be provided by local experts, the cost ranges from EUR 100 to EUR 200 per person per training. According to the information provided by the Association of Towns and Villages in the Slovak Republic, there are approximately 190 offices for the Department of Building and Construction Regulations, which jointly operate in several municipalities. Assuming two participants per office would attend such a training, the total cost of such activities amounts to approximately EUR 38 000 to EUR 76 000.

Changing or introducing new legislation has related administrative costs, which can include the costs of resources being devoted by industry representatives and civil servants to negotiate and prepare the legislation. Such costs can vary significantly, depending on the scale of change, opposition from the private sector and the like. The introduction of an aggregates tax would require a new legislation, while an increase of a landfill tax would only require a legislative amendment as the legislative framework for landfill taxes is already in place. In Denmark, the administrative cost of the implementation of the raw materials tax was estimated at DKK 752 000 (Ecotec, 2001[204]). In the Slovak context, this would equal to around EUR 60 000 after adjusting for PPP. Assuming that investment costs associated with studies range from EUR 30 000 to EUR 300 000, and those associated with the preparation of legislation are around EUR 60 000, total administrative costs range from EUR 90 000 to EUR 360 000 on average per recommendation.

Investment cost for innovation support (hubs, pilot projects)

Pilot projects: To address the missing circularity in the design phase, the Slovak Republic might consider to apply and test circular economy strategies through deconstruction and new construction pilot projects. These may focus on testing building information modelling (BIM), exploring the use of material passports, and integrating these with reversible and modular building designs. A study by the European Commission on BIMs (2021[205]) provides three case studies, including the refurbishment project of a public school building, the construction of a new public building hosting administrative offices and laboratories, and the

construction of a public residential complex built by a national public authority. All projects adopted BIM during construction. The direct costs of BIM, including model costs and coordination costs, ranged from around EUR 7 000 to 75 000 depending on the size and scale of the project. Since the location or the year of the construction of these projects is not known, we used this range for potential Slovak pilot project.

Collaborative platforms: To enhance collaboration and ensure support in implementation of policy measures, a platform set up as a public-private-partnership can act as an important vehicle to support stakeholders in the circular economy transition. This platform should represent for stakeholders, on the one hand, a space where different stakeholders can collaborate and, on the other hand, a one-stop-shop to find information on issues encountered on their journey towards circularity. Setting up such a platform would require an office space, which also holds the capacity for small events, IT infrastructure and its costs of development, costs related to engaging stakeholders, developing knowledge, research, development and user cluster, promotion of the platform and events management. In addition, a location and ICT equipment would be needed. The investment costs are estimated at approximately EUR 200 000 based on information from experts and recent projects with a similar measure. A cheaper option can be to set up an inter-ministerial working group that collaborates on topics related to circular economy. For this option, no additional investment is needed as existing structures and capacities can be used.

Renovation lab programme: Stimulating the use of secondary and renewable materials in renovation would be associated with the establishment of a "renovation lab" programme. In Belgium, the Living Labs Brussels Retrofit project promotes renovation of housing by creating privileged spaces destined for research and innovation: the living labs. The project consists of five living labs involving twenty industrial, research and non-profit organisations, and a coordinating structure. Over four years, the labs will aim to scale-up the uptake of retrofitting by providing space for research and innovation, supporting acquisition of know-how and improving cooperation with the construction industry. Total investment for the project “Living Labs Brussels Retrofit” was EUR 5.4 million, with the EU’s European Regional Development Fund contributing EUR 1.8 million through the Operational Programme.

Another initiative is a RENOLAB, launched in 2021 by the government in the Brussels region, which aimed to support designers, renovation companies and owners in the development and implementation of climate-neutral construction and renovation projects. These projects can focus not only on ideas to remove barriers to renovation, but also on financing exemplary circular and sustainable projects. The project is funded through the regional Recovery Plan with an amount of more than EUR 13 million. Similar projects or initiatives in the Slovak Republic would be associated with investment costs of EUR 3.5 to 8.4 million after PPP adjustment.

Innovation hub: For the construction phase, it is recommended to encourage business model innovation through investments in new technologies, incubators and accelerators. These investments can be supported by subsidy schemes, such as the Danish Eco-innovation Programme which focuses on sustainable construction, water, climate change adaptation, circular economy and recycling of waste, among others. For 2019, a total of almost DKK 90 million (EUR 12.1 million) is available under the scheme. New design concepts and innovative building products are also funded under the German R&D Programme for exploring a resource efficient circular economy – building and mineral cycles (“ReMin”). In the Slovak Republic, the innovation, research and development of the circular economy are planned to be supported by the forthcoming Partnership Agreement for 2021 – 2027 as part of Policy objective 1 (Ministry of Investments, Regional Development and Informatization of the Slovak Republic, 2021). The pre-allocation of funds to this policy objective amounts to EUR 1.9 billion. In the UK, GBP 72 million has been invested to establish a Construction Innovation Hub that supports collaboration in the construction sector. After adjusting for PPP and GDP per capita, this would amount to EUR 28 million in the Slovak Republic.

Investment costs for waste infrastructure

Several policy recommendations indirectly aim at increasing the CDW recycling rate. These include the aggregates tax, quality standards, minimum recycled content requirements for construction materials, mandatory selective demolition or an increase of landfill tax rates. These policies would result in a higher demand for recycling capacities, and therefore, potentially in increased investment needs for additional waste recycling infrastructure. The additional total investment associated with these policies is estimated to range from zero to EUR 3.6 million. This seems to be a low value estimate but it is based on the best available data and methodology.

The total additional investment need for the construction of new waste recycling infrastructure depends on several assumptions. Firstly, it is assumed that implementing the proposed policy recommendations would result in an increase of recycling rates of CDW to at least 88%, the EU27 average in 2018. In terms of CDW generation, the calculation relies on the data provided by the Slovak Ministry of Environment (see Box A E.2). The potential annual increase of CDW due to the planned renovation activities under the RRP is at least 100 to 280 000 tonnes, which is also taken into account. According to the available data, annual recycling capacity is 2 to 6 times higher than the estimated total amount of CDW. As a result, no additional investment in new waste management infrastructure for CDW is expected to be needed. Taking into account the high data uncertainty of current recycling capacities for CDW, it may be assumed that operational annual recycling capacity reaches only approximately 200 000, based on the amount of CDW recycled in the past years.

Factors that influence the need for additional recycling capacities are explained in detail in the sections below and include:

- Scope and ambition of a policy measure;
- Current recycling capacities for CDW and their availability;
- Current and future potential of CDW generation and treatment;
- Unit investment costs of building recycling facilities.

Data uncertainty and inconsistencies in the methodologies applied to estimate recycling capacities for CDW make it difficult to correctly evaluate and estimate the costs of CDW recycling facilities in the Slovak Republic. These challenges could be addressed by improving data collection to enable monitoring waste material flows from producer to the final waste processor. Data on capacities and their utilisation should be regularly updated as well. This should be included in the forthcoming information system for waste management (ISOH).

Scope and ambition of a policy measure

The ambition of a measure can vary significantly and its effect is difficult to estimate. Therefore, the increase in the recycling rate of CDW is typically considered a result of multiple policies, which complement each other. As an example, Box A E.13 provides an overview of investment requirements associated with the introduction of aggregates taxes. Research shows that if the aggregates tax is low, there is almost no effect, hence, there is no need for additional investment into new recycling capacities for CDW.

As a result of the proposed policy recommendations, it is assumed that the Slovak Republic can achieve a CDW recovery rate of at least 88% (the EU average in 2018), including a backfilling rate of only 8%. It is also assumed that this rate will be a result of the combined effect of all proposed measures, as within the scope of this report, it was not possible to evaluate the individual impact of each proposed measure on the level of CDW recycling rate.

Box A E.13. Effects of policy measures on CDW recycling rates

In Europe, several countries imposed taxes on the extraction of raw materials (Bahn-Walkowiak et al., 2012[206]). According to the Ecotec study, the tax rates in most countries are low and are likely to have little or no incentive effect (2001[204]). The UK and Sweden are the only countries with relatively high tax rates.

In the UK, an extracted tonne of sand, gravel and crushed stone was initially taxed at GBP 1.60, representing approximately 20% of the average commodity price. In 2022, the aggregates tax amounts to GBP 2 per tonne (HM Revenue & Customs, 2022[207]), which would represent EUR 1.6 per tonne in the Slovak context, adjusted for PPP to Slovak prices.

Since the introduction of the aggregates tax in 2002, there has been a clear drop in aggregates sales, despite an increase in the construction output. Currently, the United Kingdom has the highest recycling rate of aggregate materials, which account for almost 29% of the UK aggregates market, a larger share than in any European country (HM Treasury, 2020[208]). In contrary to other countries, the UK tax was underpinned by an economic valuation study that estimated the total external costs of aggregates extraction in the country (Söderholm, 2011[26]). However, a number of additional factors contributed to the decline in the use of primary aggregates in the UK, including the introduction of a landfill tax (EEA, 2008[23]).

ECOTEC (2001[204]) notes that the landfill tax provides a much stronger economic incentive than the tax on materials. In Denmark, an important precondition for the increase of recycling of CDW was also a supply-oriented regulation on the source separation of demolition waste. The aggregates tax combined with the landfill tax had as an effect the increase in the recycling rate of CDW from 12% in 1985 to 94% in 2004 (Söderholm, 2011[26]).

Recycling capacities

To estimate the current recycling capacities, the data on recycling facilities for CDW provided by the Slovak Ministry of Environment and a database from the Slovak Environmental Agency's website on waste recovery facilities for each type of waste and waste management, including annual capacity (Slovak Environment Agency, 2014[209]), were used. These two data sources lead to different results on the number of facilities and their annual recycling capacity. Based on the available data, it is estimated that there are approximately 75 to 100 recycling facilities, of which 25 – 30% are mobile facilities. The mobile recycling facilities enable direct waste processing (sorting and crushing) on the construction site and recycled material is then ready for further use. The known capacity is only for 80 – 85% of the facilities. In total, the capacity ranges from 2-3 to 4 million tonnes per year. See Table A E.3 for CDW generation and future potential recycling capacities.

Table A E.3. CDW production and recycling capacities in the Slovak Republic (in thousand tonnes)

Waste category	Production in 2019	Annual recycling capacity
Concrete (17 01 01)	99 - 299	1490 – 2899
Brick (17 01 02)	4 – 9	1310 – 2843
Tiles and ceramics (17 01 03)	~0	1060 – 2153
Mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06 (17 01 07)	97 – 181	1598 – 2940

Track ballast other than those mentioned in 17 05 07 (17 05 08)	39 – 87	877 – 1792
Gypsum-based construction materials other than those mentioned in 17 08 01 (17 08 02)	3 – 4	554 – 1982
Bituminous mixtures other than those mentioned in 17 03 01 (17 03 02)	31 - 98	1520 – 2778
Insulation materials other than those mentioned in 17 06 01 and 17 06 03 (17 06 04)	2 - 3	99 - 160
Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03 (17 09 04)	57 - 103	1593 – 2791
Total	**331 - 765**	**2010 – 3404***

Note: *since every recycling facility has permit to manage more than one waste category, capacities are overlapping.
Source: Adapted from data provided by the Ministry of Environment of the Slovak Republic and the Slovak Environment Agency (2014[209]).

The analysis of available data suggests that sufficient recycling capacity is available, since the total CDW production amounts to only 13% to 39% of the available recycling capacity. However, growing waste production due to the planned renovation of buildings is expected in the upcoming years. The Slovak Recovery and Resilience Plan (RRP) includes plans for renovation of 30 000 family houses, 100 historical and listed buildings and 1 000 public buildings (Ministry of Finance of the Slovak Republic, 2021[170]). Overall, EUR 741 million are allocated to support building renovation under the RRP. Accelerating building renovation in line with the target of climate neutrality by 2050 is also expected in the Long-Term Renovation Strategy for buildings (LTRS) (Ministry of Transport and Construction of the Slovak Republic, 2020[210]).

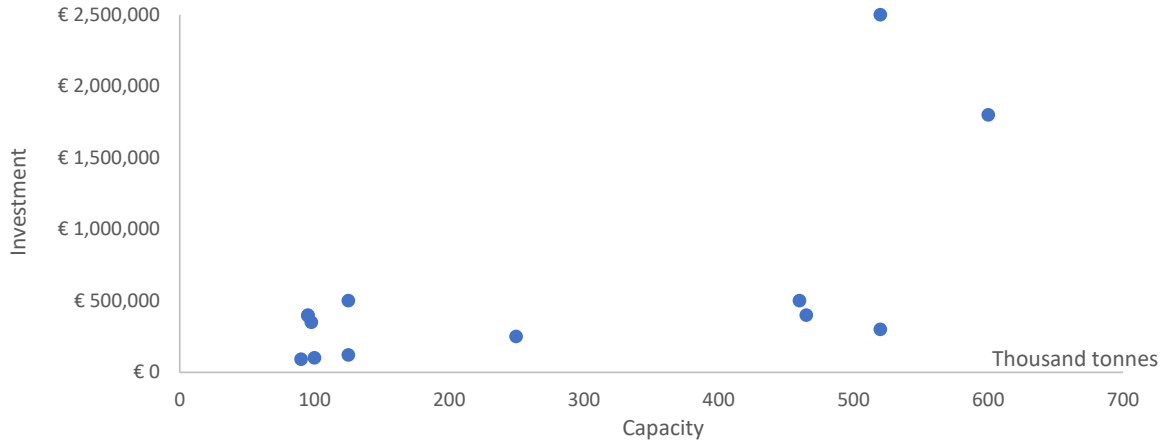
Plan to renovate buildings will include activities, such as the removal of asbestos roofing, insulation, and window or boiler replacement, associated with waste production. Based on the information provided by Slovak companies operating in the renovation sector, the removal of asbestos roofing produces 1.5 to 4 tonnes of waste, while insulation produces 1 to 3 tonnes of polystyrene waste per house. The renovation of family houses under the RRP would lead to 75 to 210 000 tonnes of CDW. Considering the LTRS and the results of the new Population and Housing Census 2021, the renovation of an estimated 480 000 family houses is required. This would increase CDW generation by at least 1 to 2.8 million tonnes during 2020-2030, or 100 to 280 000 tonnes annually. Window replacement would be also associated with significant waste production. However, no data on the CDW generation from this activity is available.

Unit investment costs

The construction activities with an available environmental impact assessment (Enviroportal, 2022[211]), provide information to estimate unit investment costs of recycling facilities. The estimated unit costs are based on 14 projects of mobile facilities for CDW recycling. Their annual capacity ranges from 90 000 to 600 000 tonnes and the total investment costs range from EUR 90 000 to 2.5 million. The investment costs increase with the annual capacity of a recycling facility, but the relationship is not linear (see Figure A E.5).

As a result, the unit investment costs range from EUR 1 to 5 per tonne of annual capacity, with the average value of EUR 2.3 per tonne of annual capacity. The unit investment costs may depend on several factors such as technology, type of treated waste, type of facility or its size in terms of annual capacity, which is estimated based on experience or maximum values indicated on labels from manufacturers. The lifespan of these facilities is assumed to be 20 years in line with a similar technology lifespan.

Figure A E.5. Capacity and investments costs of selected CDW recycling facilities in the Slovak Republic



Source: Adapted from collected information from 14 projects on mobile facilities for CDW recycling.

Data monitoring investment costs

Waste management

As explained above, the current waste data collection and monitoring system is insufficient and does not allow to monitor material flows of waste from its production to its final management. The new information system for waste management (ISOH) is being prepared since 2017 and is expected to be fully operational in the coming years. The ISOH system already costed more than EUR 16 million and no additional costs are expected.

National building stock overview

Developing a comprehensive overview of the national building stock and its renovation needs would require additional investment costs related to the investigation of existing relevant data and additional data collection to complement the identified data gaps. The costs of the recent Population and Housing Census 2021 were estimated at EUR 59 million. These data include several indicators on housing, such as the number, type, period of construction, period of the last renovation, material of the load bearing structure or the type of water and gas connection as well as the type of the sewage system.

Therefore, no additional investments costs are envisioned, if the data coming from ISOH and Census 2021 will be used. However, the introduction of digitalisation tools, such as the digital building passports, would require additional investment costs. As this is a nascent topic, relevant evidence and data on the investments needs to introduce such tools are lacking.

Prioritisation of policy recommendations (long-list)

Table A E.4. Prioritisation of policy recommendations

Life cycle stage	Policy recommendation	Evaluation	Instrument maturity level	Direct link to a target/ legal obligation	Stakeholder interest	Link to the waste hierarchy	Potential impact
		Total score	(High='1,' medium='0.5,' low=0)	(Yes='1,' potentially='0.5,' No=0)	(High='1,' medium='0.5,' low=0)	(Reduction/reuse='1,' recycling='0.5,' weak link=0)	(H='1,' M='0.5,' L=0)
Extraction design, construction	Extend mandatory GPP criteria to construction works in the short-term and consider the option of introducing minimum recycled content requirements within the GPP for certain materials used in procured construction products in the medium to long-term	4.5	0.5	1	1	1	1
End of life	Gradually increase the landfill taxes for industrial and construction waste beyond the period 2021 (in place from 1 July 2022, after this report was drafted) and reform the redistribution of ssubsidies from the landfill tax proceeds	4.5	1	1	1	0.5	1
Extraction design, construction	Encourage increased use of secondary raw materials (such as recycled steel and concrete) and of renewable materials (such as wood) in future construction and deep renovation projects. This could be done through financial incentives and educational support programmes	4	1	1	0.5	1	0.5
Use	Strengthen renovation support schemes to benefit from their indirect positive impact on extending the lifetime of a building through energy efficiency improvements, in particular for non-residential buildings (public and private).	4	0.5	1	1	1	0.5
End of life	Introduce a mandatory selective demolition, including a system of inspection/audit before and after demolitions take place	4	0.5	1	1	0.5	1
End of life	Strengthen collaboration and partnerships with universities and research institutions to explore further possibilities of reuse of CDW	4	1	0	1	1	1
End of life	Consider implementing a mandatory quality assurance certification scheme for CDW to increase the confidence in performance and quality of materials, and to contribute to the uptake of reprocessed, recycled and reused construction materials	3.5	0.5	0	1	1	1
Extraction design, construction	Introduce minimum recycled content requirements for specific construction products, through for example GPP, in the medium- to long-term	3.5	0	0.5	1	1	1
Consumption	Consider introducing a programme aimed at improving the circular economy through renovation	3.5	0.5	1	1	0.5	0.5
Crosscutting	Improve measurement - data collection and data reporting on CDW	3.5	1	1	1	0	0.5
Extraction design, construction	Use future construction projects (such as a new hospital construction) as a pilot project to test and apply circular economy principles and innovations	3	0.5	0	1	1	0.5

Extraction design, construction	Encourage business model innovation that would involve establishing key partnerships to access secondary materials, developing new recovery processes and technologies, and considering life cycle costs	3	1	0	0.5	0.5	1
End of life	Remove legal obstacles to the use of recycled materials (end-of waste criteria)	3	0.5	0	1	1	0.5
Extraction design, construction	Explore the option of introducing a quality standard for recycled construction materials	3	0	0.5	1	1	0.5
Use	Encourage renovations in a collective way by professionals instead of private owners. This would improve data on renovations and lead to renovations of higher quality	2.5	1	0	0	1	0.5
Extraction design, construction	Consider introducing an aggregate tax to discourage the extraction of construction minerals in the medium- to long-term	2.5	0.5	0	0.5	1	0.5
Extraction design, construction	Consider developing a secondary raw materials policy (or integrate the policy on secondary raw materials within the national Raw Materials Policy)	2.5	1	0.5	0	1	0
Extraction design, construction	Consider introducing a dedicated certification scheme for alternative materials (secondary or renewable materials) to facilitate their uptake	2.5	0	0	1	1	0.5
Extraction design, construction	Revise existing building codes by including performance-based and possibly other criteria enhancing circular construction design	2	0	0	0	1	1
Use	Examine the potential of revising the Zoning Codes to include more flexibility in space distribution and utilisation	2	0	0	1	1	0
Crosscutting	Develop a complete overview of the national building stock and its renovation needs	2	1	0	0	0	1
End of life	Consider adopting more ambitious and specific targets, specifically on the reuse of structural steel and concrete elements	2	0	0	0	1	1
End of life	Consider expanding EPR to construction products, for example to those used in renovation of buildings	2	0	0.5	0	0.5	1
Use	Exploit the potential of shared-use concepts, especially in the public sector	2	0	0	1	1	0
End of life	Explore the industrial symbiosis potential between the construction and steel manufacturing sectors	1.5	0.5	0	0	1	0
Extraction design, construction	Develop guidance on design principles that enhance circularity, for example, on how to integrate modularity into building's design and more flexibility into building's space	1.5	0	0	0.5	1	0
Extraction design, construction	Develop guidance on the use of alternative materials (renewable and secondary raw materials) preceded by a feasibility study	1	0	0	0	1	0
Extraction design, construction	Strengthen the enforcement of the revised Building Code supported by education and training campaigns for construction companies	0.5	0	0	0	0.5	0

Annex F. Circular Economy in the Food and Bio-waste Value Chain

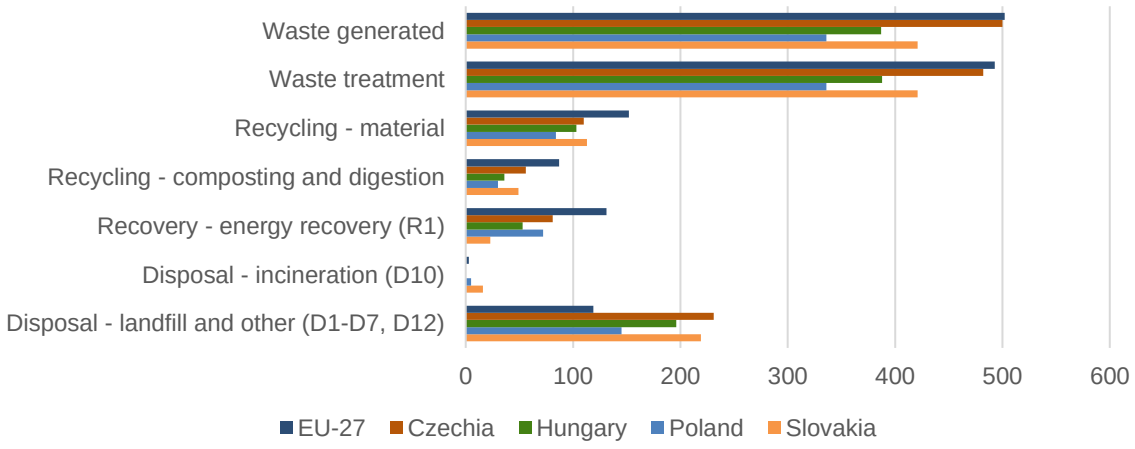
Food waste and bio-waste data

Table A F.1. Household food waste levels in various EU Member States

Country	Food waste (kg/cap/year)	Total household food waste (tonnes/year)	Reference year	Source
France	26 kg	5,000,000 tonnes	2016	ADEME, Food losses and waste – inventory and management at each stage of the food chain, 2016 (Vernier et al., 2016[212])
Netherlands	34.3 kg (solids) 45.5 litre (beverages)	592,704 tonnes (solids) 786,240 litre (beverages)	2019	Research by Voedingscentrum (2019[213])
Belgium (Flanders region)	37 kg	240,925 tonnes	2018	Dept Omgeving, Voedselverlies en consumentengedrag bij Vlaamse huishoudens 2019 (Criel and Fleurbaey, 2019[214])
Austria (NiederÖsterreich)	20.4 kg organic & unavoidable FW 17.8 kg avoidable FW	34,142 tonnes organic & unavoidable FW 29,729 tonnes avoidable FW	2018-2019	Umwelt- und Energiewirtschaft, Niederösterreichise Restmüllanalyse 2018/2019 (Pulswerk, Technisches Büro Hauer and FHAnalytik, 2019[215])
Germany	54.7 kg	4,400,000 tonnes	2016/2017	BMEL, food waste in private households in Germany, 2019 (Schmidt, Schneider and Claupein, 2019[216])

Figure A F.1. Municipal waste by waste management category

Kilogramme per capita per year, 2019



Source: Eurostat (2021[217]).

Table A F.2. Waste generation per waste category and per NACE economic activity, 2018

	Agriculture, forestry and fishing		Manufacture of food products; beverages and tobacco products		Water supply, sewerage, waste management and remediation activities		Water collection, treatment and supply;		Waste collection, treatment and disposal activities; materials recovery		Households		Total	% within total waste (excluding major mineral wastes)
	Tons	kg/cap	Tons	kg/cap	Tons	kg/cap	Tons	kg/cap	Tons	kg/cap	Tons	kg/cap	Tons	
Animal and mixed food waste														
EU - 27	1,130,000	3	6,920,000	15	640,000	1	80,000	0	560,000	1	8,490,000	19	17,820,020	3%
Czechia	2,873	0	15,925	1	2,591	0	894	0	1,697	0	4,367	0	28,348	0%
Hungary	11,173	1	66,789	7	1,712	0	951	0	761	0	9,508	1	90,902	1%
Poland	13,883	0	490,371	13	53,663	1	17,702	0	35,961	1	n/a	n.a	611,595	1%
Slovakia	3,091	1	20,713	4	2,788	1	132	0	2,656	0	19,679	4	49,065	1%
Vegetal wastes														
EU - 27	4,010,000	9	14,640,000	33	3,550,000	8	100,000	0	3,450,000	8	21,630,000	48	47,380,058	7%
Czechia	61,415	6	79,705	7	35,776	3	2,439	0	33,337	3	631,848	59	844,539	7%
Hungary	48,602	5	114,607	12	10,826	1	392	0	10,434	1	n/a	0	184,880	3%
Poland	76,988	2	570,560	15	1,449	0	485	0	964	0	1,015,378	27	1,665,841	3%
Slovakia	87,623	16	28,333	5	4,188	1	1,007	0	3,181	1	199,970	37	324,325	6%
Animal faeces, urine and manure														
EU - 27	11,500,000	26	650,000	1	40,000	0	10,000	0	20,000	0	n/a	n.a	12,220,027	2%
Czechia	57,542	5	n/a	n/a	46	0	n/a	n/a	46	0	217	0	57,856	0%
Hungary	337,453	35	1,147	0	11	0	n/a	n/a	11	0	n/a	n.a	338,657	5%
Poland	217,594	6	26,898	1	7,328	0	n/a	n/a	7,328	0	n/a	n.a	259,155	0%
Slovakia	355,669	65	3,809	1	387	0	n/a	n/a	387	0	n/a	n.a	360,318	7%
Waste excluding major mineral wastes														
EU - 27	19,450,000	44	33,790,000	76	208,460,000	467	18,100,00	41	190,360,000	426	185,770,000	416	637,831,054	
Czechia	226,565	21	253,234	24	3,208,888	302	252,781	24	2,956,107	278	4,820,895	454	11,719,119	
Hungary	427,294	44	428,576	44	1,585,717	162	466,840	48	1,118,877	114	2,742,656	281	6,770,372	
Poland	376,873	10	2,558,464	67	20,283,602	534	1,489,678	39	18,793,924	495	9,237,540	243	52,741,226	
Slovakia	490,697	90	113,352	21	1,174,415	216	290,509	53	883,906	162	2,247,835	413	5,201,256	

Source: Eurostat (2022[171]).

Analysis of relevant policy framework for the food and bio-waste value chain in the Slovak Republic

Box A F.1. Slovak regulatory framework for food waste and bio-waste – examples of key measures

Envirostrategy 2030

- Oblige restaurants and supermarkets to donate unsold food products that fulfil food safety requirements. If the food products are no longer suitable for consumption, they can be composted or recovered for energy or other reutilisation (including for animal feed);
- Remove “best before” date food labelling and introduce a uniform “use by” as food may be still suitable for consumption after the “best before” date if stored well (see Box A A.1 in Annex A for an explanation of why this measure should not be implemented);
- Review other legislative restrictions and unnecessarily stringent standards that can lead to the generation of waste from still usable foods;
- Provide information campaigns and behavioural measures aimed at changing individual behaviour towards food waste prevention and limiting biodegradable (municipal) waste; and
- Provide for a sufficient network of collection and recovery facilities for separately collected biodegradable kitchen and restaurant waste as well as green waste, including comfortable composting.

Waste Prevention Plan 2019-2025

- Develop a dedicated biodegradable municipal waste strategy, including waste compositional analysis and the application of the waste hierarchy;
- Provide legislative, financial and information support for home and community composting;
- Develop a quantification methodology to measure biodegradable waste within households and composting, and food waste;
- Prepare and implement the National Educational Programme on Prevention of biodegradable waste and food waste for individual target groups - population, self-government and state administration; and
- Ban landfilling of food waste from wholesale, retail and distribution per 1 January 2023.

Waste Management Plan 2021-2025

- Analyse the current measures and their impact on targets achievement;
- Support the financing of separate collection of household kitchen waste and of projects to build new and modernise existing facilities to recover biodegradable waste; and
- Introduce a quality label for high quality compost.

Waste Act No. 79/2015 Coll.

- Implement mandatory separate collection of biodegradable municipal waste by mid-2021, and the latest by 2023 (by municipalities, which incinerate mixed municipal waste for energy recovery); and
- Ban waste for landfilling that has not been treated by 2023 and that can be incinerated for energy recovery by 2027.

Food Waste Prevention Plan

- Develop a uniform methodology to quantify the amount of food losses and wasted food along the food value chain;
- Identify the causes of food losses and food waste and the possibilities to reduce or prevent such food waste/loss;
- Increase societal awareness of the issue and change society's behaviour towards food consumption and waste; and
- Seek opportunities for cooperation between the food chain and public authorities.

Table A F.3. Analysis of existing and planned measures in the Slovak Republic for food and other bio-waste

Topic	Type of waste	Measure	Source	Area	Development level
Cross-cutting measures					
Vision/ strategic considerations	FW	Identifying causes of FLW and opportunities for prevention/reduction	FPP	1. Target setting & monitoring	Present
Vision/ strategic considerations	FW	Provision of environmental impact information of FLW	WMP, WPP	1. Target setting & monitoring	Partially present
Monitoring Requirements	FW	Development quantification methodology food value chain	WPP, WMP, FPP	1. Target setting & monitoring	Partially present
Monitoring Requirements	FW	Provision of funds for quantification of FLW	FPP	1. Target setting & monitoring	Partially present

EU funding	FW	Verify possibilities of absorption of EU support programmes for projects on FLW	FPP	3. Prevention measures	Partially present
Monitoring Requirements	FW	Processing & evaluating data on annual basis	FPP	1. Target setting & monitoring	not present (yet)
Integrated legislation	FW	When creating legislation, take into account support for reducing FW amounts	FPP	3. Prevention measures	not present (yet)
Production related measures					
Food Safety	AF	Food code including requirements for foodstuffs, their production, safety & testing	SVFA	3. Prevention measures	Present
Capacity building	AF	Modernisation & capacity building of food processing companies (EU funds)	Agriculture	3. Prevention measures	Partially present
Capacity building	AF	Creating a level playing field for accessing resources (SMEs / large enterprises)	Agriculture	3. Prevention measures	Partially present
Capacity building	AF	Science & support programme	Agriculture	3. Prevention measures	Partially present
Capacity building	AF	Promoting innovation & technological security in production of products with higher added value	Agriculture	3. Prevention measures	Partially present
Collaboration	AF	Promoting collaboration between stakeholders of the food value chain	Agricultural	2. Cross-sectoral / MSP	Partially present
Information provision	FW	Developing guidelines & information materials	FPP	3. Prevention measures	Partially present
Collaboration	FW	Cooperation of actors in the food chain with government authorities	FPP	2. Cross-sectoral / MSP	Partially present
Platform	FW	Define form & extent of cooperation in a formal multi-stakeholder platform re. quantification & reduction of FLW	FPP	2. Cross-sectoral / MSP	Partially present
Donation	FW	Mandatory donation of safe unsold food products from restaurants and supermarkets	Enviro	3. Prevention measures	Partially present
Integrated legislation	FW	Reviewing legislative restrictions and unnecessarily stringent standards that lead to FW generation	Enviro	3. Prevention measures	Partially present
Information provision	FW	Information network on FLW prevention	FPP	3. Prevention measures	not present (yet)
Information provision	FW	Information seminars on FLW prevention	FPP	3. Prevention measures	not present (yet)
Green Public Procurement	FW	Institutional green procurement incl. environment and health benefits + efficient use of resources	FPP	3. Prevention measures	not present (yet)
Animal feed	FW	Exploring possibilities for utilising former foodstuffs as animal feed	FPP	5. Animal Feed	not present (yet)
Animal feed	FW	Consider simplifying rules for delivering food no longer fit for human consumption to feed purposes	FPP	5. Animal Feed	not present (yet)
Donation	FW	Adopting provisions to facilitate the donation of food for charitable purposes	FPP	3. Prevention measures	not present (yet)
Measures related to production and consumption					
Food Safety	AF	Food Chain Safety Strategy	MARD	3. Prevention measures	Present
Vision / strategic considerations	FW	Focus on food waste prevention	WPP	3. Prevention measures	Present
Information provision	FW	Information campaign on imperfect F&V	WMP	4. Consumer behaviour	Partially present
Date marking	FW	Create better understanding of the use of date marking by consumers	FPP	4. Consumer behaviour	not present (yet)
Date marking	FW	Removing best-before date labelling, introducing uniform use-by labels	Enviro	3. Prevention measures	not present (yet)
Measures related to production and waste					
Information provision	BW	Information campaign on possibilities using agricultural biomass for energy production	Bio-economy	6. Waste mgt & recycling	Partially present

Economic incentives	FW	Stimulating efficient use of resources through investment subsidies, price signals, taxation, sanctioning, benchmarking	FPP	3. Prevention measures	not present (yet)
Consumption related measures					
Information provision	FW	Information campaign on food waste prevention through behavioural change	Enviro	4. Consumer behaviour	Partially present
Prevention projects	FW	Municipal level projects involving citizens on FW prevention, with expert involvement	FPP	4. Consumer behaviour	not present (yet)
Measures related to consumption and waste					
Monitoring Requirements	BW	Development of a quantification methodology to measure food waste from households & composting	WPP	1. Target setting & monitoring	Partially present
Monitoring Requirements	BW	Compositional analysis of mixed municipal solid waste & ongoing analysis	WPP	1. Target setting & monitoring	Partially present
Monitoring Requirements	BW	Local level statistical information on waste collection and composting	WPP	1. Target setting & monitoring	Partially present
Information provision	BW	Online portal on waste prevention (incl. bio-waste)	WPP	3. Prevention measures	Partially present
Educational programme	BW	National Education programme on prevention of biodegradable (and FW) for consumer target groups	WPP	4. Consumer behaviour	Partially present
Economic incentives	BW	Support for product waste collection systems & local back-up systems	WPP	6. Waste mgt & recycling	Partially present
Educational programme	FW	Information & advice via educational programmes to professionals & schools	FPP	4. Consumer behaviour	not present (yet)
Waste management measures					
Landfill ban	FW	Assessing exemptions related to separate collection of bio-waste (incl. food waste) from households (2022)	WMP, WPP	6. Waste mgt & recycling	Partially present
Separate waste collection	FW	Prohibition of landfilling food waste from wholesale, retail and distribution (Jan 2023)	WMP, WPP	6. Waste mgt & recycling	Partially present
Separate waste collection	BW	Mandatory quantitative collection of municipal waste (Dec 2024)	WPP	6. Waste mgt & recycling	Partially present
Market incentives	BW	Promoting utilisation of agricultural biomass for heat production & drying industry	Bio-economy	6. Waste mgt & recycling	not present (yet)

Note: FW = food waste, BW = other bio-waste, AF = Agri-food system, FPP = Food Waste Prevention Plan, WPP = Waste Prevention Plan 2019-2025, WMP = Waste Management Plan 2021-2025, Agriculture = Action Plan for the Development of Agriculture 2014-2020, Enviro = Envirostrategy 2030, SVFA = Slovak Veterinary and Food Administration, MARD = Ministry of Agriculture and Rural Development, Bio-economy = Concept for the use of agricultural and forestry biomass.

Inventorying examples of international good practices and creating an overview of possible additional interventions

The development of the Slovak Roadmap to a Circular Economy within the food and bio-waste value chain can highly benefit from the international evidence base of good practices. The authors have collected an overview of examples from international and national levels:

- Circular economy strategies;
- Food waste strategies; and
- Bio-waste strategies.

Another source are the Recommendations for Actions in Food Waste Collected within the EU Platform on Food Losses and Food Waste (European Commission, 2016[218]). The recommendations call for all stakeholders in the agri-food system to take their role. Specifically related to the cross-cutting actions, national authorities have an important role in initiating, coordinating and facilitating actions. An overview and analysis of these recommendations is provided below.

Analysing the international best practices collected by the desk research, the recurrence of a number of issues and measures for food waste and other bio-waste is apparent.

Food waste actions

Information & communication instruments

- Awareness raising campaigns to (targeted) consumer groups; addressing:
  - Setting of new social norms, to make it “normal” not to waste food;
  - Good household food management practices regarding planning, storing, cooking and waste separation;
  - The proper use of date marking and on-pack information;
  - Portion sizes: how much food do you need to prepare to avoid leftovers?
  - Discounts: for example, how to make use of 2-for-1 offers or family sized packages within small households?
  - Saving potential: reducing food waste saves money and has environment and climate benefits.
- Through a varied set of communication channels, both on- and offline and using the latest findings of behavioural scientific research;
- Education programmes at schools (various levels), also linked to healthy and/or locally produced and seasonal food;
- Training and education of food professionals and employees, also linked to healthy and/or locally produced and seasonal food; and
- Best practices inventory or (online) resource database accessible to consumers and professionals.

Box A F.2. Towards effective information and education tools that aim at food waste reduction by consumers

Consumer targeted campaigns are advocated by the European Commission and the EU Platform on Food Losses and Food Waste to raise awareness and increase consumer knowledge on how to reduce food waste. The step towards actual behavioural change is not direct, and the impact of campaigns on food waste reduction is difficult to measure. Producing campaigns requires a budget, a targeted dissemination strategy and the use of appropriate communication channels. A single campaign effort is likely to be less effective than a longer-running effort, containing a series of planned events in combination with incentives that encourage consumers to implement the new knowledge into their new routine behaviour. Without such incentives, the campaigns may be less effective.

Dedicated, targeted and appropriate information for the various target groups of professionals and schools (at varying levels) needs to be translated into a coherent education programme. The information needs to be integrated into the regular curriculum and/or canteen offerings. It is important to distinguish programmes targeting food waste and other bio-waste prevention 'skills' from programmes targeting food waste reduction in for example canteens. Quantification of current amounts of food wasted in the educational setting needs to be established as well as core causes for losses during preparation and display as well as from the plate.

Examples of campaigns implemented in some of the EU Member States include events around joint action “weeks” where retailers and food service companies join forces to promote consumer oriented actions to reduce food waste, food waste community coaches, shopping lists, food sharing groups,

leftover cooking, date marking campaigns, storing at 4 degrees Celsius, information on correct use of organic waste bin and neighbourhood competitions or festivities to save food (e.g. the Dutch Food Waste Free Campaign, the UK's Love Food Hate Waste campaign, Food Battle or Disco Soup).

Through its platform 'Love Food Hate Waste,' the charity WRAP engages and helps companies and the public on food waste prevention. WRAP collaborates with businesses to enhance product design, such as via the use of re-sealable packs and pack sizing, while developing labels that inform and encourage consumers to use up food wisely. For example, following the Government's advice to use clearer labelling, Lidl introduced a 'Little Blue Fridge' icon for products, like apples, that customers may not realise should be refrigerated below 5°C. Meanwhile, motivational messaging on Lidl's fresh produce and bakery packaging informs customers about their food's journey, providing helpful hints to prevent waste. WRAP continues collaborating with Lidl on best practice labelling and monitoring customer feedback (The Government of the United Kingdom, 2018[219]).

A recent study from the United States on developing a national strategy to reduce food waste at the consumer level identified similar key strategies for increasing consumers' motivation, opportunity and ability to reduce food waste (Schneeman and Oria, 2020[220]):

- To conduct a national behavioural change campaign;
- To take advantage of the influence of popular food experts (e.g. chefs on cooking shows, food blogs) on consumers' attitudes and preferences; and
- To include instruction and experiential learning on food literacy in curricula from primary to postsecondary education.

Box A F.3. Actions that the food industry can take to reduce food waste

Food promotions against increased food waste in the UK

WRAP UK has developed guidance for manufacturers and retailers on how to create food promotions that would not contribute to increased food waste (2015[221]). This guidance provides practical steps for preventing waste at each of the main stages in the promotion planning process and identifies potential savings for manufacturers (valued at GBP 950 per tonne of waste prevented at the manufacturing stage). The guidance identifies key issues at each stage of the promotion planning process which may lead to increased food waste and provides a list of potential solutions. Guiding principles include:

- Build waste prevention into promotion planning and make waste production an evaluation metric for all promotions;
- Develop and adopt standard operating practices that include actions to reduce waste for all promotions;

- Collaborate and communicate on waste prevention with supply chain partners at all stages in promotion management; and
- Avoid promotion-specific material, for example packaging, as this limits the potential for re-work.

Examples of other actions that the food industry can take

A recent study from the United States aimed at reducing food waste by consumers identified a number of actions directed at consumers that manufacturers, retailers and food service venues can take to reduce food waste (Schneeman and Oria, 2020[220]). Some of these actions could be taken forward in a national guidance document.

- Display in-store labelling related to the benefits of frozen foods;
- Combine perishable with non-perishable or well-preserved goods in bundles (e.g., buy one fresh, get one frozen);
- Pair storage tools and containers with appropriate food quantity promotions;
- Make smaller baskets and carts available to reduce over-acquisition;
- Offer smaller plates, plates with guides to portioning, and serveware with a less disposable appearance (e.g. plastic instead of paper); or
- Encourage customers to bring their own containers or offer containers for taking leftovers home.

Source: Adapted from WRAP (2015[221]) and Schneeman and Oria (2020[220]).

Voluntary collaboration/multi-stakeholder platforms (MSP)

- Developing partnerships with actors across the whole value chain and with other agri-food system stakeholders, in various degrees of formalisation (e.g. think tanks, platforms, voluntary agreements, independent coordinating foundations or binding industry agreements), expressed via commitment declarations on strategies in line with SDG 12.3 and action agendas (including measurement and prevention or reduction measures).

Box A F.4. Voluntary agreements (VA) as a collaborative solution for food waste reduction

VAs as a key policy area for food waste reduction

- The objectives of a VA are collectively designed in consultation with all supply chain actors to ensure that each actor's needs and specificities are represented, which facilitates the development of relevant and attainable targets.
- The voluntary and non-legal characteristics of a VA make its structure flexible, which is advantageous as its targets and objectives can be quickly and easily adjusted in response to changing policy contexts.
- The potential for large savings and/or enhanced brand image creates a strong business case for participating members to join a VA, especially if key organisations and businesses are involved.

Creating a favourable context for a Voluntary Agreement

- Agree on a target (link to a pre-existing target or establish a new one) – in the absence of a legislative target, the United Nations SDG 12.3 is recommended to act as a guiding principle;
- Ensure long-term financing and governance (a donation/grant ideally from a mix of public and private funding operated by e.g. a steering committee with focused working groups);
- Establish an independent third-party to lead the VA (main pillar of a VA's success);
- Consider wider supply chain issues in VA discussions;
- Define a short-list of the key actors across the value chain committed to the VA; and
- Establish measurement methodology to define progress and track results.

Source: Adapted from REFRESH (2019[222])

Financial/market-based instruments

- Establishing earmarked funding/investments for MSP-activities;
- Providing funding for improving technological capacities within the agri-food system (general measures) as well as investments for resource efficiency/energy saving (production and processing) technologies; and
- Creating scientific research funds for innovation.

Box A F.5. Green public procurement of food products and catering services in the EU

According to a recent study by the Joint Research Centre (JRC), the purchase of food products and catering services plays an important role within public procurement. Many meals are provided by contracted catering companies to public services, including the education sector (e.g. kindergartens, schools and universities), the healthcare and welfare sector (e.g. hospitals and care homes), the defence sector (e.g. army, navy and air force), the judicial sector (e.g. prisons and correctional services) and government office canteens. The study reports that the overall volume of meals served to public institutions is estimated to be 55% of the total number of meals provided by catering companies in Europe. The share distribution, in number of meals, among the distinct food service sectors is the following: 43% healthcare and welfare (e.g. hospitals and care homes), 31% education (e.g. schools and kindergartens), 18% business and industry (e.g. government building canteens) and 8% others (e.g. prisons or military services).

The study analysed the extent of the use of green criteria in the public purchase of food products and catering services in the EU on a sample of 23 GPP schemes (eight national schemes, three regional schemes and 10 local schemes) across 12 EU Member States.

Some of the findings include:

- The main food products covered by the criteria are fruits and vegetables, dairy products, fish and seafood, and meat;
- The majority of the schemes reviewed focus simultaneously on both aspects (procurement of food products and catering services);
- Criteria associated with kitchen equipment and vending machines are covered by some of the GPP schemes reviewed;

- Cities, municipalities and counties are, within the schemes reviewed, the main public authorities reporting procurement for the education sector while national GPP guidelines have a broader scope and are applicable to multiple sectors carrying out public tendering;
- A group of nine criteria are frequently used in the reviewed schemes: organic production (mentioned by 96% of the reviewed schemes), seasonal and fresh produce (83%), staff training (74%), transportation and packaging (both 65%), menu planning (61%), waste management (including food waste) (57%), marine and aquaculture products (52%), and animal welfare (48%);
- For food procurement, most of the reviewed schemes set environmental criteria related to the production of food products and packaging, and less so related to the transport associated with the supply of the food products; and
- For the procurement of catering services, a large number of criteria is found to be related to the stage of the supply of the food service itself, followed by the life cycle stages of packaging and the production of food products.

Source: Adapted from Neto and Gama Caldas (2017[223])

Legislative/regulatory instruments

- Initiating research to identify barriers and potential measures to remove/change or add legislative measures within related policy areas and on municipal, regional, national and/or EU-level. Frequently mentioned relevant policy areas include:
  - Food loss and waste measurement/reporting (voluntary/obligations);
  - Discard ban (fisheries);
  - Landfill ban (waste);
  - Food donations (VAT, hygiene, product liability, date marking);
  - Cosmetic/marketing standards (private/legal);
  - Surplus food to animal feed; and
  - Health & safety regulations (norm setting, compliance).
- Integrating FLW prevention and reduction measures into related policy areas, including agricultural production, health & nutrition, food safety, waste management and unfair trading practices.
- Developing and disseminating guidelines on relevant legislation and its interpretation, including support documentation, templates and tools.

Box A F.6. Best practices in food waste measurement

Quantifying food loss and waste in primary production in the Nordic countries

A regional study funded by the Nordic Council of Ministers (2016) aimed to test adequate methods for data collection and measure the amount of food loss and waste from primary producers in Denmark, Sweden, Norway and Finland. In order to do this, the project involved work on definitions and method development. To gain a holistic picture of food loss and waste in primary production, the term ‘side flows’ was introduced to represent flows of food waste and production losses that were meant for human consumption but never entered the food chain (excluding inedible parts of food). Compared to other

definitions, e.g. the FUSIONS definition for food waste, 'side flows' may be preferable when understanding the amount and driving forces of food waste and production losses from the point of view of food security (Franke et al., 2016[224]).

Inter-ministerial Working Group for food waste measurement in Germany

In 2019, the National Strategy for Food Waste Reduction was adopted and stipulated, among others, an inter-ministerial 'Indicator 12.3 Working Group' responsible for the preparation of data and methods for food waste measurement, setting the basis for progress monitoring and reporting on food waste reduction in Germany. The Working Group coordinates reporting for the national Sustainability Strategy and to the EU WFD. The preparation of the 2015 baseline report follows European guidelines on uniform food waste measurement, using all available data sources and supplementing data gaps on food waste generation in trade with additional surveys and statistical coefficients. Physical data, e.g. waste statistics, supplemented (if needed) by waste compositional analysis, represent the most reliable data. The report (2019) also notes that coordinated cooperation between actors along the food value chain is needed to improve data quality, especially in the primary production, processing and trade sectors. Food waste in each part of the value chain is classified as 'avoidable' or 'unavoidable', which allows for a substantiated analysis and the identification of targeted interventions (Schmidt et al., 2019[225]; Schmidt, Schneider and Claupein, 2019[216]).

Measuring household food and drink waste in the UK

The Waste & Resources Action Programme (WRAP) charity undertook a UK-wide study to estimate household food and drink waste based on detailed waste compositional analyses, including the weight and types of food and drink waste, a week-long household diary, and a summary of waste data gathered from local authorities. Households are not the only source of food waste, but WRAP's work shows that they make the single largest contributor, covering about half of the total food waste across sectors in the UK. The evidence gathered on the amount and motives behind household food waste have been key to raising awareness and driving behavioural changes, as well as developing targeted measures (Quested, Ingle and Parry, 2013[226]).

Bio-waste actions

Information & communication instruments

- Information campaigns for citizens on the "why, how & what" of separate bio-waste collection schemes.

Box A F.7. National campaigns on engaging citizens in bio-waste sorting and composting

The UK's 'Our Waste, Our Resources' strategy

The UK's strategy on waste prevention defines how to preserve material resources by minimising waste, promoting resource efficiency and moving towards a circular economy (The Government of the United Kingdom, 2018[219]). It addresses, among others, dependency on single-use plastics, confusion over household recycling, problems of packaging and ending food waste as well as waste crime, which cost the English economy around GPB 600 million in 2016. To improve household recycling rates and separate waste collection, the strategy encourages behavioural change through incentives and good communication, exploring innovative ways for positively engaging citizens in recycling issues. For example, the UK's national charity for organic growing (Garden Organic) runs schemes such as the

Master Composter programme to train volunteer ambassadors that inspire local communities in picking up organic growing and composting since 2001 (Garden Organic, 2022[227]).

The Arun District Council home composting scheme

The home composting scheme established by the Arun District Council (ADC), covering the coastal towns of Littlehampton and Bagnor Regis as well as a rural area with approximately 26 villages, represents a success story for the promotion of home composting in households. The scheme aimed to support the local authority in meeting the national targets on household waste recycling rates, and involved the sale of home composters to each householder in the ADC area at an advantageous price. The 300 litres composters were built from recycled plastic and their particular design was chosen by the council in collaboration with manufacturers. Householders were advised to put garden and food waste into their composters and use the end product as compost for their gardens. As the end product remained unsold, issues relating to quality standards and finding a market for compost did not need to be addressed. Part of the success of ADC's home composting scheme has been attributed to the high percentage of elderly residents in the district's population, having available time and interest in gardening, and were keen to participate in the scheme. Moreover, householders had to pay for the collection of garden waste, thus composting represented an economic alternative (European Commission, 2000[228]).

Germany's Aktion Biotonne and #WirfuerBio

German waste management companies and municipalities have launched the initiatives Aktion Biotonne and #WirfuerBio to harmonise communications with the public. Citizens are informed about the various reward schemes as well as how to improve their home sorting of bio-waste, such as through the phrase "NO PLASTICS IN THE BIN FOR BIO-WASTE." In 2017, the campaign #WirfuerBio was launched with the goal of reducing pollutants, particularly plastic, in bio-waste compost. At the time, the initiatives involved six municipal operations in Schleswig-Holstein and Hamburg, whereas today, over sixty municipal waste management businesses operate in twelve federal states (European Compost Network, 2022[229]).

Separate waste collection, composting and PAYT schemes in Italy

The Italian provinces of Parma and Treviso show best practices in reducing municipal waste through separate waste collection and a Pay-As-You-Throw (PAYT) scheme. The fee for waste generation by every household or company is composed of two parts, one fixed (based on household size) and one variable (according to the number of additional residual waste removals). Home composting is incentivised through a discount on the variable part of the fee for households doing home composting. Following the introduction of PAYT schemes to door-to-door waste collection, rates of municipal waste generation have dropped and separate collection (in terms of quantity and quality) have improved in both provinces. Recycling rates can be further enhanced through the introduction of mechanical biological treatment (MBT) of bio-waste for material and energy recovery, such as in the case of the Treviso province (Zero Waste Europe, 2018[116]; Zero Waste Europe, 2018[117]).

The city of Milan rolled out a scheme in 2014 for the separate collection of residential food waste and its treatment through anaerobic digestion for the production of biogas and compost digestate. Buildings were provided with 10 litres ventilated kitchen caddies, a free starter kit of compostable plastic bags and dedicated bins. Since the start of the plan, about 90-110 kg of annual per capita food waste were separately collected (of which 30% commercial and 70% residential), capturing almost all food waste from disposal, having low impurity levels and high levels of citizen participation and satisfaction (European Compost Network, 2022[229]).

Voluntary collaboration/Multi-stakeholder platforms

- Multi-stakeholder collaboration to design and implement action plans.

Financial/market-based instruments

- Developing processing capacity for anaerobic digestion (AD) and composting facilities and infrastructure through financing/investment funds;
- Stimulating development of cost-efficient separate municipal waste collection schemes including logistics, collection materials, and cross-docking. Various collection scheme options are possible, including Pay-as-you-throw (PAYT) systems, kerbside/drop-off collection or collection frequency. The use of IT-tooling, such as automated bins equipped with scales and RFID technology can increase the efficiency of the system; and
- Developing the market for compost and digestate materials.

Legislative/regulatory instruments

- Developing quality requirements for composting and digestate, including prohibitions on undesirable materials (e.g. plastic packaging waste);
- Developing national and local strategies on bio-waste, including target setting for waste management options;
- Integrating policy on biomaterials, also aligning with biodiversity and climate change policy areas;
- Introducing landfill bans; and
- Supporting compliance audits on waste management systems (including health & safety, cost control and environmental performance).

Box A F.8. Regulatory instruments around composting and the use of digestate

Landfill tax and refund scheme in Catalonia

The Waste Agency of Catalonia (ARC) established an incentive scheme with the objective of making separate collection and treatment of bio-waste a more economically viable option than landfill or incineration. Since 2004, a progressively increasing tax on landfill was introduced (initially at EUR 10/t, EUR 53.1/t since 2021 and planned to increase to EUR 70/t in 2024), and a lower tax on incineration. Virtually all the revenue from the tax is distributed back to municipalities to improve waste treatment and compost quality. The amount repaid to each municipality is calculated based on separate collection performance, which necessitates a set of waste composition analyses to be carried out, partly funded through the landfill and incineration taxes (Favoino and Giavini, 2020[230]) (European Compost Network, 2022[229]).

Austrian waste legislation on compost products

Since 1995, the Austrian Bio-waste Ordinance (FLG No 68/1992) requires the source separation and biological treatment of organic waste (primarily through composting and anaerobic digestion), while the Compost Ordinance (FLG II No 292/2001) established end-of-waste regulation for compost produced from defined organic wastes, as well as monitoring and external quality assurance obligations. In Austria, the aim has been to avoid recommending the imposition of excessive technical obligations in order to preserve the well-established decentralised, mostly on-farm composting systems. Since the early 1990s, this has been widely recognised as a sustainable bio-waste recycling system. Compost can be classified and marketed as a product in Austria provided it meets certain quality criteria and has been processed from specific input ingredients. The minimum organic matter level of 20% (m/m) is one

of the most important requirements, as compared to artificial or dredged soils having substantially lower organic matter concentrations (Austrian Ministry for Agriculture and Forestry, Environment and Water Management, 2009[231]).

Slovenian Decree on the treatment of biodegradable waste and the use of compost or digestate

Slovenia became one of the first countries to have introduced compulsory operations in the treatment of biodegradable waste and conditions for its use, as well conditions for placing treated biodegradable waste on the market (European Commission, n.d.[232]). The legislation on the recovery of biodegradable waste and the use of compost and digestate lays down, among others, the conditions for designing and operating biogas plants (e.g. applying to an environmental permit), the types of biodegradable waste that can be treated (listed in Annex 1), specific requirements for composting and anaerobic digestion, and quality control (1st or 2nd quality class in accordance with Annex 4) of compost and digestate. The regulation prescribes that digestate must be further composted following anaerobic degradation (article 12), and that a quality control of the compost or digestate must be carried out by a company, public institution or private individual (article 14).

Lithuania's industrial bio-waste management

Since 2006, Lithuania introduced a prohibition for landfills to accept bio-waste and promoted the construction of composting sites. By the end of 2006, six facilities had been put in operation for the production of gas from sludge, slurry and other biodegradable waste of industrial origin. Where feasible, such industrial bio-waste shall be recycled through the combination of waste treatment with energy generation and preservation of nutrients; waste treatment with preservation of nutrients only; or incineration with energy production. The solutions available thus include anaerobic digestion of food waste with the production of compost digestate and biogas; separated collection and anaerobic digestion of food waste together with waste treatment sludge; and mechanical biological treatment (MBT) with refuse delivered fuel (RDF) in specific co-incineration power plants (ARCADIS, 2009[233]).

The actions for food and bio-waste are partially overlapping, although bio-waste strategies do not usually include prevention measures as bio-waste is what 'happens' when food is no longer used for human consumption or fed back into the agri-food system via animal production. Of course, there are also the bio-resources, which are not derived from the food system that are included in bio-waste, which cannot always be prevented from becoming bio-waste (e.g. from private and public gardens or roadside).

Summarising the actions, instruments can be structured according to:

- Strategy development;
- Multi-actor/cross-chain collaboration;
- Definitions, measurement and monitoring (of baseline and progress-to-target);
- Prevention measures:
  - In production and processing for resource efficiency, aligning supply and demand, repurposing for human consumption (including processing of unsold food and donation);
  - Addressing consumer behaviour: buying – storing – preparing – consuming – discarding;
- Reduction measures, including animal feed and biomaterial valorisation options; and
- Recycling and waste management, including separate collection, composting, anaerobic digestion (AD) and Energy Recovery from Waste (EfW) options.

When measures are transferred into implementation, the development and application of IT-tooling for information, monitoring and other processes will likely play an increasingly important role. For example, when data collection becomes more mature, smarter and quicker decision making tools, benchmarks and

dashboard indicator models could be developed and made available to the general public and business community.

European recommended actions on food loss and food waste

During the first mandate of the European Platform on Food Loss and Food Waste, the members to the platform were consulted to formulate a set of recommended actions for national Member States and segments of the value chain to address food loss and waste. In December 2019, the "Recommendations for actions in food waste" were published. In line with the integrated and holistic approach needed to tackle food waste without compromising food safety, the Platform's recommendations address actions required by public and private players at each stage of the food supply chain (including food redistribution). The recommendations also include a set of horizontal or 'cross-cutting' recommendations, which are common across various stages of the food value chain, often involving multiple actors and which are needed to achieve global food loss and waste targets (SDG Target 12.3). The recommendations for action were presented to play a key role in helping to scale-up action across the EU, mobilising Member States, food businesses and civil society. The 123 recommended actions are divided among cross-cutting actions (44), primary sector (12), manufacturing sector (18), retail (20), food services (12), consumers (6) and donations (11). Next to these value chain segment actors, stakeholders such as the EU Platform itself, EU authorities, national authorities, the research community and civil society actors are called to act and to collectively create 'fertile ground' to develop, implement and scale up measures in practice. Important topics for change include:

- Forecasting & measurements;
- Behavioural change;
- Repurposing / valorisation of surplus food;
- Packaging; and
- Donations & redistribution.

Prioritisation of proposed policy interventions by stakeholders

Methodology

To achieve a preselection of interventions to formulate the policy recommendations, a stakeholder consultation process was organised through interviews and an interactive stakeholder webinar. The consultation served to collect and gain insights into the priorities, preferences, opportunities, potential bottlenecks and pitfalls expressed by Slovak stakeholders relevant to the food and other bio-waste sector.

The following analysis of proposed interventions from the viewpoint of Slovak stakeholders has been made using a feasibility and impact analysis approach. A number of the proposed interventions have not been scored due to being too generic (e.g. focus on market principles instead of enforcing compliance) or having no specific action (e.g. prevention is not always the main focus in business operations). In some instances, the intention of the proposed intervention remained unclear (e.g. analyse harmful advertising).

Building on the portfolio of proposed interventions, each intervention was scored according to feasibility and impact to facilitate further prioritisation. A set of criteria was created for this purpose (Table A F.4). These criteria are based on the criteria developed by WUR in the report "Changing the rules of the game – impact and feasibility and regulatory measures on the prevention and reduction of food waste" (Bos-Brouwers et al., 2020[17]). These criteria can be scored on three levels, ranging from poor – average – good. After scoring each proposed intervention, the expected output is a preliminary list of proposed interventions, structured against type of instrument, food and bio-waste, and value chain involvement.

Table A F.4. Defining feasibility and impact criteria

Criteria	Poor = 0 points	Average = 0.5 points	Good = 1 points
Feasibility criteria			
The goal/target is clear	The objective of the measure is not clear	The objective of the action is not yet 100% clear but there is an idea	It is clear what the purpose of the action is
Duration of the implementation of the measure	>5 years	> 1 year but < 5 years	>1 year
Required investment (expenses)	A lot of investment is needed to get started and maintain the action	A lot of investment is needed to start up action but once it is in place the investment is low every year	Little investment is needed to get started and maintain the action
Required effort	A lot of effort is needed to get started and main the action	A lot of effort is needed to start up action but once it is in place the effort is low every year	Little effort is needed to get started and maintain the action
Support	Many stakeholders oppose the idea	Most stakeholders are in favour but not yet everyone	There is sufficient support. Lobbying is no longer necessary
Implementation	It is not clear how this action should be structured	It is not yet clear how this action should be structured but there are some ideas	It is clear how this action should be achieved
Impact criteria			
Number of stakeholders involved	This action is only useful for a single stakeholder in the chain	This action affects a large part of the stakeholders but the entire chain is not included yet	This action affects almost all stakeholders and the entire chain is included
Impact	This action has no impact on the reduction of food waste	This action only has an indirect impact on the reduction of food waste	This action has a direct impact on the reduction of food waste.
Volume reduction	This action does not reduce the volume of food waste = 0%	This action reduces the volume of food waste by <1% and <25%	This action substantially reduces the volume of food wasted by >25%
Application of multiple KPIs	Only the volume of food waste is taken into account in this action = 0 or 1	In addition to the volume, 1 other KPI is taken into account in this action = 2	In addition to the volume, multiple KPIs are taken into account in this action > 2

Source: Bos-Brouwers et al. (2020[17])

Creating a priority matrix of interventions

Based on the findings from the desk research and stakeholder consultation, and utilising the scoring and collected argumentation, a priority matrix of proposed interventions was created. The scoring follows the feasibility and impact criteria which are plotted on 2 axis.

The proposed interventions can then be organised into 4 categories (high impact-high feasibility, high impact-low feasibility, low impact-high feasibility, low impact-low feasibility), which support further prioritising and selection. It must be taken into account that scores are qualitative impressions, and not always supported by (scientific) evidence. Also, there can be justified arguments to include lower scoring interventions for inclusion in new policy actions, as they could contribute to other targets and policy ambitions and developments.

Results

Table A F.5. Analysis of proposed measures by stakeholders

	Actions							Feasibility							Impact				
		Interview / Webinar	Food / Bio-waste	1. Definitions 2. MSP 3. Prevention (processing) 4. Prevention (consumers) 5. Animal feed 6. Recycling & waste	Production	Consumption	Waste management	Goal	Duration	Investment	Effort	Support	Implementation	Total Feasibility	No. Stakeholders	Impact reduction	Volume reduction	Multiple KPIs	Total impact
Information & communication instruments (i-n)																			
i-1	Information and communication with the professional public	Interview	Food waste	3	x			0.5	1	1	0.5	1	0	4	1	0.5	0.5	0	2
i-2	Education and information of consumers to incentivise prevention of food waste	Interview	Food waste	4		x		0.5	0.5	0.5	0.5	1	0.5	3.5	0.5	0.5	0.5	0	1.5
i-3	Awareness raising campaign, also on local and seasonal produce	Webinar	Food waste	4		x		0.5	0.5	0.5	0.5	1	0.5	3.5	0.5	0.5	0.5	0	1.5
i-4	To create an educational campaign to address consumer behaviour in general regarding CE, including food waste (integrated campaign), utilising different media channels, using publicly known 'ambassadors' (famous Slovaks, influencers, chefs etc.)	Webinar	Food / bio-waste	4		x		1	0.5	0.5	0.5	1	1	4.5	0.5	0.5	0.5	0	1.5
i-5	Making consumers understand what is food waste, and to make food waste socially unacceptable	Webinar	Food waste	4		x		1	0.5	0.5	1	1		4					0
i-6	Expand education to schools on waste in general, but also food waste	Webinar	Food / bio-waste	4		x		0.5	0.5	0.5	0.5	1	0.5	3.5	0.5	0.5	0.5	0.5	2
i-7	The impact of behaviour change on waste levels needs to be measured.	Webinar	Food / bio-waste	1	x	x		1	0.5	1	1	1	0.5	5	0.5	0.5	0.5	0	1.5
i-8	There are food cultural difference in the Slovak Republic as compared to other Member States: the fresh food market is much smaller, as well as the use of plastic packaging.	Webinar	Food waste	3	x	x	x							0					0
i-9	Stimulate home composting to motivate citizens to produce less waste	Webinar	Bio-waste	4		x	x	1	1	1	1	0.5	1	5.5	1	1	0.5	0	2.5
i-10	Analyse harmful advertising and take measures to ban it	Webinar	Bio-waste											0					0
Voluntary agreements / MSP (v-n)																			
v-1	Cooperation of the Ministry of Environment with experts in the field	Interview	Food / Bio-waste	2	x		x	0.5	1	0.5	1	0.5	0.5	4	1	0.5	0.5	1	3
v-2	Stimulate cross-chain collaboration, removing information asymmetries	Webinar	Food / Bio-waste	2	x		x	0.5	1	0.5	1	0.5	0.5	4	1	0.5	0.5	1	3

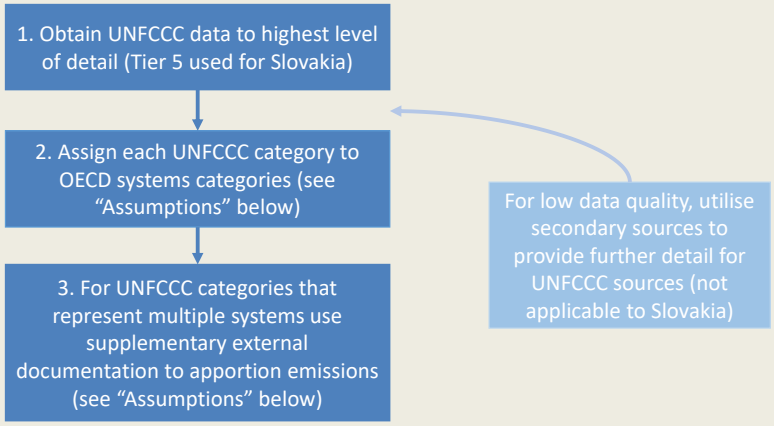
v-3	Further develop the Circular Economy Platform to stimulate collaboration across the value chain.	Webinar	Food / Bio-waste	2	x	x	x	0.5	1	0.5	1	0.5	0.5	4	1	0.5	0.5	1	3
v-4	New group for this type of actors could help them meet requirements for utilising food surplus for animal feed and to allow its use in as safe way	Webinar	Food waste	5	x		x	1	1	0.5	1	1	0.5	5	1	0.5	0.5	1	3
Financial/market-based instruments (f-n)																				
f-1	Support of pre-treatment of food and kitchen waste	Interview	Bio-waste	6			x	1	0.5	1	1	1	1	5.5	0.5	0	0	0.5	1
f-2	Support of renewable energy sources goals for GHG in transport sector	Interview	Bio-waste	6			x	1	0.5	0.5	1	0.5	0.5	4	1	0	0	0.5	1.5
f-3	Support for the use of recycled materials on the market	Interview	Bio-waste	6	x		x	1	0.5	1	1	0.5	0.5	4.5	1	0	0.5	1	2.5
f-4	Support of biomethane production as a product of biogas plants	Interview	Bio-waste	6			x	1	0.5	0.5	1	0.5	0.5	4	0.5	0	0	1	1.5
f-5	Continue in support of renewable energy sources scheme for biogas plant	Interview	Bio-waste	6			x	1	1	0.5	0.5	1	1	5	0.5	0	0	1	1.5
f-6	Support energy recovery of waste (EfW)	Interview	Bio-waste	6			x	1	0.5	1	1	0.5	0.5	4.5	0.5	0	0	1	1.5
f-7	Improve investment procedures (appropriate preparation time, EIA procedure, public statements, information and education of public)	Interview	Bio-waste	6			x	1	0	1	1	1	0.5	4.5	1	0	0	1	2
f-8	Allowing implementation of mixed local fee for municipal waste, including fixed fee to cover collection costs (waste transportation, operation of collection sites and littering) and a variable fee depending of the amount	Interview	Bio-waste	6		x	x	1	0.5	0.5	0.5	1	1	4.5	0.5	0.5	0.5	1	2.5
f-9	Remove market disrupting subsidies	Interview	Food / Bio-waste	3	x		x	0.5	0	0.5	1	0.5	0.5	3	1	0.5	0.5	0.5	2.5
f-10	Focus on market principles instead of enforcing compliance	Webinar	Food / Bio-waste	3	x									0					0
f-11	Consumers are viewed as responsible for the majority of food waste. It is suggested that customers in restaurants pay if they leave uneaten food in their plates (in all-you-can-eat concept restaurants).	Webinar	Food waste	4	x	x		1	1	1	1	0.5	1	5.5	0.5	1	1	0	2.5
f-12	It is expressed that additional economic instruments are needed to make food waste more expensive than the alternative in prevention/reduction	Webinar	Food waste	3	x		x							0					0
f-13	Prevention is not always the main focus in business operations	Webinar	Food waste	3	x		x							0					0
f-14	There is a lack opportunities to process bio-waste into higher valorisation options (upcycling)	Webinar	Bio-waste	5			x							0					0
f-15	Better storage technologies are needed	Webinar	Food / Bio-waste	3	x		x	0.5	0.5	1	1	0.5	0.5	4	1	0.5	0.5	0.5	2.5
f-16	Shortening food value chains (e.g. farm to consumer)	Webinar	Food waste	3	x			0.5	0.5	1	1	0	0.5	3.5	1	0.5	0.5	0	2
f-17	Donations should be made easier (incl. VAT, legal requirements, definitions on donating unsold fruits and vegetables)	Webinar	Food waste	3	x			1	0.5	1	1	1	0.5	5	1	0.5	0.5	0.5	2.5
f-18	Price incentive for unpacked produce (making pre-packed produce more expensive)	Webinar	Food waste	4	x	x		1	0.5	0.5	0.5	0	0.5	3	1	0.5	0.5	0	2
f-19	State support of recycled materials (incl. compost) should help to increase the interest of private sector to do business in the area of recycling	Webinar	Bio-waste	6	x		x	1	0	1	1	0.5	0.5	4	1	0	0	1	2
f-20	Prevention strategies contribute more to GHG emission reduction than waste management strategies	Webinar	Food / bio-waste	3	x									0					0

f-21	Use see-through waste containers so citizens see what they waste: this can change their mindset and behaviour	Webinar	Bio-waste	6			x	1	0.5	1	0.5	0	0.5	3.5	0.5	0.5	0.5	0	1.5
Legislative/regulatory instruments																			
r-1	Improve legislation	Interview	Food / Bio-waste											0					0
r-2	Introducing extended producer responsibility (such as within textiles, building materials and wood products), e.g. on cooking oil	Interview	Bio-waste	3	x		x	1	0	1	1	0	0	3	1	0.5	0.5	0.5	2.5
r-3	Mandatory separate collection of kitchen waste, subsidised to make it economically viable for the municipality	Interview	Bio-waste	6		x	x	1	0.5	1	1	0.5	0.5	4.5	1	0	0	1	2
r-4	Remove restrictions by law on establishing different fees for businesses and citizens. The fee for mixed municipal waste is too low to incentivize entrepreneurs to collect separately	Interview	Bio-waste	6	x		x	0.5	0.5	0.5	1	1	0.5	4	0.5	0	0	0.5	1
r-5	Provide municipalities with competence to control and fine businesses	Interview	Bio-waste	6	x		x	1	0.5	0.5	0.5	0.5	0.5	3.5	0.5	0	0	0.5	1
r-6	Improvements in (food) waste data collection across the value chain	Webinar	Food / Bio-waste	1	x	x	x	1	0.5	1	1	0.5	0.5	4.5	1	0.5	0.5	1	3
r-7	Food waste definitions differ across institutions, causing uncertainties what is, and what isn't food waste. Calling for creating a waste catalogue to harmonise measurements	Webinar	Food waste	1	x		x	1	1	0.5	0.5	1	0.5	4.5	1	0.5	0.5	0.5	2.5
r-8	A competent authority for the measurement of food waste should be established	Webinar	Food waste	1	x	x	x	1	1	0.5	1	0.5	0.5	4.5	1	0.5	0.5	0.5	2.5
r-9	Consider option of mandatory food waste reporting	Webinar	Food waste	1	x	x	x	1	0.5	1	1	0	0.5	4	1	0.5	0.5	0.5	2.5
r-10	Disaggregate food waste data based on different dimensions and characteristics (recyclability, feed, compost, etc.)	Webinar	Food waste	1	x	x	x	1	0.5	1	1	0.5	1	5	1	0.5	0.5	0.5	2.5
r-11	Remove bureaucratic barriers where several authorities are requiring different licenses and registries (e.g. veterinary, hygiene, environmental)	Webinar	Food / Bio-waste	6	x		x	0.5	1	0.5	1	1	0.5	4.5	1	0.5	0.5	0.5	2.5
r-12	Regardless of national measurement issues, the retail sector has initiated to set up programmes to measure food waste (spoilage) from stores and to support the donation of unsold products to people in need.	Webinar	Food waste	1	x									0					0
r-13	The option to valorise surplus food as animal feed is promising, but faces problems with legislative requirements, including the requirement to register as an animal food producer.	Webinar	Food waste	5	x		x	0.5	0	0.5	1	0.5	0.5	3	1	1	1	0.5	3.5
r-14	The regulations are too strict to use food waste as animal feed	Webinar	Food waste	5	x			0.5	0	0.5	1	0.5	0.5	3	1	1	1	0.5	3.5
r-15	The mandatory separate collection system by 2023 imposes challenges such as removal of (plastic) packaging waste (technological barrier)	Webinar	Bio-waste	6		x	x	0.5	0.5	1	1	1	0.5	4.5	1	0	0	1	2
r-16	There are multiple solutions, but it is unclear what works within the Slovak Republic and what not	Webinar	Bio-waste	6										0					0

Annex G. Links between Circular Economy and Greenhouse Gas Emissions

Box A G.1. Methodology to allocate sector-based emissions into materials management categories

In 2012, the OECD developed a methodology to allocate sector-based emissions from UNFCCC inventories to materials and non-materials management activities, i.e. systems-based categories, and applied it to four case studies (Australia, Mexico, Slovenia and Germany). The approach uses a production-based perspective and follows three main steps (see the figure below):



The same approach was used to estimate GHG emissions associated with materials management activities for the Slovak Republic. The following assumptions were made:

- **Step 2** - The OECD approach (2012[234]) to mapping categories was followed. For example, all GHG emissions from 'Manufacturing industries and construction' (UNFCCC category 1.A.2) were mapped to the systems-based category 'Production of goods and fuels'.
- **Step 3** – The OECD approach (2012[234]) to the use of external sources was followed to allocate UNFCCC categories that represented more than one systems-based category. This was necessary only for a few sub-categories within the 'Energy' category (UNFCCC category 1). Energy final consumption data per sector in 2019 from the International Energy Agency (IEA) were used to allocate 'Public electricity and heat production' (1.A.1.a), 'Petroleum refining' (1.A.1.b), 'Oil' (1.B.2.a) and 'Natural gas' (1.B.2.b) to systems-based categories. The existing shares of final consumption per sector were used to make the allocations: 'Industry' share was used as a proxy for 'Production of good and fuels'; 'Transport' was split between 'Passenger transportation' and 'Transportation of goods'; 'Residential' for 'Residential energy use'; 'Commercial and public services' for 'Commercial energy use'; 'Agriculture/ forestry' for 'Crop

and food production and storage'; and 'Non-energy use' share was added to the share of 'Production of goods and fuels'.

- The approach did not take into account the Land Use, Land Use Change and Forestry (LULUCF) emissions sinks.

Note: UNFCCC inventory data for step 1 from 2019 (latest available) were obtained from United Nations Climate Change (2022[235]).
Source: Adapted from (2012[234]).

Box A G.2. Limitations of the production- and consumption-based approaches to estimate GHG emissions

Important limitations exist to the production-based approach, which uses UNFCCC inventories to allocate GHG emissions to materials management activities. UNFCCC inventories focus on domestic production rather than on consumption, as the inventories do not capture emissions related to the material extraction and production of imported products and the post-export use and disposal of exported products (OECD, 2012[234]). A consumption-based approach with a life cycle perspective would provide a better view on the level of emissions associated with products and materials actually consumed by end-users in the country. Eurostat estimates that from a production-based perspective, the total carbon footprint of EU27 was equal to around 7 tonnes of CO_2 per person in 2019 compared to 6.7 tonnes of CO_2 per person from a consumption-based perspective (Eurostat, 2021[236]). EU27 was a net exporter in 2019, which could partly explain why the production-based perspective provided a higher estimate than the consumption-based perspective.

However, the consumption-based method to estimate the total carbon footprint of a country/region is complex, data-intensive and does not only consider the trade balance of a country/region. The complexity of the consumption-based method and potential lack of data make the applicability of the approach less attractive to estimate regional GHG emissions.

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The use of materials globally has increased over the past century and it will continue to grow with sustained population and economic growth. Such growth also leads to increased environmental pressures, including climate change. While the Slovak Republic has made notable progress in decoupling environmental pressures from economic activity, its economy remains energy-, carbon- and resource-intensive. The urgent need to steer the country towards circularity calls for a national circular economy strategy to help focus efforts where they are needed most. This report identifies and analyses three areas where circular economy policy would be particularly impactful: the use of economic instruments to promote sustainable consumption and production, the construction sector and the food and bio-waste value chain. It also proposes more than 30 concrete policy recommendations supported by an implementation plan and a monitoring framework. Implementing these recommendations can also help the Slovak economy reach its climate change mitigation objectives.

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