Co-funded by the European Union

CLOSING THE LOOP IN THE SLOVAK REPUBLIC

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

OECD ENVIRONMENT POLICY PAPER NO. 30

OECD
BETTER POLICIES FOR BETTER LIVES

Closing the Loop in the Slovak Republic

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

MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC

OECD

Co-funded by the European Union

Disclaimers

The "Technical support for the preparation of circular economy roadmap for the Slovak Republic" was co-funded by the European Union via the Structural Reform Support Programme (REFORM/IM2020/004). This publication was produced with the financial assistance of the European Union. The views expressed herein can in no way be taken to reflect the official opinion of the European Union.

Authorised for publication by Alain de Serres, Acting Director, Environment Directorate.

Photo credit: Cover © 2022

Cover Illustration Credit: Christophe Brilhault

Acknowledgements

This report was carried out under the overall responsibility of Shardul Agrawala, Head of the Environment and Economy Integration Division at the OECD Environment Directorate. Katarína Svatíková and Eva Barteková prepared the report and carried out the underlying policy analysis under the guidance of Peter Börkey, Principal Administrator and Circular Economy lead (all OECD Environment Directorate).

Jean Chateau, Ruben Bibas and Eleonora Mavroeidi (all OECD Environment Directorate) provided the modelling analysis. Norbert Monti (OECD Environment Directorate) drafted the background report on socio-economic and circular economy-related trends and developments, and he supported the creation of communication materials for the report and its publication. Frithjof Laubinger and Andrew Brown provided feedback on earlier versions of chapters 5 and 8, and Maarten Dubois supported the discussions around the selection of priority areas (all OECD Environment Directorate). Matthieu Cahen (OECD Public Governance Directorate) provided feedback on sections discussing green public procurement. Giulia Galli (OECD Environment Directorate) supported the finalisation of the report. Peter Janoska, Josefine Koehler, Koen Rademaekers, Ondřej Černý and Stella Slučiaková (all Trinomics) developed the analysis of the construction sector (Chapter 6). Hilke Bos-Brouwers, Vera Vernooij, Toine Timmermans (all Wageningen Food & Biobased Research), Nina Sweet (WRAP) and Elena Bodíková (EIB consultants) prepared the analysis of the food and bio-waste value chain (Chapter 7). Emily Seftel, Aziza Perrière and Ijeoma Inyama-Dalles (all OECD Environment Directorate) provided administrative support. The report received copy-editing support from Cathy Lee (independent editor).

The report also benefitted from extensive expert input from and feedback by Mária Fischerová, Viktória Pokorná, Ján Mičuda and other colleagues from the Ministry of Environment of the Slovak Republic, in particular from Rastislav Zamboj, Director-General of the Circular Economy Department of the Ministry of Environment, and his colleagues. Mauro Sibilia (DG REFORM of the European Commission) also provided valuable inputs to the report and co-ordinated feedback from other Directorates-General of the European Commission, including from DG Environment, DG REGIO and DG GROW. The stakeholder working group set up by the Slovak Ministry of Environment reviewed earlier drafts of the report and was consulted on the content of the different chapters. A stakeholder working group consisted of representatives from the Slovak ministries, agencies and other public bodies, as well as representatives of industry and NGOs.

This work was carried out with funding from the European Union via the Structural Reform Support Programme in co-operation with the European Commission's Structural Reform Support Service. The views expressed in this report can in no way be taken to reflect the official opinion of the European Union.

Table of contents

FIGURES

TABLES

Abbreviations and acronyms

AD	Anaerobic digestion
BAT	Best Available Technologies
BIM	Building Information Modelling
CDW	Construction and Demolition Waste
CE	Circular Economy
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DRS	Deposit-Refund Scheme
EC	European Commission
EfW	Energy Recovery from Waste
ELV	End-of-Life Vehicle
EMAS	Eco-Management and Audit Scheme
EoW	End-of-waste
EPR	Extended Producer Responsibility
EU	European Union
FPP	Food Waste Prevention Plan
GDP	Gross Domestic Product
GHG	Greenhouse gas
GPP	Green Public Procurement
IEA	International Energy Agency
IRP	International Resource Panel
ISOH	Waste Management Information System
LTRS	Long-term Renovation Strategy
MoE	Ministry of Environment
Mt	Million tonnes
NACE	Statistical Classification of Economic Activities in the European Community
NAP	National Action Plan
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PAYT	Pay-As-You-Throw
PRO	Producer Responsibility Organisation
R&D	Research and Development
RRP	Recovery and Resilience Plan
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprise

SPI	Sustainable Products Initiative
SR	Slovak Republic
SUP	Single-use plastics
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
V4	Four Visegrad countries: Slovak Republic, Czech Republic, Republic of Poland, and Hungary
VA	Voluntary Agreement
VAT	Value Added Tax
WFD	Waste Framework Directive
WMP	Waste Management Plan
WPP	Waste Prevention Programme

Executive Summary

This report provides an analysis and a set of key elements for the development of a circular economy roadmap and its implementation plan for the Slovak Republic. The key findings and policy recommendations are summarised in the sections below.

There is a strong case for a circular economy transition in the Slovak Republic

On current trends, the demand for raw materials by the Slovak economy will continue to increase significantly. While the Slovak Republic has made notable progress in decoupling environmental pressures from economic activity in the past decades, its economy remains energy-, carbon- and resource-intensive due to a large manufacturing sector. The overall materials consumption in the country is projected to increase by more than 50% by 2050 compared to 2017 levels (from 94 million tonnes [Mt] to 142 Mt) if no additional policy measures are implemented. Metals, particularly iron, and non-metallic minerals, such as construction sand, gravel and crushed rock, are projected to grow at a faster rate than the EU average. Economic growth and increased consumption will drive this demand for raw materials.

The increased consumption of materials will generate significant negative environmental impacts. The projected increase in materials consumption in the Slovak Republic is likely to have large associated environmental impacts, including climate change. Around 70% of the country's greenhouse gas (GHG) emissions were associated with materials management activities in 2019, mainly with the production of goods. The highest share of production-related emissions was associated with steel and cement production, which are important inputs to the construction sector. This large share of emissions related to materials management highlights the importance of the circular economy transition in the Slovak Republic for the achievement of climate targets.

A national circular economy roadmap is needed to steer the country towards circularity by helping to focus efforts where they are needed most

Given the significant projected growth in materials consumption and therefore the intensification of environmental pressure, policy reforms are urgently needed. **A national circular economy roadmap can help to identify how the existing policy framework needs to be complemented, as well as determine where scarce resources are needed to maximise impact.** The current policy landscape related to the circular economy in the Slovak Republic is fairly well advanced in the area of waste management, but there remains an implementation gap that needs to be addressed. In addition, earlier stages in the product life cycle, such as materials extraction, product design and production, are currently insufficiently addressed by policies. To succeed in fully exploiting the circular potential of the economy, the Slovak Republic will need to support eco-design, eco-innovation and the use of secondary raw materials in production, as well as enable citizens to become more environmentally friendly, while improving waste prevention and materials recovery.

Proposed priority areas and key policy recommendations

The OECD analysis and stakeholder consultations identified three areas where circular economy reforms 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**. This report proposes more than 30 concrete policy recommendations supported by an implementation plan and a monitoring framework that would need to be introduced across the three priority areas to achieve circularity by 2040. Implementing these recommendations can also help the Slovak economy reach its climate change mitigation objectives.

Stimulating sustainable consumption and production through the use of economic instruments

Economic instruments offer the prospect of achieving circular economy objectives at a lower economic cost, while also incentivising innovation. These policy measures prompt firms and individuals to change their behaviour through price signals, but they also provide a degree of flexibility. Such policy measures can provide incentives upstream in the value chain, directed at changing product design and production, but they can also be used to stimulate circular consumption patterns, or re-use and recycling downstream.

Key policy recommendations to strengthen the use of economic instruments:

- Strengthen the incentives already provided by existing landfill taxes and implement new tax measures to address additional stages in the product life cycle (e.g. value added tax or materials taxes).
- Improve and reinforce existing Extended Producer Responsibility (EPR) schemes by introducing eco-modulated fees that incentivise circular design, and possibly extend EPR to additional product groups and waste streams, such as construction products.
- Gradually extend the mandatory use of green public procurement (GPP) criteria as award criteria and apply GPP to additional product groups (e.g. construction, food and canteen services).
- Expand the coverage of well-designed pay-as-you-throw (PAYT) schemes and move beyond volume and frequency subscription-based schemes towards sack- or weight-based schemes.

Towards a circular construction sector to improve waste management and reduce the use of virgin raw materials

Large untapped opportunities exist in the Slovak construction sector to reduce the use of virgin raw materials and stimulate the use of recycled construction materials. The construction sector is an important economic sector in the Slovak Republic, accounting for more than half of the domestic raw materials used, as well as a considerable amount of generated waste. Until recently, efforts aimed at increasing circularity in the sector were very limited, with most of the attention focused on improving the energy efficiency of buildings. However, new construction and renovations also offer important opportunities to deploy circular economy approaches. In particular, incentives encouraging circular design and the use of secondary construction materials are currently lacking and therefore there is significant potential to reduce materials consumption and their associated environmental impacts.

Key policy recommendations to help the country transition to a circular construction sector:

- Introduce a quality standard for recycled construction materials to stimulate the marketing and use of recycled materials and construction products.
- Consider introducing minimum recycled content requirements for certain construction materials within the context of GPP.

- Encourage greater use of secondary raw materials and renewable materials in future deep renovation projects through fiscal incentives (e.g. raw material taxes on aggregates).

A circular food and bio-waste value chain to support waste prevention and management

Implementing circular strategies in the food and bio-waste value chain will help the Slovak Republic achieve EU and national targets as well as decrease food waste. The food system is among the most frequently targeted priority areas in national circular economy strategies across the EU given its high consumption of land, water and energy, as well as its large potential to produce GHG-emitting waste. Consequently, a wide range of measures still needs to be implemented within the Slovak food and bio-waste value chain. While the country's short- and medium-term goals should focus on achieving EU waste targets (e.g. recycling and landfill targets), long-term efforts will need to be directed towards preventing food and other bio-waste, including through food redistribution and by-product valorisation.

Key policy recommendations for a circular food and bio-waste economy:

- Develop effective information and communication tools focused on food waste prevention targeted to consumers (e.g. campaigns and interactive events).
- Strengthen the use of economic instruments (e.g. GPP and incentive subsidies) to provide food producers with incentives to reduce by-products at source, to use recycled materials and to provide consumers with incentives to improve their sorting of bio-waste (e.g. PAYT-based charges).
- Develop a supportive regulatory framework for bio-waste management and support, not only for processing and recycling technologies but also innovation in applications aimed at increasing resource efficiency and valorisation techniques.

1 Introduction

Context

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, coupled with the environmental consequences of materials extraction, processing and waste, is likely to place significant pressure on resources, causing greater environmental degradation and jeopardising future gains in terms of well-being (OECD, 2019[1]). In order to reverse these trends, and to keep resources as long as possible in the economy, governments around the world, as well as the European Commission (EC), have made the transition to a circular economy one of their priorities. For example, transitioning to a circular economy is one of the main building blocks of the European Green Deal (European Commission, 2019[2]) and the revised European Union (EU) waste legislation. Moreover, the EU's new Circular Economy Action Plan (European Commission, 2020[3]) has instigated a flow of legislative proposals to support the circular economy.

The Slovak Republic, as other countries, has responded to these global developments by proposing, adopting and implementing relevant policies and legislation in the areas of resource efficiency and circular economy, and by applying recommendations proposed by the EC and the OECD within their reviews (European Commission, 2019[4]; OECD, 2017[5]). While the EC Environmental Implementation Review (EIR) (2019[4]) identified some of the progress made in the Slovak transition to a circular economy, namely, the preparation of relevant policy frameworks, the review acknowledged that several challenges remain when looking at the actual data and indicators related to circular materials use, resource productivity, eco-labelling or eco-innovation. One of the EC's priority recommendations in this area was to complete a policy framework that would enable the uptake of circular economy measures in the Slovak Republic (2020[6]; 2019[4]).

The OECD report *Making the Slovak Republic a more Resource Efficient Economy* concluded that given the country's limited natural resource base, its important manufacturing sector and its rising materials consumption "improving resource efficiency and establishing a circular economy is of prime importance for the country's growth and development" (2017[5]). The study further noted that the current resource management policy framework was incomplete, lacked coherence and needed to be strengthened. According to the report, improvements in the policy framework would provide more effective conditions for a resource-efficient economy, upgrade resource- and pollution-intensive sectors, and achieve green growth (OECD, 2017[5]).

In line with developments at the EU level, several recent policy documents in the Slovak Republic have integrated these recommendations and have included the circular economy in their vision and strategic objectives, recognising the necessity to develop a national circular economy roadmap. This includes, for example, the Envirostrategy 2030 (Ministry of Environment of the Slovak Republic, 2019[7]), the Economic Policy Strategy 2030 (Ministry of Economy of the Slovak Republic, 2018[8]) and the Vision and Sustainable Development Strategy for Slovakia up to 2030 (Ministry of Investments, Regional Development and Informatization, 2020[9]). In response, the Slovak Republic is in the process of preparing the country's Circular Economy Roadmap and Implementation Plan (hereafter "the roadmap"), which is expected to be adopted by the Slovak Government in 2023.

Objectives and scope

The overall objective of this report is to support the Slovak Republic in the development of its roadmap. This report (and its Annexes) is the final output of the technical support provided by the OECD for the Slovak Republic. It outlines potential elements of the future Slovak roadmap, along with key policy recommendations for the selected three priority areas, and it provides examples of good practices of other countries in addressing similar situations.

Provided the measures outlined in this report are adopted and implemented into the country's regulatory framework, a coherent policy framework can be expected, including concrete measures enabling the transition to a circular economy and its contribution to a carbon-neutral economy. Other benefits include: (a) improved resource efficiency; (b) improved waste management; (c) reduced environmental pressure; (d) the associated benefits for public health; (e) improved material security; and (f) increased industrial competitiveness and related job creation. In the long term, these benefits are expected to improve the strategic guidance and the institutional infrastructure and conditions required to transition towards a circular economy, including their positive effects in attaining national climate and other environmental objectives.

The key elements of this report that support the development of a Slovak roadmap are:

- A rationale for the transition to a circular economy in general and within the Slovak context, including an assessment of current and future trends related to materials and the economy.
- A presentation of the relevant context and targets of EU and Slovak policies.
- A potential overarching vision, and strategic goals and targets of the roadmap.
- An analysis of the selected three priority areas, along with key policy recommendations, including an assessment of sustainable consumption and production with a specific focus on economic instruments, the construction sector, and the food and bio-waste value chain.
- A discussion on the links between the circular economy and greenhouse gas (GHG) emissions.
- A draft implementation strategy.

A value chain approach, based on an analysis of production, consumption, waste management and recycling, provides the overall structure of the roadmap and its selected three priority areas. Besides an overview of proposed implementation actions, the proposed implementation strategy includes a monitoring framework with a set of key indicators to measure the progress made towards reaching the roadmap's objectives.

Structure of the report

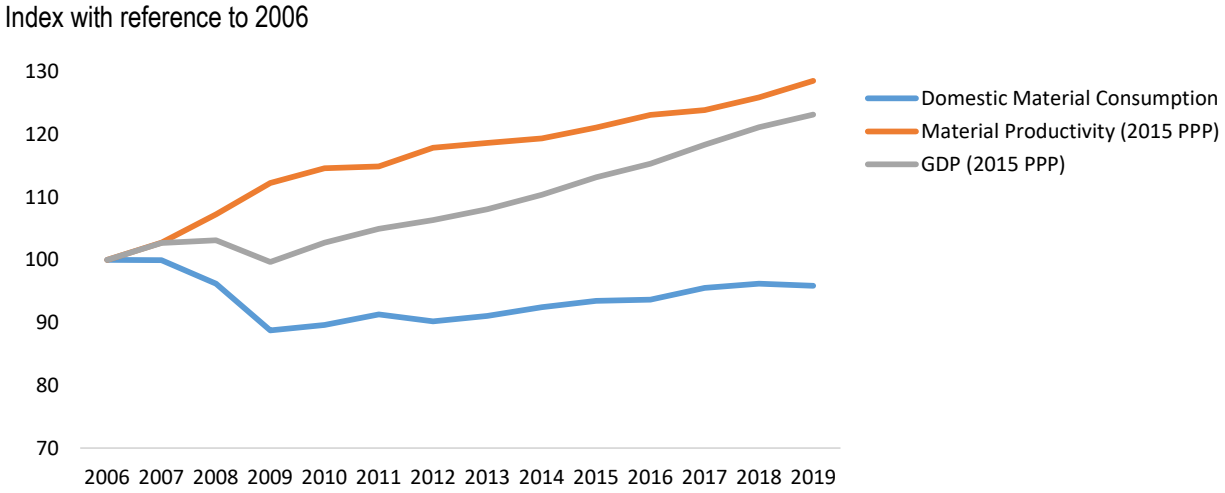
The report is structured as follows. Chapter 2 provides insights into global trends in resource use and its environmental implications, and it discusses the rationale for transitioning to a circular economy in the Slovak Republic. Chapter 3 reviews the existing policy landscape related to the circular economy in the Slovak Republic, highlighting the key policy gaps in the country. Chapter 4 presents the roadmap's potential vision, goals and priorities. Chapters 5, 6 and 7 provide in-depth analyses of selected priority areas. Chapter 5 outlines policy measures with a focus on economic instruments that promote sustainable consumption and production. Chapter 6 focuses on the construction sector and Chapter 7 focuses on food and bio-waste. The chapters also identify and highlight key recommendations to strengthen existing policy instruments, and introduce new ones where needed. Chapter 8 explores the links between the circular economy and GHG emissions. Chapter 9 outlines an implementation plan, including a set of key indicators to monitor the progress made on the implementation of the roadmap. The report draws on analyses in several background reports, which were prepared within the context of this technical support project and whose findings feed into this report.

2 Rationale for a Slovak Circular Economy Roadmap

Increasing global resource use and its negative impact on the environment

The use of materials globally has significantly increased over the past century and it will continue to increase driven by continued economic growth, industrialisation and a rising global population. Recent OECD modelling suggests that the use of materials more than doubled between 1990 and 2017 and is projected to double again by 2060 (from 89 Gigatonnes [Gt] to 167 Gt) if no further policy action is taken (2020[10]). Although materials consumption in OECD countries has been decoupling from economic growth in the past decades, this decline has happened at a slower rate than the increase in economic output (Figure 2.1). This reflects a relative decoupling, as opposed to absolute reduction, in materials use (OECD, 2019[1]).

Figure 2.1. Materials consumption, materials productivity and economic growth in OECD countries



Note: Materials consumption is measured as Domestic Material Consumption (DMC), economic growth is measured in USD (2015 Purchasing Power Parity [PPP]) and material productivity is measured as the ratio of GDP/DMC (USD per kg of domestic materials consumption 2015 PPP); data for 2018 and 2019 are provisional for the GDP.
Source: OECD (2022[11]).

The growing use of materials is set to worsen the environmental consequences along the life cycle of materials, with adverse consequences for human health, natural ecosystems and the economy. Environmental pressures from land degradation, GHG emissions and the release of toxic pollutants into the environment, among other things, are projected to more than double by 2060 (OECD, 2019[1]). For instance, raw materials extraction can result in air and water pollution, waste generation and pressures on biodiversity. Processing raw materials is energy and water intensive. Plastics and chemicals manufacturing

leads to persistent plastic waste and toxic contamination, and construction activities are linked to high GHG emissions, while the unsustainable production of biomass leads to soil degradation and biodiversity loss. Further, the dismantling and disposal of products at the end-of-life stage worsens air, land and water pollution from landfilling waste.

Circular economy as a way to reverse these trends

Concerns about the continued growth of materials use and the associated environmental consequences have received increased international attention. The traditional linear model of resource extraction, product ownership and end-of-life disposal is unlikely to deliver the sustainable future so desired. Promoting improved resource efficiency has become a major focus of a number of high-profile multilateral and national initiatives and frameworks, including the OECD Council Recommendation on Resource Productivity (2008[12]), the Kobe 3R Action Plan (G8 Environment Ministers Meeting, 2008[13]), the G7 Alliance on Resource Efficiency (2017[14]) and the G20 Resource Efficiency Dialogue (2017[15]).

One of the channels through which decoupling of economic activity from materials use can be achieved is the transition to a circular economy – one where materials and products are repaired, reused and recycled. Such a transition leads to lower rates of natural resource extraction and use through resource efficiency and circularity measures for materials. A circular economy helps to keep resources flowing within rather than through the economy by modifying the flow of products and materials through three main mechanisms (McCarthy, Dellink and Bibas, 2018[16]):

- **Closing resource loops** through the substitution of secondary materials and second-hand, repaired or remanufactured products in place of their virgin equivalents.
- **Slowing resource loops** through the emergence of products which remain in the economy for longer, usually due to more durable product design.
- **Narrowing resource flows** through more efficient use of natural resources, materials and products, including the development and diffusion of new production technologies, an increased utilisation of existing assets and shifts in consumption behaviour.

Achieving real progress in transitioning to a circular economy will require greener modes of production and consumption, and circular business models gaining a greater foothold in the economy. There are five types of business models that support the transition to a more resource efficient and circular economy (OECD, 2019[17]):

- **Circular supply models** replace traditional material inputs derived from virgin resources with bio-based, renewable or recovered materials.
- **Resource recovery models** recycle waste and scrap into secondary raw materials, diverting waste from final disposal while displacing the demand for the extraction and processing of virgin natural resources.
- **Product life extension models** extend the period of use of existing products, slow the flow of constituent materials through the economy, and reduce the rate of resource extraction and waste generation.
- **Sharing models** facilitate the sharing of under-utilised products and reduce the demand for new products.
- **Product service system models** where services rather than products are marketed, and incentives for green product design and more efficient product use are improved.

Transition to a circular economy yields environmental, economic and social gains. These include a reduction in the environmental pressures arising from current linear systems of production and

consumption, economic expansion and job creation driven by the emergence of new opportunities in certain sectors, as well as a reduced risk of raw materials supply shocks (OECD, 2019[17])

EU policy framework and legislation promoting a circular economy

As a response to the global pressure on resources and valuable materials leaving the economy, the EU has made the transition to a circular economy one of its priority policy areas. The European Resource Efficiency Platform was established in 2012 (European Commission, 2014[18]), and the first Circular Economy Package, which also included the EU Action Plan for the Circular Economy (European Commission, 2015[19]), was adopted in 2015. Since then several initiatives have been undertaken to strengthen the circular economy within the EU (for an overview see Annex A). In March 2020, the EC adopted a new Circular Economy Action Plan (European Commission, 2020[3]), which encompasses initiatives along the entire life cycle of products, targeting their design, sustainable consumption and the reuse and recovery of resources in its economy for as long as possible, among other things. This action plan has also become one of the main building blocks of the European Green Deal – the new European agenda for sustainable growth (European Commission, 2019[2]).

A key means to deliver on the European Green Deal, a circular economy is also considered to play an essential role in rebuilding the post-COVID-19 Europe into a greener, more digital and more resilient economy. In response to the COVID-19 pandemic, the EU agreed on a Recovery Plan for Europe. As much as one-third of the EU's Multiannual Financial Framework 2021-2027 and the temporary recovery instrument NextGenerationEU will be channelled into fighting climate change (European Commission, 2020[20]), part of which includes allocations for natural resources and the environment, and therefore also circular economy measures. In response, EU Member States have developed their national Recovery and Resilience Plans, which may include investments and reforms supporting a circular economy.

National efforts to transition to a circular economy are gaining momentum

At national and subnational levels, a large number of countries have been developing their respective circular economy strategic frameworks and roadmaps. Within the EU alone, more than 60 such frameworks at different levels (national, regional and municipal) have been developed since 2015. The common aim of these strategic frameworks revolves around developing measures to accelerate the transition to a circular economy.

A great diversity of approaches towards developing circular economy strategic frameworks exist across countries. They largely depend on the local context, the existing challenges and potential benefits, as well as on the underlying drivers and stakeholder involvement in the development and implementation of policy actions and strategies related to a circular economy. Yet, the strategic frameworks have some building blocks in common. They each build on the following elements:

- Vision and strategic objectives that the transition aims to achieve.
- Links to related strategies and an enabling policy framework.
- Stakeholders involved in the process of creation and the implementation of the strategy.
- Selection of priority areas.
- Quantitative targets and monitoring of their attainment.
- Implementation measures driving the transition.

Annex B provides some key findings of the analysis of national circular economy roadmaps and strategies across selected EU Member States. These key findings largely guide the development of the elements of the Slovak circular economy roadmap contained within this report.

Current trends and recent developments in the Slovak Republic

This section presents the performance of the Slovak Republic on several economic and environmental indicators. It also briefly discusses some current socio-economic and circular economy-related developments.

Socio-economic trends, opportunities and challenges

The Slovak Republic has been successful in harnessing economic growth, lowering unemployment rates, and improving the welfare of its population. This success can be attributed to the increased foreign direct investment that has entered the country due to its geographic location, low-cost but skilled workforce, as well as euro membership since 2009, which have all contributed to an attractive investment environment (OECD, 2019[21]). The Slovak Republic is a small, open economy that has benefitted from being well integrated in global value chains. Its Gross Domestic Product (GDP) growth in recent years has been robust with almost 4% growth on average over the last two decades. The Slovak economy was also one of the first to recover from the global financial crisis. Household consumption and exports have been driving this growth. Growth has also translated into a convergence towards the OECD standard of living average measured as GDP per capita, which has for many years surpassed that of larger economies, including Poland and Hungary, among its Visegrad 4 (V4) peers. As of 2019, GDP per capita stood at USD 34 000, which was USD 12 000 lower than the OECD average in the same year.

The Slovak Republic is an industry-heavy economy and this is reflected in the structure of the economy. An analysis of the value added by sector can shed light on the most important sectors (Figure 2.2). According to this measure, more than one-quarter of the economy in 2018 was reliant on industry, including energy. Manufacturing had an especially important role to play in a large portion of industrial output, representing nearly one-fifth of total output. Construction contributed 9% to value added.

Figure 2.2. Value Added (2018)

Source: OECD (2020[22]).

The Slovak economy is also heavily reliant on its trade in manufacturing products, making manufacturing and related services immensely important to the economy, being both a source of growth and a source of long-term risk. The fact that the country's exports have low value added, even compared to its peers, and that its import content of exports remains relatively high, shows that the economy has not yet been able to move beyond assembling intermediate products. In addition, lack of innovative activity in the private and public sectors, as well as low productivity of local small and medium-sized enterprises (SMEs) show that fast growth and integration has not translated into local technical know-how. Recent trends, such as automation, trade disputes and the disruption of global value chains, could undermine the success of such an open economy. These structural characteristics of the Slovak economy will have an important role to

play in the transition to a circular (and carbon neutral) economy, as it is the economic sectors that will have to undergo structural changes during this transition.

Besides automation, other long-term trends posing potential risks to the country's growth trajectory include the need for more skilled labour and rising labour costs. Reskilling, especially teaching digital skills, will therefore be of paramount importance in preparing the labour force for the possible technological changes in the medium and long term. Ensuring that the Slovak Republic is able to attract and retain a highly skilled labour force and ensure sustainable jobs remains another avenue for tackling labour shortages.

A transition to a circular economy could potentially be a solution to a variety of these issues. For example, it could improve the country's competitiveness through increased resource efficiency and innovation, which is a driving force behind circularity. It could allow for a diversification of the economy and the shortening, as well as decoupling, of value chains. This would further increase the competitiveness of Slovak companies in the global value chains and increase the value added generated by Slovak firms, in particular SMEs. It could restructure and innovate the manufacturing sector, transferring the technical know-how to local firms. It could create jobs that are longer lasting, where there are risks of automation, thereby creating more labour-intensive economic activity to offset the increase in the capital-intensity of the manufacturing sector. It could also create highly skilled, high-quality jobs, increasing the know-how as well as the standard of living of the country's population.

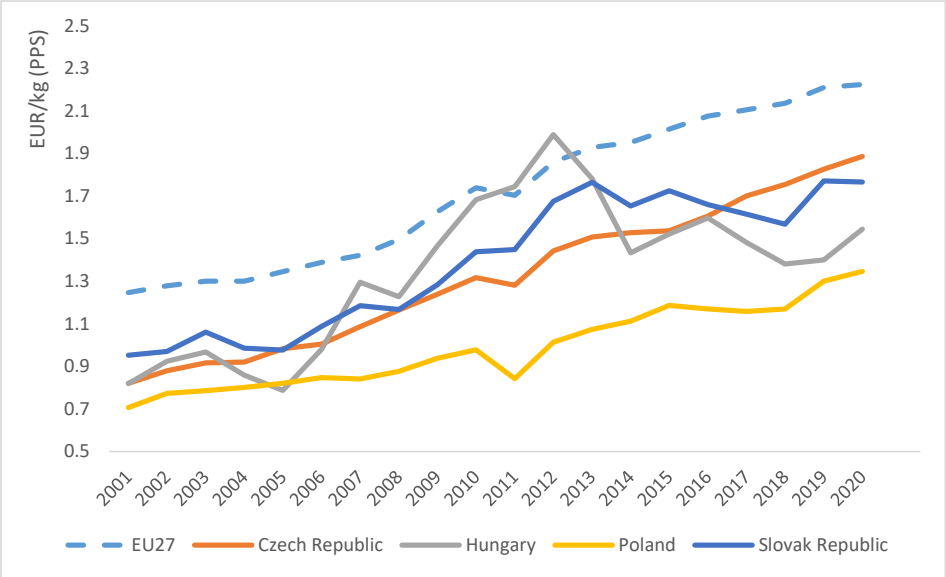
Materials use and waste-related trends

The Slovak Republic has levels of waste generation and materials consumption well below the most advanced economies. Nevertheless, as its economy converges towards those of its more affluent peers, the risk remains that its environmental and materials footprint will reach similar levels if it does not undertake any further action in terms of resource efficiency and circularity.

While environmental developments have generally been positive, especially given the intensive energy and materials use of the past Slovak economy, the decreasing trends are mainly due to economic restructuring and improvements in energy efficiency. This may be considered as "low-hanging fruits", which shows the need for even deeper commitment. Nevertheless, climate developments have been positive, but an uptick in GHG emissions has been observed due to greater economic activity; a sign that decoupling growth from fossil fuels has only been partially successful. Manufacturing, construction, and the energy needed for these activities, continue to contribute a significant share of GHG emissions.

Resource productivity, although increasing, still falls short of the EU average (Figure 2.3). By achieving higher levels of resource efficiency, the Slovak economy would become increasingly competitive because of lower production costs. Therefore, improving performance in this domain should be seen as both lowering environmental stressors and an opportunity to maintain and deepen competitive advantages.

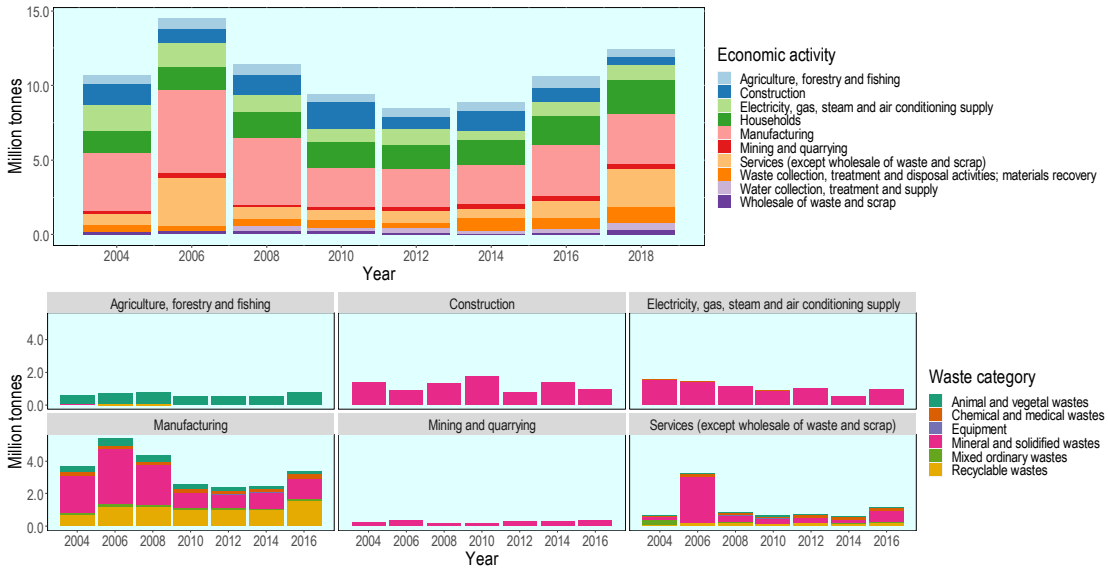
Figure 2.3. Resource productivity, Visegrad 4 and EU-27 (2000-2020)



Note: Resource productivity is expressed as the amount of economic output generated (in terms of GDP) per unit of materials consumed (in terms of DMC). This indicator is measured in euros per kg (GDP in current prices expressed in Purchasing Power Standards (PPS) and Purchasing Power Parities (PPPs).
Source: Adapted from Eurostat (2021[23]).

Both waste generation levels (Figure 2.4) and materials consumption are not as high as in the past. However, there is an upwards trend for both, potentially undermining the progress made by the Slovak Republic so far. Many of the materials and waste indicators have dramatically decreased following the financial crisis of 2008-09, however, they have been increasing again as the Slovak economy has picked up. This should be a cause for concern as the current trend indicates that the levels of waste generation and materials consumption could reach pre-2008-09 levels without further policy intervention. It is therefore recommended to put in place stronger waste management and resource efficiency measures to ensure that past, environmentally unsound trends are not replicated.

Figure 2.4. Waste generation by economic activity and by waste category



Note: Includes both hazardous and non-hazardous waste. Water collection, treatment and supply refers to Water collection, treatment and supply, sewage, remediation activities and other waste management services in the NACE Rev. 2. classification of economic activities. The peak in 2006 can be partly explained by an increase in construction waste, namely, of excavated soil from the construction of a tunnel in Bratislava and the surrounding access roads, and a one-off reporting of debris from U.S. Steel Košice (Monitoring report of the Waste Management Plan of the Slovak Republic for 2006-2010). In Eurostat, this waste has been classified as dredging spoils and falls under the economic activity "services (except wholesale of waste and scrap)". The 2018 values for waste categories are omitted due to incomplete data. Some economic activities are not shown for waste categories given the relatively low amount of waste generation as well as incomplete data.
Source: Adapted from Eurostat (2020[24]).

There are some longstanding challenges to waste treatment. However, the Slovak Republic has shown some improvement. For most of the decade, landfilling was the predominant treatment option, fluctuating from 50% of waste to almost 60%. In 2018, this trend flipped, with recovery representing more than half of all treatment options. This was possibly due to legislation as well as systems that favoured materials recovery and backfilling, especially in high waste generating sectors, such as construction or manufacturing. Meanwhile, landfilling and other means of disposal remain the predominant treatment option for municipal waste, with 50% of municipal waste still landfilled in 2020. Energy recovery accounted for 8% of total municipal waste treatment, while material recovery stood at 29%, and composting and digestion at 14%. Increases in materials recovery have been significant with a 40% increase from 2017 to 2018. Similarly, composting and digestion increased by 20% in the same period.

The Slovak Republic is striving to reach the ambitious EU waste legislation targets on municipal waste treatment for 2025, 2030 and 2035, but the country did not reach its targets for 2020. This warrants a re-visit of measures to strengthen the role of recycling and preparation for reuse as the primary, default option for municipal waste treatment. A circular economy roadmap could help the country form the basis of its long-term vision and strategy to achieve more environmentally friendly outcomes.

Macroeconomic projections to 2050 for the Slovak Republic

The OECD developed business-as-usual projections for the evolution of major macroeconomic, material and environmental impact indicators for the Slovak Republic during the period 2020 to 2050. These projections could serve as a reference for assessing a roadmap or policy package to support the transition towards a more resource-efficient and circular economy.

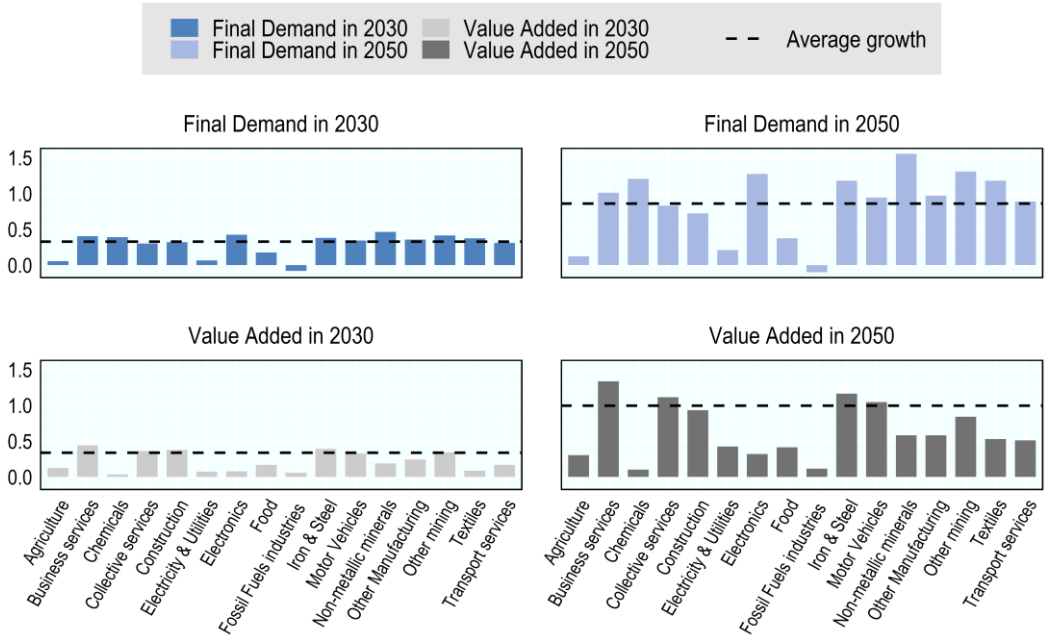
Future economic growth prospects and sectoral transformation

The Slovak Republic has enjoyed relatively fast economic growth compared to EU and OECD averages, which is projected to continue towards 2050 at an annual rate of 2.2% over the period 2020-2050. The GDP changes are largely driven by the evolution of the main primary factors of production (capital and labour) as well as technological progress. These in turn are dependent on a wide range of drivers, including continued efforts to optimise existing production processes, the adoption of new business models, or the development and spreading of new technologies (e.g. automation and artificial intelligence).

The final demand for non-metallic minerals shows sustained (above average) growth by 2050, followed by other mining, electronics, textiles and chemicals (Figure 2.5). The value added of services is expected to more than double by 2050, followed by significant growth of iron and steel, and motor vehicles industries. This indicates the continued importance of services and manufacturing sectors (namely, motor vehicles and steel) in the Slovak Republic in 2050. This may reflect the changes in industry structure, wealth increases and the overall size of the population.

Figure 2.5. Projected changes in value added and final demand in 2030 and 2050 in the Slovak Republic

Relative to 2020, by group of commodities



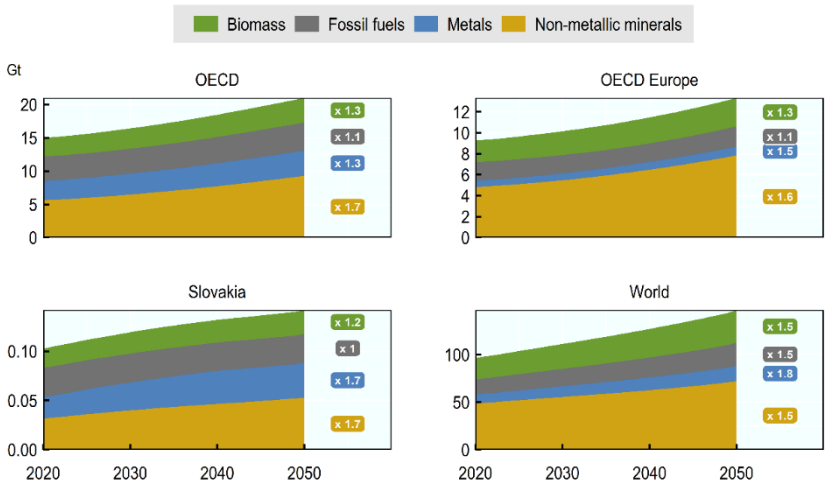
Note: A change of 1 means a doubling of the quantity.
Source: OECD ENV-Linkages.

The impact of different factors on growth in materials use

The use of non-metallic minerals, primary metals and biomass is expected to grow substantially in the Slovak Republic by 2050 (Figure 2.6). The highest growth is expected to be for non-metallic minerals (mainly construction materials, such as sand, gravel and crushed rock) and metals (mainly iron ores and steel). These are the materials needed for the country's key economic sectors: the automotive industry, steel and construction. The growth of secondary materials and recycling is expected to pick up by 2050, however, not fast enough to curb the rise in overall materials use by 2050.

Even in the business-as-usual scenario, materials use is expected to progressively decouple from real GDP, implying that structural and technological changes driven by current resource efficiency policies are effective to some extent. The GHG emissions follow a similar decoupling trend from economic growth.

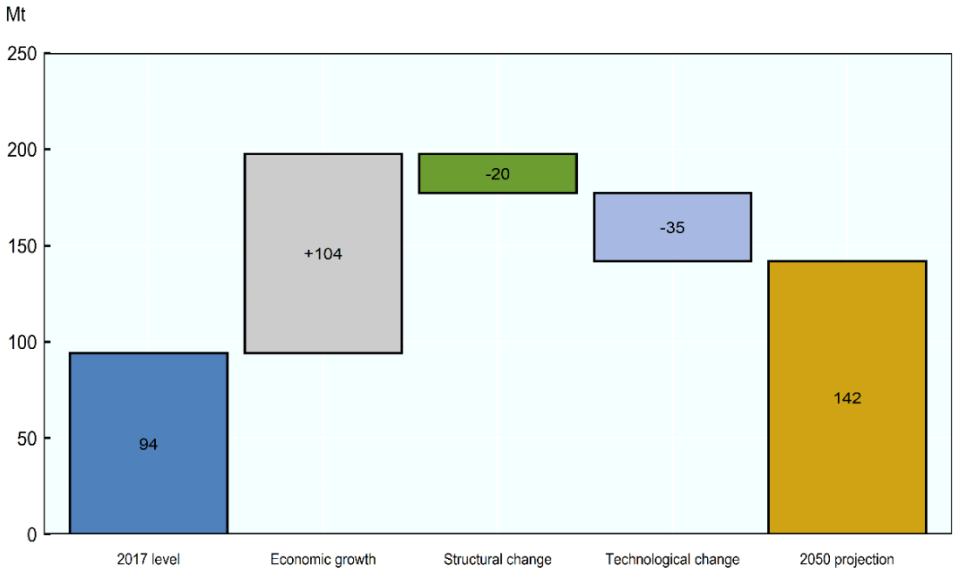
Figure 2.6. Materials use growth – 2020-2050



Note: Materials use varies widely across regions; therefore, the scale is different across the four charts.
Source: OECD ENV-Linkages.

In the absence of new policies, materials use in the Slovak Republic is projected to grow by approximately 50% compared to 2017 levels, reaching 142 million tonnes (Mt) by 2050 (Figure 2.7). This will exert significant pressure on the environment, including exacerbating climate change, and put the country at risk of missing important environmental goals and targets. Structural and technological changes (such as servitisation, digitalisation and increased resource efficiency) are expected to mitigate the rise in materials use driven by economic growth to some extent. The results of the analysis of drivers of materials use indicate that the potential for increased structural changes, but also technological change, appears particularly large given their relatively small contribution towards decoupling in the baseline scenario. In order to achieve a stronger mitigating effect of such changes and drive the Slovak economy towards a circular (and carbon neutral) economy by 2050, the Slovak Republic may well benefit from implementing additional policies in these areas.

Figure 2.7. Breakdown of projected materials use between 2017 and 2050 in Mt



Note: The five bars read as follows (from left to right): 1. Materials use in 2017; 2. Economic growth represents a counterfactual projection in which materials use is assumed to grow at the same speed as GDP and thus in which the regional materials intensity of GDP stays constant. 3. Structural change identifies the contribution of sectoral shifts to reducing global materials use by differentiating sectoral growth rates. 4. Technological change identifies the contribution of technology improvements to reducing global materials use by differentiating growth rates of materials inputs to sectoral output. 5. The combined effects lead to the baseline projected growth in 2050.
Source: OECD ENV-Linkages.

There is a need for additional resource efficiency and circular economy policies

The modelling analysis shows that both metals (in particular iron ores and steel) and non-metallic minerals (namely, construction materials), as well as sectors using these materials, will continue to play an important role in the Slovak economy by 2050. The materials intensities of these sectors are also expected to remain relatively high. This indicates that in order to decrease primary materials use in these sectors, while still ensuring economic growth, stronger and faster decoupling of GDP from materials use (and GHG emissions) will need to take place. This will require new resource efficiency and circular economy policy interventions to curb such trends in materials use in order to achieve a carbon neutral economy by 2050.

The analysis further shows that structural and technological changes across the economy are critical to curb the growth in materials use. Both factors only mitigate growth in the country's baseline scenario to a limited extent. This implies that in addition to sectoral raw materials and waste policies targeted at increasing resource efficiency in specific sectors, the Slovak Republic may want to support additional horizontal policies directed towards greater structural and technological changes. Such policies may include research, innovation and digitalisation, as well as policies directed towards greater use of circular business models and economic instruments, shifting the economy away from materials-intensive industries towards higher-end manufacturing and services.

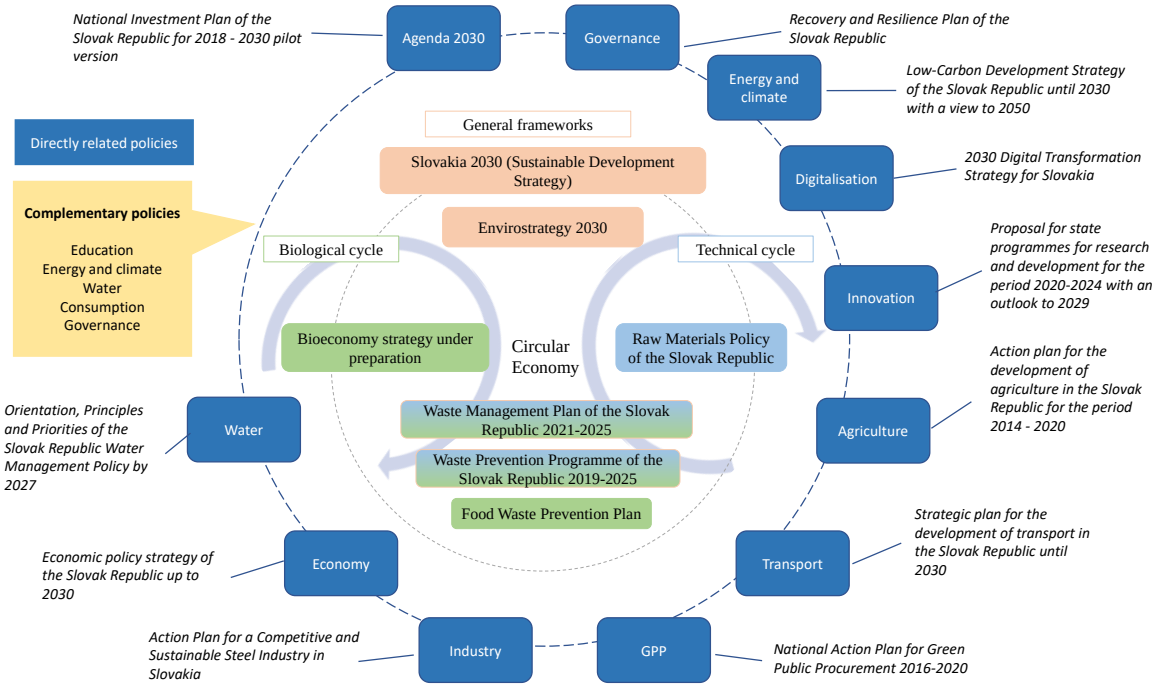
3 Existing Circular Economy Policy Landscape in the Slovak Republic

This chapter analyses the current policy landscape related to the circular economy in the Slovak Republic and identifies policy areas that could have important implications for the country's transition to a circular (and carbon neutral) economy. The identified policy gaps, jointly with other analyses, provide important insights into the selection of priority areas for the future roadmap (see Chapter 4).

Overview of the Slovak policy landscape related to the circular economy

This policy analysis covered approximately 30 policy documents (out of a long list of around 60) currently in place and identified across a number of thematic areas considered to be highly relevant for the transition to a circular economy. This thematic scope includes both technical and biological cycles in the circular economy, as well as policy frameworks enabling this transition, such as education and digitalisation (Figure 3.1).

Figure 3.1. Overview of the Slovak policy landscape relevant to a circular economy



Note: The examples of directly related policies are not exhaustive.

Screening of the selected policy documents classified them into "core", "directly related" and "complementary" (see Table 3.1). The categorisation methodology identified 6 core policy documents, 24 directly related policy documents within 11 thematic areas, and 5 complementary policy documents within 5 relevant thematic areas. The list of analysed policy documents and their categorisation can be found in Table A C.1 in Annex C.

Table 3.1. Categorisation of policy documents

Category	Definition
Core policies	Core policy linked to circular economy. The policy focuses largely on a circular economy-related thematic area or at least on one of its core principles.
Directly related policies	Policy that is directly relevant to a circular economy, e.g. focusing on one of its sectors or principles, however, it goes beyond them in scope. Such a policy applies to a wider range of areas outside circular economy.
Complementary policies	Policy which has less direct links to circular economy and goes significantly beyond it in scope, e.g. the policy acts as an enabling factor and can be applied to a wide range of areas.

The analysis of policy documents was based on mapping out similarities and differences across four key elements contained in the strategies and plans:

- **Vision** – aspirations for the future.
- **Goals** – the qualitative goals the policy document sets out to achieve.
- **Targets** – the quantitative targets the policy document puts forward to achieve the goals.
- **Key implementation measures** – specific instruments and measures the policy document recommends to achieve its goals and targets.

These elements have been identified as common building blocks of strategic frameworks and plans in general, as well as common building blocks of circular economy strategies in a number of selected EU Member States (see Annex B). These elements were assessed in detail for the core policy documents (see Annex C for an overview of goals and targets), and briefly per thematic area for the directly related policies. Policy documents classified as complementary were not assessed in detail.

The core policy framework for materials and waste

Figure 3.1 shows that the core policies relevant to the circular economy in the Slovak Republic include two general frameworks (Slovakia 2030, Envirostrategy 2030), one sectoral policy on raw materials related to the technical cycle in a circular economy (Raw Materials Policy), and three waste management related policies (Waste Management Plan, Waste Prevention Programme, Food Waste Prevention Plan), the details of which are outlined below.

- **Vision and Sustainable Development Strategy of Slovakia up to 2030** (hereafter "**Slovakia 2030**", adopted by the Slovak Government on 20 January 2021). Slovakia 2030 is the key overarching strategic document outlining key changes and measures to achieve sustainable development in the Slovak Republic by 2030. It replaces the National Regional Development Strategy and forms the basis for the National Investment Plan to 2030 Pilot Version (Ministry of Investments, Regional Development and Informatization, 2020[9]). The adopted strategy takes into account a number of recent developments, including the European Green Deal, the new EU budgetary programming period 2021-2027 as well as the impacts of the COVID-19 pandemic of 2020. While the strategy goes beyond circular economy, its strategic importance makes it a core policy document in the Slovak policy landscape.

- **Greener Slovakia – Strategy of the Environmental Policy of the Slovak Republic until 2030** (hereafter "**Envirostrategy 2030**"). This is the key overarching strategic document for the implementation of environmental policy to 2030 for the Slovak Republic. It is broader than circular economy, however, the circular economy is integrated into the strategy's vision and core goals (Ministry of Environment of the Slovak Republic, 2019[7]).
- **Updated Raw Materials Policy for the Slovak Republic.** This policy document defines the overall goals and priorities with regard to the use and protection of raw materials (energy and non-energy). Furthermore, it regulates the organisation of the raw materials market and requirements in the Slovak Republic (Ministry of Economy of the Slovak Republic, 2004[25]). A new raw materials policy of the Slovak Republic is under preparation.
- **Waste Management Plan (WMP) of the Slovak Republic 2021-2025** (hereafter "WMP"). The plan is the core waste management policy document for the Slovak Republic that comes from an obligation under the EU Waste Framework Directive (Ministry of Environment of the Slovak Republic, 2021[26]).
- **Waste Prevention Programme (WPP) of the Slovak Republic 2019-2025** (hereafter "WPP"). Similarly, the Waste Prevention Programme comes from its obligation under the EU Waste Framework Directive (Ministry of Environment of the Slovak Republic, 2018[27]) and complements the WMP.
- **Food Waste Prevention Plan** (hereafter "FFP"). This document presents a national long-term plan to prevent and decrease food waste and food losses in the Slovak Republic along the entire food value chain (Ministry of Agriculture and Rural Development of the Slovak Republic, 2016[28]). It has been prepared by the Ministry of Agriculture and Rural Development, and it complements the WMP and WPP.

The Slovak Republic is currently preparing its "Bioeconomy strategy".

Apparent gaps and challenges in key policy

The analysis shows that the Slovak Republic has fairly well-developed policy frameworks for waste, research, innovation and digitalisation, industry, energy and climate, sustainability and environment in general. The country adopted (or is about to adopt) a number of recent key strategic documents integrating circular economy into sectoral visions and strategic objectives. Some of the key policy documents include the Envirostrategy 2030, Slovakia 2030 and the Economic Policy Strategy 2030, to name a few. This pledge towards a circular economy comes from the country's own commitment to making the transition to a circular economy a key national priority, but also from the commitments agreed at the EU and international levels.

Nevertheless, the policy gap analysis shows that the Slovak Republic lacks the implementation of measures to support a circular economy. As a result, the country has not yet succeeded in fully exploiting the circular potential of its economy and several challenges remain, even in areas where policy frameworks exist. By taking a three-pronged approach consisting of sectoral, value chain and horizontal perspectives, the research identified nine key policy gaps, some of which will be addressed in the future roadmap (Table 3.2). The approach compares the current state of play of the policy landscape with a possible sought-after policy framework, which could facilitate the transition to a circular economy in the Slovak Republic and reach the identified goals and targets. The sought-after policy framework is based on:

- Strategic goals and targets identified in the existing policy landscape and their likelihood of being achieved.
- Expectations with regard to policy actions coming from the 2020 EU's Circular Economy Action Plan.

Table 3.2. List of potential policy gaps and their initial assessment

Policy gap	Assessment summary
Improve policy instruments stimulating sustainable production, in particular in energy and material intensive industries.	Industrial production seems to have high economic and policy importance. The policy gap appears significant, especially with regard to circular design. New legislative proposals coming from the EC are expected.
Support the use of secondary raw materials and the use of waste as a resource in the economy.	An important policy gap seems to exist in this area. The economic and policy importance of material intensive sectors, both primary and secondary production of metals and non-metallic minerals, as well as related manufacturing industries appears high. A circular economy, especially in these sectors, may make an important contribution towards achieving the EU and national climate targets.
Strengthen support for innovative service-based business models, e.g. "product-as-a-service" models, repair services.	The economic importance of such services appears moderate. Currently no legislative proposals are expected to stimulate the market uptake of such business models, except for the expected legislative proposals coming from the EC to support "the right to repair" by consumers.
Support implementation of a wider range of policy instruments to stimulate circular consumption.	Existing policies provide a number of relevant policy instruments in this area. The policy importance appears moderate. Currently no legislative proposals are expected. However, further work may be needed to drive behavioural change among consumers.
Improve waste management in a number of areas, e.g. municipal and biodegradable waste.	The relevant policy landscape appears fairly complete. However, several key challenges remain, namely, high landfilling rates. This area seems to have a high policy importance as it is linked to the EU waste targets.
Strengthen policy instruments addressing specifically food waste.	This area appears to have a relatively low economic and moderate policy importance. Potential legislative changes may be expected from the EC.
Stimulate research, innovation and digitalisation in the circular economy, e.g. increase domestic innovation capacity, public and private funding, and education.	This area seems to have a high policy importance as it is linked to domestic manufacturing sectors. Policy instruments exist, however, several challenges remain. There are numerous existing national targets. No legislative proposals are expected from the EC.
Increase the availability and effectiveness of economic instruments, in particular fiscal instruments, to support the circular economy transition.	A number of economic instruments exists; however, the policy gap appears to be important. The support for the circular economy largely depends on direct subsidies (mainly on European Structural and Investment Funds). This area appears to have moderate economic and policy importance. No legislative proposals are expected in this area, except a potential environmental fiscal reform.
Establish an adequate education and awareness-raising framework, supporting the transitioning to a circular economy.	An environmental education and awareness-raising policy framework exists but it is not specific to the circular economy. Moderate policy importance of education policy in general appears to be the case. No legislative proposals are expected. A number of national targets exists.

Notes: Economic importance has been judged based on the sector's value added. Policy importance has been assessed based on the inclusion of the area in strategy documents, plans and programmes.
Source: Authors' own based on the policy landscape analysis.

This assessment indicates a need to address the production and waste management points in the value chain, in particular, the need to increase the uptake of secondary raw materials in product design and production, as well as reuse and recycling. The key sectors to target include the manufacturing and construction sectors, as they are the energy- and materials-intensive sectors in the Slovak Republic. Food waste and municipal waste in general are key waste streams that would require further policy attention. Additional areas worth exploring are such horizontal areas as research, innovation and digitalisation, and the use of economic instruments, which will help create a well-founded enabling framework for the transition to a circular economy. The Slovak Republic will include some of the above-mentioned areas in its future roadmap.

4 Roadmap Vision, Goals and Priorities

A national vision encompasses the high-level objectives individual countries wish to achieve by embarking on a path towards a circular economy. Positioned within the current context of the country's sectoral trends, its political priorities and the international context (i.e. climate, development and trade policies), such a vision is ideally linked to existing national and international strategies, and takes equal account of economic, natural and social capital (Weber and Stuchtey, 2019[29]). Moreover, for a vision to be compelling, it is crucial for it to develop a narrative that makes the transition to a circular economy relevant to *all* stakeholders involved. The following proposed vision is the result of extensive discussions with government representatives and other stakeholders.

Proposed vision towards 2040

By 2040, the Slovak Republic has achieved significant progress in its transition towards a circular economy and has become a sustainable and low-carbon economy. The Slovak Republic establishes itself as one of the circular economy actors in Central Europe by focusing on the construction sector, the food and bio-waste value chain, and its use of economic instruments for the circular economy and for sustainable consumption and production. Different levels of the government widely promote such circular economy practices, and businesses and citizens adopt them. The Slovak Republic improves its legislative and regulatory framework and effectively uses the economic instruments at its disposal.

Circularity plays an essential role in securing and improving the competitiveness of the Slovak economy and in incentivising the application of new technologies, eco-innovation and circular business models. The Slovak Republic promotes sustainable production, namely, eco-design and the use of secondary raw materials. Being a small open economy, the Slovak Republic draws particular benefits from the implementation of resource efficiency and circular business models across its value chains, which help to lessen companies' dependence on virgin raw materials, reduce their costs, and increase their competitiveness further. This in turn leads to the workforce acquiring new skills and the creation of new, high quality jobs. The SMEs, which currently represent around 60% of business turnover and 70% of jobs in the Slovak Republic, are a driving force behind this transition.

The transition has also allowed the Slovak Republic to significantly improve its waste management practices. Waste prevention measures have contributed to limiting waste generation. For remaining waste, the country also achieves high waste recycling and recovery and low landfilling rates, which is coupled with a strong use of recovered materials in its economy. The country's construction waste, food waste and bio-waste also receive particular attention.

Circularity has also contributed to the decarbonisation of the Slovak economy. The Slovak Republic sees circularity as a complementary tool to GHG emissions mitigation, which will contribute to achieving carbon neutrality in the country by 2050. Resource efficiency in the construction sector, coupled with the widespread use of recycled materials, as well as a change of consumption patterns towards circular products, have significantly reduced the carbon footprint of the construction sector.

Slovak citizens are well informed and educated about the circular economy and actively contribute towards it. They take ownership of the circular transition through their behaviour and actions. The entire educational system incorporates the concept of circular economy into curricula. Slovak citizens can find relevant information on the durability, reparability and recyclability of the products they consume and then discard. As a result, Slovaks have switched their consumption patterns towards more circularity and sustainability.

Strategic goals

To operationalise the vision outlined above, the proposed strategic goals include:

- Supporting eco-design, eco-innovation and the use of secondary raw materials in production.
- Reducing the environmental impact of production and consumption.
- Preserving and efficiently managing natural resources.
- Improving waste management and waste prevention.
- Improving innovation capacity and co-operation between Slovak industries and other stakeholders, in particular, between the private sector and academia.
- Improving legislative and regulatory frameworks.
- Using the circular economy as a complementary tool to achieve the decarbonisation of the economy.
- Strengthening circularity, namely, in the construction sector and along the food value chain.

The potential supporting strategic goals could include:

- Increasing the use of effective economic instruments for a circular economy.
- Acquiring new transversal competences, knowledge and skills.
- Defining new fields of study for formal education, and new qualifications in line with the new needs in society and in the labour market.
- Increasing the competitiveness of Slovak companies.
- Improving consumers' behaviour.

Selected priority areas of the roadmap

A key step to developing a national circular economy strategy or a roadmap is to identify and select priority areas. The literature (Laura Järvinen and Riku Sinervo, 2020[30]; Ellen MacArthur Foundation, 2015[31]; Salvatori, Holstein and Böhme, 2019[32]) and the review of existing circular economy strategies and roadmaps (Annex B) show that there is no consensus on the definition of and approach to the selection of such focus areas. The review also demonstrates that different countries, organisations and academics have developed unique quantitative and qualitative methodologies, or a combination of both, to inform the choice of the prioritisation approach and the selection of specific priority areas.

Approach taken to select priority areas of the Roadmap

The OECD analysis of existing prioritisation approaches provided the analytical basis for the approach to define and select priorities for the future roadmap. The identified options were then discussed in stakeholder consultations, leading to the value chain approach to guide the overall structure of the Slovak Circular Economy Roadmap and the selection of the priority areas.

The Slovak Republic has further chosen three priority areas for which the OECD provided an in-depth analysis: (a) the horizontal area of sustainable consumption and production, with a specific focus on

economic instruments; (b) the construction sector; and (c) the food and bio-waste value chain. Each priority area captures the different points in the value chain (production, consumption, waste management and recycling). The selection of the roadmap's priority areas is based on an initial OECD analysis informed by a number of criteria and indicators (e.g. economic importance, circularity potential, policy relevance and decarbonisation potential), and was subsequently discussed in bilateral inter-ministerial discussions and in a dedicated meeting with all the stakeholders. The three priorities were finally selected following an inter-ministerial roundtable negotiation led by the Ministry of Environment of the Slovak Republic.

Three selected priority areas of the Roadmap

The analysis focused on the following three priorities: sustainable consumption and production with a focus on economic instruments, the construction sector, and the food and bio-waste value chain.

Sustainable consumption and production with a focus on economic instruments

Sustainable consumption and production has been chosen as an overarching theme of the roadmap. Economic instruments, as key policy instruments that contribute to sustainable consumption and production, were selected as a key roadmap priority because they offer the prospect of achieving environmental outcomes at a lower economic cost, and because they incentivise innovation. The roadmap can be instrumental in charting a course for their wider use in the Slovak Republic and for them to drive the roadmap's successful implementation. In addition, the horizontal nature of this priority provides a comprehensive and balanced approach to the country's transition to a circular economy, with the other two priorities focusing on specific sectors and value chains. While the focus in this report is on economic instruments, Annex D provides a brief assessment of relevant regulatory, voluntary and information instruments, as well as measures to promote education and facilitate co-operation.

Circular economy potential in the construction sector

The construction sector is a key priority for the future roadmap due to its current and projected importance in the Slovak economy (e.g. in terms of value added and employment), its high circular and decarbonisation potential as well as its link to the Slovak Recovery and Resilience Plan (RRP). The sector plays a prominent role in materials consumption (more than half of domestic materials consumption relates to construction materials), and waste generation and treatment in the Slovak Republic. One of the priorities of the Slovak RRP is the renovation of buildings, including a reform around construction and demolition waste, which can lay the foundation for a circular economy transition in this sector in the Slovak Republic. It is also a sector where the circular economy can substantially complement climate change mitigation policies in decarbonising the sector. In consultation with Slovak authorities, the focus in this sector has been placed on buildings along their entire life cycle, ranging from extraction, design and construction, through to the use and end-of-life phase of a building.

Achieving circularity in the food and bio-waste value chain

The food and bio-waste value chain is another key priority of the future roadmap, in particular, due to its high circularity potential and policy relevance as well as its importance in achieving the EU municipal waste targets. The need to address food waste, and bio-waste in general, has been identified as a priority at the EU level, resulting in the adoption of a number of EU strategies and pieces of legislation (e.g. the EU's new Circular Economy Action Plan or the Farm to Fork Strategy). These developments have also been reflected in national strategies (e.g. the Envirostrategy 2030, the Waste Management Plan [WMP], the Waste Prevention Plan [WPP] and the Food Waste Prevention Plan [FPP]). Moreover, a substantial share of mixed municipal waste in the Slovak Republic forms bio-waste. In order to meet the EU municipal waste targets and obligations, the Slovak Republic will need to step up its management of bio-waste and bio-waste prevention.

5 Roadmap to Sustainable Consumption and Production with a Focus on Economic Instruments

This chapter analyses the priority area "sustainable consumption and production with a specific focus on economic instruments". It discusses and proposes policy recommendations on how to improve circularity across the value chain, i.e. related to product design and production processes, consumer consumption patterns as well as waste management practices. The chapter does so by analysing existing policy instruments in the Slovak Republic that could drive this change, as well as international good practices. Both the use of economic instruments and the potential of other regulatory, voluntary and information instruments, as well as measures to promote education and facilitate co-operation, are included in the analysis. Annex D provides a summary overview of all 18 policy instruments assessed in this chapter.

Definitions and concepts

Definition and scope of economic instruments

Economic instruments, such as taxes and incentive subsidies, are policy instruments that provide important market signals which can influence the behaviour of producers and consumers alike. They can incorporate environmental costs and benefits into the budgets of businesses and households by increasing (or decreasing) the price of a product or service (OECD, 2017[33]). In other words, economic instruments help internalise environmental costs into firms' and households' decisions and establish incentives for changes in behaviour while offering a degree of flexibility about the method and pattern of compliance. As such, they offer the prospect of achieving a given level of environmental outcome at a lower economic cost, and possibly more rapidly than through more inflexible forms of regulation (OECD, 2021[34]). They may also stimulate greater innovation in technologies and can generate revenues in the form of tax or proceeds from tradeable permits (OECD, 2014[35]). The revenues can be earmarked for some environmental objective, fund or budget, or they can accrue to the general public budget.

Economic instruments, such as landfill taxes, packaging taxes, deposit-refund systems and taxes on virgin materials have become an established and effective part of the materials management policy landscape in EU Member States over the past four decades (OECD, 2016[36]; OECD, 2016[37]; OECD, 2019[38]; OECD, 2014[35]). However, experience has shown that there is considerable scope for further development and application of economic instruments as part of circular economy strategies and roadmaps. These instruments can help re-shape the economy towards a circular pattern of recovery, re-use and recycling rather than the linear pattern of production and consumption followed by disposal, while avoiding an excessive economic burden and adverse effects on economic performance (OECD, 2021[34]).

The literature identifies six main types of economic instruments that can be implemented at the different points in the value chain. Four types of economic instruments could be categorised as *explicit* economic instruments: taxes and charges, tradeable permits, deposit-refund systems and incentive subsidies. There

are two other instruments that share some of the important properties of economic instruments: Extended Producer Responsibility (EPR) schemes and Green Public Procurement (GPP).

Within the Slovak context, the category of taxes and charges in the Slovak Republic includes taxes (*dane*), fees (*poplatky*), levies (*odvody*) and other payments (*platby*). The rates and conditions of taxes and charges are stipulated in the different pieces of national legislation. The Slovak Environmental Act No. 17/1992 Coll. establishes the role economic instruments can play in compensating for environmental pollution and for the use of natural resources, as well as in stimulating environmentally friendly behaviour and activities.

Additional policy instruments relevant to sustainable production, consumption and waste management

Despite the importance of economic instruments in a circular economy transition, countries strive to use a mix of policy instruments. There is substantial heterogeneity in the use of these instruments as they are applied across the different stages of the value chain: from design, production and use of secondary materials, through consumption, waste collection and processing, to investment, all of which encourage circular business models and solutions.

Policy instruments, beyond economic instruments, can be classified into the following categories:

- **Regulatory instruments** are used to foster legislation and regulation to remove any potential regulatory barriers. They are also used to develop legal frameworks that encourage innovation and promote investments in circular business models and solutions. In particular, regulatory instruments focus on adapting waste regulations and setting waste reduction targets, they introduce standards and certification (for reused, remanufactured or recycled products), they create framework conditions to facilitate reuse of secondary materials, and they ease regulatory barriers and administration burdens for circular business development and sustainable innovation. They can also take the form of obligations, bans and restrictions, such as expanding the obligation for car repairs, preventing the use of harmful substances, or enforcing the installation of plastic particle recovery filters.
- **Voluntary approaches** can be seen as supplements to regulation, helping sectors to find less costly means to achieve objectives. Examples of such initiatives include voluntary certification standards in the construction industry, voluntary sustainability standards in agro-food chains, as well as voluntary commitments for recycled plastic material in products.
- **Information instruments** refer to eco-labelling and improving consumer information in order to enable consumers, companies and public authorities to make responsible purchases based on the environmental characteristics of the product, its reparability and the availability of spare parts. They may also take the form of analysis and digitalisation of data, informing and connecting potential partners (e.g. information on the anticipated capacity requirements for future waste infrastructure to ensure that such infrastructure is appropriately developed).
- **Education and research** promotion measures are the main drivers of knowledge creation and innovation, informing decisions and actions for the transition to a circular economy. The instruments target capacity-building through education and training programmes, the establishment of circular economy observatories and sectoral knowledge networks (at national and regional levels), the promotion of research projects related to material flows across sectors, and the collection of materials use statistics.
- **Measures to facilitate co-operation** in the circular economy may involve public-private co-operation, strategic coalition-building across private sector stakeholders (e.g. through circular hotspots), inter-sectoral co-operation (for instance across waste and packaging industries and

within manufacturing industries), and economic diplomacy to strengthen business links and international competitiveness of circular pioneers.

The review of national circular economy strategies of some EU Member States has shown that a combination of economic and regulatory instruments is most frequently proposed. In practice, however, information instruments (especially business advice services and awareness-raising campaigns for citizens), as well as public procurement and EPR are often used. Conversely, taxes, fees and subsidies have so far been used to a limited extent and only for specific sectors or products (Weber and Stuchtey, 2019[29]).

The following sections focus on economic instruments that are available along the different life cycle stages of products and materials.

Fostering circularity in design and production processes in the Slovak Republic

The importance of circular product design and production

The circular economy starts at the beginning of a product's life cycle. Decisions made during the different stages of product design and production processes may significantly impact the sourcing of raw materials, their use, as well as the management of the resulting waste streams (European Commission, 2015[19]). They also enable value recovery from products that have lost their initial usability, thereby creating new circular business opportunities.

Product design

Smart product design influences all stages of the product life cycle, creating significant environmental and economic benefits. Design choices help preserve the functionality and usability of products, components and embedded materials for as long as possible. They thereby help increase value retention and prevent waste creation.

Early on in the life cycle of products, smart product design can help create value by producing **high-quality** products with **long durability**. It can engage the **use of secondary raw materials and recovered components** (e.g. construction and demolition waste as input into new infrastructure projects) and can **prevent the use of environmentally harmful inputs** into production (e.g. toxic materials in construction projects) (European Environment Agency, 2017[39]). At the same time, the development of **service-based circular business models** to replace product-based models can create additional value in preserving resources and generating economic and social benefits (e.g. renting tools, online education courses). Taken together, these considerations help minimise the reliance on the use of primary materials, lowering the environmental footprint of products.

Once products reach the end of their intended use, smart product design can extend their lifetime. Products can be reintroduced back into the value retention loops through new production processes, thereby lowering environmental impacts as well as costs to both producers and consumers (UNEP, 2019[40]):

- **Repairing** by replacing broken parts and removing defective components makes products fully functional again, as per their original purpose. Such products are then returned to owners or resold in second-hand stores.
- **Refurbishing** during maintenance operations restores or increases a product's performance or functionality, and helps meet new technical standards and regulatory requirements, while ensuring at least its original use.
- **Remanufacturing** restores the components or modules to "same as new" or with better conditions and performance. This industrial process yields products with a full warranty.

At the final stages of the product life cycle, smart product design helps to recover value from products. It allows products, their components and materials to be returned to their respective technical or biological cycles, reclaiming materials and reducing waste generation and treatment (UNEP, 2019[40]):

- **Repurposing** discarded products and their components means adapting them for different functions, while retaining at least some of their value.
- **Recycling** involves reprocessing waste into products and materials, typically with different functions from the original design and characteristics. It helps prevent waste disposal and creates a supply of secondary raw materials.
- **Cascading loops** enable biologically sourced materials and nutrients to be returned to the soil. They help maintain productive agro-ecological systems and reduce waste generation.

Production process

Unless circular considerations are incorporated throughout the production processes, the value created by smart product design may be undermined. From the sourcing of raw materials, through production techniques to the generation and management of by-products, circular activities help improve the environmental, economic and social impacts of production processes across industries.

Sustainable sourcing of resources is key to unlocking the circular economy potential. The sustainable and transparent sourcing and trade of resources and products can have significant environmental and social impacts (e.g. The Forest Stewardship Council [FSC] certifies wood sources and critical minerals sourced from outside areas impacted by civil unrest) (Euractiv, 2014[41]). The application of best available techniques (BAT) help prevent and control industrial emissions, and their adverse impacts on the environment, from the use of materials and chemicals (OECD, 2020[42]).

The efficient use of these resources during production can deliver savings in materials, energy and water, and decrease waste generation, while creating additional value and unlocking new circular business opportunities (European Commission, 2020[3]; European Commission, 2015[19]). Along with these benefits, new production technologies, often enabled by digitalisation, help make the production processes more circular. For instance, additive manufacturing technologies (such as 3D printing) help deliver customised parts with accelerated time to the marketplace and improve manufacturing efficiency (e.g. in automotive and construction sectors) (Everett, 2021[43]).

At the final stages of production, co-operation across value chains, through the promotion of innovative industrial processes, can minimise waste generation (European Commission, 2015[19]). During industrial symbiosis, by-products and waste from one industry can become inputs to production processes for another (for instance between chemical, cement, metal and paper industries). Besides resource exchange, businesses may also share infrastructure and services within industrial parks (WBCSD, 2018[44]).

There is a large potential to improve circularity in production systems. Evidence shows that existing policy frameworks are significantly less developed in this upstream area than further down the value chain (OECD, 2016[36]). Policy mixes would therefore benefit from strengthening instruments that: (a) target product design; (b) increase demand for resource-efficient products; and (c) promote more resource efficient production processes and new circular business models. Improved incentives in these areas are crucial for maximising circularity opportunities, both upstream and downstream of the value chain.

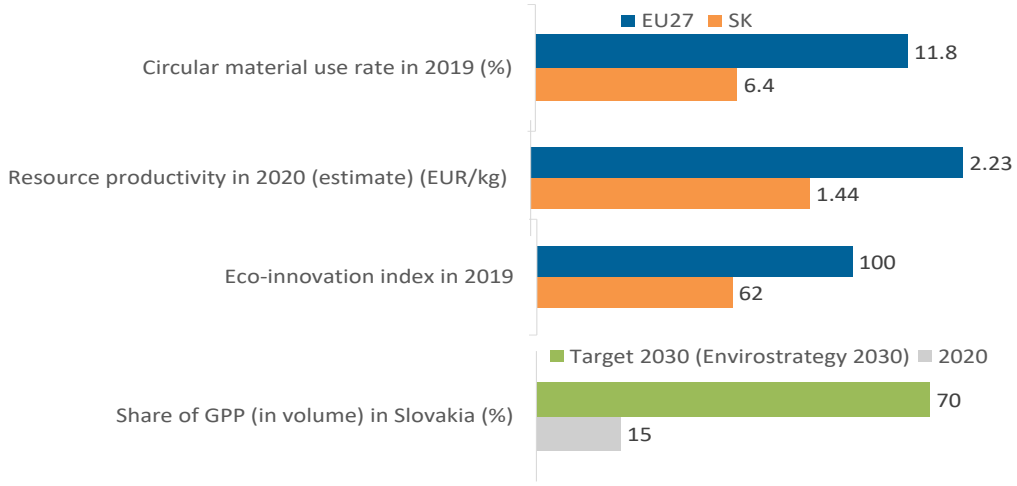
Annex A describes the circular economy policy landscape for production and product design on the EU level, including key EU level policies, as well as examples of circular production strategies by a number of EU Member States.

Analysis of the existing policy framework for producers, businesses and innovators

The shift to circular production can significantly impact resource and waste management in the Slovak Republic, helping it to achieve the waste management targets set by the EU. The Slovak Republic has made significant progress in increasing the share of GPP from 0.31% in 2019 to 14.74% in 2020 in terms of volume, and from 10.92% in 2019 to 11.45% in 2020 in value of contracts (data provided by the Slovak Ministry of Environment). The share of GPP contracts (in volume) for the 12 product categories covered by the GPP target included in the National Action Plan on Green Public Procurement 2016-2020 (i.e. to achieve a GPP share of 50% by 2020 in volume of contracts) increased from 3.6% in 2019 to 32% in 2020 (Ministry of Environment of the Slovak Republic, 2021[45]). The GPP target included in the Envirostrategy 2030 aims to achieve a GPP share of 70% in volume and value of contracts across all product groups and services by 2030. The country has also improved the registration rates of the EU Eco-Management and Audit Scheme (EMAS) in 2021 (Slovak Environment Agency, 2021[46]). Nevertheless, the Slovak Republic is less advanced on several other indicators of circular production (Figure 5.1).

The use of secondary materials, measured as circular materials use rate, reached only 6.4% in 2019 in the Slovak Republic (well below the EU-27 average at 11.8%) (Eurostat, 2021[47]). The Slovak Republic's resource productivity was also below the EU average with a rate of EUR 1.42 per kg (compared to the EU-27 Eurostat estimate of EUR 2.23/kg [provisional data] in 2020) (Eurostat, 2021[23]). The Slovak Republic ranked 23rd on the 2019 Eco-Innovation Scoreboard with a score of 62, which is below the EU average of 100, showing that it is lagging in terms of its European peers (Eco-innovation Observatory, 2019[48]). Although the environmental performance of the Slovak SMEs has been in line with the EU average, their performance has deteriorated over time. In particular, the public support measures related to resource efficiency have decreased to 43%, with the number of companies benefitting from this support shrinking to a mere 1% in 2017. The proportion of companies undertaking new resource efficiency actions also declined by 13% between 2015 and 2017 for those targeting waste minimisation. However, despite this downward trend, the Eurobarometer finds that there is still substantial interest to invest in resource efficiency measures by Slovak SMEs (European Commission, 2019[4]).

Figure 5.1. Performance of the Slovak Republic on selected production related metrics



Source: Adapted from Eurostat (2021[47]) (circular material use rate and resource productivity), and Eco-Innovation Observatory (2019[48]) (eco-innovation index) and information provided by the Ministry of Environment of the Slovak Republic (GPP share).

To stimulate circular product design and production processes, governments have often used a policy mix consisting of economic instruments, such as taxes, subsidies or EPR schemes, and regulatory

instruments. Policy instruments targeting the upstream part of the value chain can, in particular, have the following positive effect:

1. Discourage producers to use virgin and non-recyclable materials.
2. Link product design to end-of-life disposal costs.
3. Enhance business research and development (R&D) and eco-innovation.

Each of the above goals can be achieved through a set of key policy instruments described in Table 5.1.

Table 5.1. Key policy instruments for circular product design and production processes

Goal	Policy instrument	Short description
1. Discourage producers to use virgin and non-recyclable materials	*Virgin materials taxes*	These are environmental taxes intended to increase the price of the virgin raw materials, often associated with resource extraction. This price increase makes the use of secondary raw materials and recycling more attractive for producers.
	Other materials taxes	Currently imposed primarily on non-recyclable packaging from plastics, other materials taxes work in a similar way as virgin materials taxes. The tax increases the price of the targeted material, which creates incentives for producers to replace that material by another or by recycled material.
	Tax benefits in the form of tax deductions, credits or exemptions	Often applied in the context of the Value Added Tax (VAT) for certain environmental goods and services. Through the price mechanism, the tax benefits reduce, for example, the cost of environmental services, recycled materials, repair and reuse. They can sometimes be referred to as subsidies.
	Recycled content mandates	Typically takes the form of a regulatory requirement for producers to use a minimum percentage of recycled material in their production, which creates incentives to use recycled materials instead of virgin or non-recyclable materials. Recycled content mandates are not explicit economic instruments but they can offer a similar type of flexibility in compliance for firms if the requirement is imposed at the industry level rather than at the company level. A group of firms can then divide the responsibility among themselves to achieve the target in an efficient way.
2. Link product design to end-of-life disposal costs	*Advance disposal fees*	These are fees or product taxes charged on products at the point of sale based on the estimated costs of collection and treatment. They can form a part of an EPR scheme. These fees are used to finance post-consumer treatment of the designated goods. If these fees are passed on to consumers in higher selling prices they are likely to discourage purchase of the designated products and may encourage items to be used longer. This may in turn incentivise producers to alter product design choices towards more durability.
	Extended Producer Responsibility (EPR) schemes	EPRs extend a producer's responsibility for their products to the post-consumer stage of a product's life cycle. In practice, EPR commits producers to take responsibility for collecting end-of-life products and for sorting them before their final treatment, ideally, recycling. This includes providing the financial resources to pay for the costs of related waste management and treatment activities.
	Green Public Procurement (GPP)	Refers to public purchasing of products and services, which are less environmentally damaging when taking into account their whole life cycle. GPP can provide industry incentives to innovate and develop environmentally-friendly works, products and services with potentially lower waste disposal costs, particularly in sectors such as construction, health services or public transport where the share of public contracting is relatively large.
3. Enhance business R&D and eco-innovation*	*Economic and financial incentives*	These often include fiscal instruments, such as R&D tax benefits and subsidies, in the form of grants. Innovation could also be supported by public procurement. All these instruments provide an economic incentive to innovate.
	Capacity-building through information and educational instruments	These soft instruments offer firms business support and training and increases their information awareness about sustainable solutions and access to funding.
	Cooperation through voluntary agreements (VAs)	These are agreements negotiated between government agencies and, typically, industry bodies, civil society and other stakeholders to undertake certain actions or meet particular targets.

Note: This table does not provide an exhaustive list of policy instruments and the categorisation is not exclusive.
*There are numerous policy instruments which could enhance government support to business R&D and eco-innovation. The relevant instruments are classified into three categories in this table.
Source: Adapted from OECD (2021[34]).

Discouraging the use of virgin and non-recyclable materials

The Slovak Republic has not until now implemented any of the above upstream tax instruments belonging to the group of instruments that discourage producers from using virgin or non-recyclable materials besides transposing the EU Single-Use Plastics (SUP) Directive into national legislation.[1] The SUP Directive sets minimum recycled content requirements targets on plastic bottles (25% of recycled plastic in PET beverage bottles from 2025, and 30% in all plastic beverage bottles from 2030). The country intends to achieve the recycled content requirements for plastic bottles by introducing a deposit-refund scheme for single-use PET bottles from January 2022, which is an economic instrument directed more towards consumers than producers (see Box A D.9 in Annex D).

Companies could also improve their environmental performance, including reducing their material inputs, by implementing a voluntary Environmental Management Scheme, such as EMAS or ISO14001 standards. With EMAS, organisations can quantify their resource use and develop plans to improve their environmental performance (European Commission, n.d.[49]). While the current examples of resource reduction through EMAS typically refer to emissions savings and waste reduction, other resource types could also be potentially reduced.

Linking product design to end-of-life disposal costs

The Slovak Republic has a functioning EPR system for product groups required by EU legislation as well as a GPP system with a mandatory application of GPP criteria for four product groups (to date) for the procurement of products and services by the central state and other state administration bodies:

- EPR schemes for: (a) electrical equipment and e-waste; (b) batteries and accumulators; (c) packaging and packaging waste; (d) vehicles and end-of-life vehicles (ELV); (e) tyres; and (f) certain products and their waste, excluding packaging (Slovak Waste Act No. 79/2015).
- A GPP system with a strategic target to reach 50% GPP share of public procurement contracts (in volume) by 2020 for 12 product groups and 70% (in volume and value) by 2030 across all procured products and services. GPP is mandatory since 2020 for state-level administration bodies for three product groups: “road transport”, “copy and graphic paper”, and “computers and monitors” (Government of the Slovak Republic, 2020[50]), and since 2021 also for “cleaning products and services” (Government of the Slovak Republic, 2021[51]). The requirement to include environmental aspects in public procurement (as a separate requirement to fulfil the contract or as an award criterion) will take effect from April 2022 for certain entities and for a certain share of contracts (Amendment No. 395/2021 Coll. to the Public Procurement Act No. 343/2015 Coll.).

The EPR and GPP systems are not explicit economic instruments but they share some of their properties in that they offer firms flexibility in terms of compliance. Hence, firms can achieve environmental outcomes in a cost-effective manner.

Until recently, the Slovak Republic combined take-back targets with a product tax imposed on manufacturers/importers of packaging on every unit of packaging produced within the country’s existing EPR scheme, if the manufacturer/importer did not ensure the recovery of these products. The proceeds from the product taxes on packaging were earmarked for the Recycling Fund, and thus product taxes could be seen as a form of advance disposal fees (Grgulová, 2014[52]). However, the country has decided to abolish such advance disposal fees because of their alleged redundancy within the existing EPR system (OECD, 2016[37]). Advance disposal fees are further discussed in the section dealing with consumer product taxes.

[1] EPR and GPP are covered in the second group of instruments, which link product design to end-of-life disposal costs, even though these instruments can also contribute to the use of recycled materials.

Enhancing government support to R&D and eco-innovation

The Slovak Republic implements R&D incentives in the form of a R&D tax allowance and a tax relief which is available to firms to support their research and innovation activities. There is currently no dedicated economic instrument to support eco-innovation in the Slovak Republic besides this general R&D tax support instrument. Producers and other actors in the supply chain have to largely rely on national and European grant or loan programmes to receive public funding support, such as grants provided by national R&D subsidies programmes, the Slovak Environmental Fund, the European Structural and Investment Funds, and by other EU grant programmes, including Horizon Europe or the LIFE Programme. This is especially challenging for domestic SMEs as they have difficulties in accessing this type of funding (Eco-innovation Observatory, 2020[53]).

The Slovak ministries, in particular, the Ministry of Environment, organise several information and educational campaigns and events to raise awareness on environmental issues. However, these often target students, municipalities or citizens rather than businesses. Targeted information campaigns and business support for companies in this area are provided, in particular, by the Circular Slovakia platform, established in 2019 as a co-operation between public, private and non-governmental actors. However, this level of exposure might not be sufficient. Moreover, to date, there does not appear to be any relevant voluntary agreement negotiated between the Slovak Government and industry to incentivise businesses to eco-innovate.

Besides these instruments, there are also regulatory instruments and standards steering industry towards innovation in the circular economy. These instruments, even though they are not all fully effective, include existing EPR schemes, emission limit values for pollution sources (for example, in air and water), technical requirements for operating equipment, some product standards and quotas, and targets (for example, waste management targets: recycling rates, landfill rates, etc.). Some of these measures are discussed in other sections of this chapter.

Gap analysis and policy recommendations

The evidence suggests that the Slovak Republic has not yet introduced explicit economic instruments, such as materials taxes or tax benefits, directed towards producers and importers to adopt resource efficient or circular economy practices besides the above-mentioned general R&D tax support instrument.[2] The R&D tax allowances and tax reliefs stimulate research and innovation activities, but the Slovak R&D tax support instrument does not specifically aim at eco-innovation or at supporting the use of secondary raw materials. The EPR and GPP are not explicit economic instruments, such as a tax, and neither of the two instruments in its current form in the Slovak Republic discourages use of virgin and non-recyclable materials in the production of goods, as would a materials tax. The existing EPR schemes in the Slovak Republic have been successful in reaching their recycling targets but they only cover a limited set of products. They also do not sufficiently incentivise producers to adopt design-for-environment practices, which would favour the production or import of products that are more circular, especially as eco-modulated fees have not yet been implemented within the existing collective Producer Responsibility Organisation (PRO) schemes. Eco-modulation of fees is a term often used to describe modulation of the financial contribution paid by the producer in a collective EPR system to comply with its extended producer obligations. It works by taking into account certain criteria, which support design-for-environment changes, such as the product's recyclability, durability or reparability. The share of GPP increased substantially between 2019 and 2020 in the Slovak Republic and GPP became mandatory for four product groups since 2020 in their procurement by state-level administrations. The mandatory use of GPP criteria will be further

[2] A recent OECD review of Slovak environmental fiscal instruments concluded that the implementation of market-based policy instruments directed at environmental policy objectives remains limited, and regulatory approaches are often preferred even if better alternatives exist (2020[235]).

extended to some other entities from April 2022. Nevertheless, the national GPP target of 50% share of GPP, in the number of publicly procured contracts by 2020, was not reached.

The Slovak Republic could benefit from introducing further changes to some of the existing systems to enhance greater circularity in product design and production processes. For example, introducing eco-modulated fees within EPR schemes, extending EPR to new products and legislating for an increased use of GPP criteria when awarding public contracts could increase the supply of products placed on the Slovak market that are more durable, reparable, recyclable, and which minimise the use of toxic and hazardous substances. Legislating the use of GPP will need to allow for a great degree of flexibility in order to provide incentives for competition on green criteria.

The introduction of materials taxes on virgin aggregates and plastics, value added tax (VAT) reductions for repairs, refurbishment or the sale of second-hand products, and integrating minimum recycled content mandates for certain products into some of these instruments could further economically incentivise producers to use more secondary and recyclable raw materials in their design and production processes. While measures to facilitate information, co-operation and education exist in the country, their effectiveness and outreach could also be considerably strengthened, in particular, with regard to eco-innovation. Adjustments to the existing instruments and the introduction of new ones should be based on a multi-stakeholder decision process, which considers the views of public authorities at the different levels of government, as well as the views of industry and civil society organisations.

Box 5.1 provides a synthesis of policy recommendations to stimulate circularity in production processes in the Slovak Republic. Annex D deep-dives into the above-mentioned economic instruments and provides concrete suggestions on how the Slovak Republic could support a wider use of secondary and recycled raw materials and stimulate design-for-environment in the country. A brief assessment of the potential to improve government support to R&D and eco-innovation can also be found in Annex D.

Box 5.1. Overview of policy recommendations to stimulate circularity in production

Fiscal instruments

- Reduce VAT for repair services and the sale of refurbished, upcycled or second-hand products.
- Reconsider introducing a form of plastics tax and explore the option of introducing taxes on aggregates.
- Consider introducing a dedicated tax incentive to stimulate R&D and eco-innovation (e.g. an instrument offering an enhanced tax deduction of eligible costs for R&D into environmental technologies or a flexible fiscal depreciation of environmental investments).

Minimum recycled content mandates

- Introduce recycled content mandates for plastics and some other materials (e.g. construction materials).
- Further research the best policy instrument to implement recycled content requirements (e.g. by direct regulation, within an EPR or GPP scheme, or by means of a voluntary agreement).

Extended Producer Responsibility (EPR)

- Increase recycling rates and strengthen producers/importers' incentive to design for the environment by implementing eco-modulated fees in existing EPR schemes.

- Further research the type of eco-modulated fees that would be most suitable in the Slovak context of competitive EPR markets, taking into account the forthcoming EU guidance on EPR fee modulation.
- Expand the EPR system to additional products, e.g. construction products.
- Ensure effective monitoring and enforcement of EPR systems.

Green Public Procurement (GPP)

- Strengthen GPP by gradually increasing the use of GPP criteria in awarding contracts for all public entities and consider the option of introducing minimum recycled content requirements within the GPP system for certain materials used in procured products, e.g. paper and plastics.
- Further research the development of a tailored tendering and monitoring methodology to evaluate proposed products and services in GPP.

Incentive subsidies

- Allocate targeted funding for business eco-innovation and R&D in environmental technologies (e.g. in the next Partnership Agreement of the Slovak Republic and in Programme Slovakia 2021-2027, or through national grant and loan programmes).

Soft approaches

- Strengthen co-operation with stakeholders, in particular, with the Slovak business and research community, to select the most needed and potentially effective policy measures to stimulate circularity in product design and production processes.

Engaging consumers and households in circular consumption patterns

The role of consumers and households in a circular economy

The role of consumers and households is vital in furthering circular economy transition. While technology can help to consume resources more efficiently, technological improvements alone cannot keep pace with the ever-increasing levels of consumption. Far-reaching lifestyle changes are required to complement technological advancements (Wiedmann et al., 2020[54]).

Along with changing the way we produce (and recycle), changing the way we consume is considered as the most effective means of tackling environmental problems (European Commission, 2020[55]). According to a recent Eurobarometer survey (European Commission, 2020[55]), environmental protection is important to 94% of European citizens, with climate change, air pollution and mounting waste ranking among the three most pressing environmental issues. Three-quarters of the respondents believe that environmental issues directly impact their daily life and health, while around two-thirds of Europeans acknowledge that their consumption habits adversely affect the environment.

Accepting a personal responsibility to help address environmental challenges, consumers are adapting their behaviour and making more conscious consumption choices. Changing consumption patterns will impact the way producers design, manufacture and deliver products. For instance, when buying clothing and food, more consumers have declared to prioritise environmental impact over the brand name. Almost two-thirds of consumers say they would be less willing to buy a company's products if its poor performance on environmental practices is known, and more than one-third have already refused to do so in practice (ING, 2020[56]).

Even if not directly involved in the production process, consumers have a central role to play in promoting new circular business models and in improving waste disposal practices. Consumers can support circular economy transition in various roles (Maitre-Ekern and Dalhammar, 2019[57]):

- As **purchasers**, consumers may decide to buy durable high-quality products, prioritise re-used and second-hand products to new ones, avoid buying unnecessary items altogether, or opt for services instead of products.
- As **maintainers**, consumers may decide to avoid replacing products that work and prolong their life cycles through proper use, maintenance or updates.
- As **repairers**, consumers prefer repair to buying new products, either doing own repairs (i.e. DIY) or in repair communities (e.g. repair cafes and repair workshops).
- As **sellers**, consumers avoid disposing of items that can be re-sold or re-used.
- As **sharers**, consumers prioritise sharing over buying.
- Consumers **engaging with waste sorting and re-use** prioritise re-use over recycling and ensure that their waste is sorted and collected properly.

Adapting consumer demand towards more circular choices is particularly relevant for fast-moving consumer goods, which account for about 60% of consumer spending, 35% of material inputs and 75% of municipal waste (Ellen MacArthur Foundation, 2013[58]), and involve sectors like textiles, electronics and plastics. Each of these face specific challenges and opportunities for a more circular consumption, such as fast fashion, packaging and single-use products, and premature obsolescence (CSCP, 2021[59]). Other sectors for which more circular consumer behaviour is crucial are food and household waste.

To drive the transition towards a circular economy, consumers and households need guidance for a more circular behaviour. Despite the fact that consumers across the EU declare their willingness to be involved in circular consumption practices, their engagement rate is in reality quite low (LE Europe et al., 2018[60]). For example, a consumer survey in 10 EU Member States found that one-third of consumers claimed to buy second-hand products, while only between 5% and 9% of respondents had bought a second-hand vacuum cleaner, dishwasher, TV, smartphone or clothing (LE Europe et al., 2018[60]). Policy instruments need to be introduced to positively shape consumer choices. In order for consumers to make informed decisions, they need to be able to understand, select and favour products that are best able to meet circular economy principles. This in turn requires consumer education, transparency about product characteristics, information about product performance, as well as assistance with post-consumption actions and a sharing culture, to name a few positive actions (Italian Consumer Associations, 2021[61]).

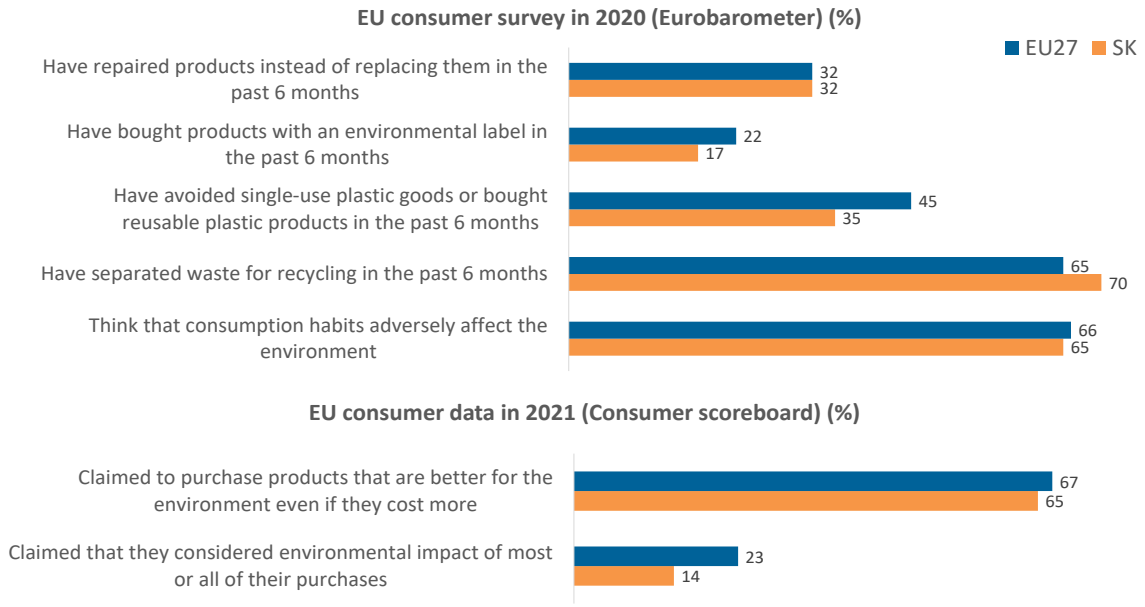
Policy instruments directed at consumer behaviour in the Slovak Republic

Slovak consumers, similar to consumers from other EU Member States, are very conscious about protecting the environment. When surveyed, 94% of them stated that environmental protection was either fairly important or very important to them (European Commission, 2020[55]). Among their top three environmental issues, the growing amount of waste was the most pressing (60%), followed by air and water pollution (42% each). The majority of Slovak consumers believe that these issues have a direct impact on their daily life and health. Two-thirds think that consumption habits adversely affect the environment. At the same time, they perceive themselves as not sufficiently engaged in solving environmental issues (European Commission, 2020[55]).

An increasing number of Slovak consumers have been adapting their behaviour to better protect the environment, though the rates vary across different activities (Figure 5.2). When asked about their actions over the past six months, more than two-thirds of respondents affirmed having separated waste for recycling (European Commission, 2020[55]). At the same time, only about one-third of Slovak consumers avoided single-use plastic goods or bought reusable plastic products, and only one-fifth avoided buying over-packaged products. Moreover, while nearly half of the respondents had purchased local products,

less than one-fifth bought products marked with an environmental label (European Commission, 2020[55]) and only around 14% claimed that they considered the environmental impact of most or all of their purchases (European Commission, 2021[62]). The rates are somewhat higher when it comes to decisions about purchasing second-hand products over new ones (23%) and repairing products over replacing them (32%) (European Commission, 2020[55]), with respondents claiming to consider the environmental impact of at least one purchase (49%) and purchasing products that are better for the environment even if they cost more (65%) (European Commission, 2021[62]).

Figure 5.2. How do Slovak consumers behave?



Source: Adapted from European Commission (2020[55]) and European Commission (2021[62]).

To change consumer demand and consumption patterns, countries have implemented a mix of policy instruments, including consumer product taxes, household waste charges in the form of pay-as-you-throw (PAYT)based schemes or deposit-refund systems (DRS) for drink packaging. In addition to these economic instruments, countries have organised awareness-raising campaigns and administered eco-labels to inform consumers about the environmental consequences of their choices and about the environmental characteristics of the products they choose to buy. Consumption-related policy instruments can, in particular:

1. Influence consumer decisions at the point of sale.
2. Change consumer behaviour at the product's end-of-life.

Each of the two goals can be achieved through a set of key policy instruments described in Table 5.2.

Table 5.2. Key policy instruments for circular consumption patterns

Goal	Policy instrument	Short description
1. Influence consumer decisions at the point of sale	*Consumer product taxes*	Taxes levied on the sale of a product or a group of products with the aim of achieving a certain environmental objective. The aim within the context of a circular economy transition is to provide economic incentives for consumers to purchase products that are more circular by increasing the price of products which are non-recyclable, hard to recycle or that have high disposal costs.

	Product eco-labels or other relevant information available at the point of sale	Information tools that help consumers to distinguish between products that have been produced in a more environmentally friendly way, have been refurbished or are second-hand, or which are more durable or reparable compared to other products.
2. Change consumer behaviour at the product's end-of-life	*Household waste charges, in particular PAYT-based charges*	Charges for the collection and disposal of household waste based on the volume, weight or material of waste collected (also called "unit-based waste collection charges" or "differential and variable rate (DVR) charging systems". Their aim is to account for the waste treatment costs of municipal waste and to entice consumers to better sort their waste, which will result in increased recycling rates.
	Deposit-refund schemes (DRS)	A DRS combines a charge on the sale of a product with a subsidy paid when the end-of-life product is returned through an approved collection facility. In a DRS, consumers buying a product pay an additional sum of money (deposit), which is reimbursed upon the return of the product or its packaging. This provides an incentive for consumers to bring back empty packaging, which can then be reused or recycled.
	*Information-awareness and educational tools**	They have an important role to play in transforming consumers' behaviour in depth. These instruments include mainstreaming "circular economy" into education programmes in schools, vocational training and higher education, as well as introducing awareness-raising initiatives about the importance of waste reduction, re-use, repair and recycling, and information campaigns about the benefits of waste sorting.

Note: This table does not provide an exhaustive list of policy instruments and the categorisation is not exclusive.
* There are numerous information and educational tools to support reuse, repair and sorting household waste.
Source: Adapted from OECD (2021[34]) and OECD (2006[63]).

Influencing consumer decisions at the point of sale

The Slovak Republic currently does not have any consumer product taxes in place on products that are hard-to-recycle or which have significant negative environmental impacts. The country has implemented environmental product taxes on mineral oils, electricity, gas and coal (excises) and on some other activities (road transport and pollution). However, none of them are directed towards reducing disposable or hard-to-recycle products. The country has mandated producers of packaging to charge consumers for the use of light plastic bags as of January 2018 and to provide bags from alternative materials (Waste Act No. 79/2015), however, these are not product taxes.

With regard to eco-labels and relevant quality certificates for products that are repaired, the country has been operating an environmental labelling scheme for products and services since 1997. The national eco-label "Environmentally friendly product" applies to both products and services, which fulfil the national environmental criteria for such labels. Since 2004, when the country joined the EU, companies operating in the Slovak Republic can also apply for the EU Ecolabel. However, there has been an overall downward trend in the number of eco-labelled products in the country with regard to both the national as well as the EU Ecolabel (Ministry of Environment of the Slovak Republic and Slovak Environment Agency, 2020[64]). Consumer surveys also indicate that a large share of Slovak consumers are unfamiliar with the national or other international eco-labels, and an even smaller share consider an eco-label when buying a product (only 241 respondents out of 531 surveyed could identify the national eco-label "Environmentally friendly product" and only 56 out of 531 respondents considered the eco-label when purchasing a product (Rusko et al., 2016[65]), or less than one-fifth bought products marked with an environmental label (European Commission, 2020[55])).

The country does not operate a quality standard or a certificate for repaired or second-hand products.

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

The Slovak Republic has in place PAYT-based charges and DRS to create economic incentives for consumers to better sort their waste. Slovak municipalities have the option to implement PAYT-based charges for municipal waste collection, as well as the treatment of waste streams not covered by EPR, instead of a fixed annual fee per person. However, only around 5.8% of municipalities chose to do so in

2018 (i.e. 167 municipalities out of a total of 2887), affecting less than 13% of the Slovak population (Slučiaková, 2021[66]).

The country has two DRS for the packaging of beverages, a long existing DRS for reusable beer glass bottles, and a new DRS for single-use plastic PET bottles and cans, which came into effect from 1 January 2022. The DRS for reusable beer glass bottles has been functioning well, while the effectiveness of the new DRS for PET bottles and cans is yet to be seen.

The Slovak Republic also has in place a number of education and awareness-raising measures targeting consumer behaviour at the product's end-of-life. These include interactive education activities at the different school levels, as well as public awareness-raising material co-ordinated by the Slovak Environment Agency. The information and awareness-raising campaigns at the level of households focus on waste prevention, sorting and composting, and are mainly implemented at the level of municipalities and non-governmental organisations (NGOs).

The country had also foreseen the implementation of a mandatory separate collection of bio-waste by mid-2021 (see Chapter 7 on food and other bio-waste value chain) and a mandatory door-to-door separate collection for recyclables in single-family houses by 2023 to further incentivise municipalities and households to separate waste.

Gap analysis and policy recommendations

The country does not appear to have a strong policy framework providing consumers with incentives and information to make informed (and sustainable) purchasing decisions. While eco-labels exist, only around one-fifth of Slovak respondents bought a product with an eco-label, according to the latest Eurobarometer survey (European Commission, 2020[55]). The low purchase of products with an eco-label is not unique to the Slovak Republic as the EU average for this indicator is only 22%. The Slovak Republic has also not yet introduced any product taxes (excises), which – by increasing the price of a product – would steer consumers to buy products that are more durable, reparable or recyclable.

Nevertheless, a relevant legal framework is in place, which has the potential to change consumer behaviour at the product's end-of-life. The Slovak waste legislation has been amended, in particular, through the landfill tax reform in 2018 (Box A D.12 in Annex D) to incentivise the introduction of PAYT schemes across the country by offering municipalities a subsidy for sorting their municipal waste above certain thresholds each year. As previously mentioned, the country has also introduced a DRS for reusable beer glass bottles and for single-use PET bottles and cans, the latter taking effect from 1 January 2022. Both DRS can be successful at achieving high collection rates of targeted packaging, as evidenced by DRS performance from across the world.[3]

The Slovak Republic could benefit from introducing further changes to some of the existing systems to encourage greater consumer engagement in circular consumption patterns and practices both at the point of sale and at the disposal stage. The Slovak Republic needs to introduce further interventions to expand the coverage of well-designed PAYT schemes across the country in the short term, and to move beyond volume and frequency subscription-based schemes, particularly in densely populated areas. In 2018, only around 13% of the population was covered by a PAYT scheme, with the majority of cases covered by a volume and frequency subscription-based scheme (Slučiaková, 2021[66]). These are effective at reducing mixed municipal waste but only under certain conditions, such as a sufficiently small container size and a wide range of subscription options (see Annex D). However, such schemes do not provide sufficient incentives for individual households to decrease their waste in densely populated areas where multiple

[3] The Reloop study on DRS system performance shows that countries, states and provinces that have implemented DRS consistently achieve higher collection rates for beverage containers than those relying solely on municipal curb side collection programmes (2021[234]).

households share the same set of containers to deposit their waste, which makes it impossible to associate the amount of waste generated per household to different household waste charges. For example, a volume and frequency subscription-based scheme has been implemented in parts of Bratislava (e.g. Petržalka) where up to 96 households can share the same set of containers. To expand the use of PAYT, the country could make PAYT-based charges mandatory in regions or nationwide, while allowing the municipalities to choose the form of PAYT. If this option proves to be too difficult and costly to implement, the country could enhance its efforts by making the sorting of municipal waste more attractive to municipalities and households. In this regard, the country could further extend its work on education and information campaigns or implement nudging strategies. Some stakeholders during the consultation process suggested that further education and information campaigns were needed, even as a prerequisite to introducing PAYT schemes. The country could also strengthen the effectiveness of incentives provided by landfill taxes, which would increase the cost of landfilling for municipalities and, hence, motivate them to implement additional measures, such as PAYT, aimed at better sorting and the recycling of municipal waste. Additional waste infrastructure will also need to be put in place to make it more convenient to sort household waste and facilitate PAYT schemes.

An in-depth analysis preceded the design and set-up of the new DRS for PET bottles and cans (Dráb and Slučiaková, 2018[67]), which should make the DRS effective in reaching the goal of increasing the separate collection of PET bottles and cans in line with national and EU targets. As an increasing number of products is being covered by EPR schemes, and DRS can be an expensive instrument to implement, there is no particular need at present for the Slovak Republic to introduce additional product taxes or DRS for hard-to-collect or hard-to-recycle products and materials. However, this option could be considered in the long term for underperforming EPR systems (e.g. which do not reach a high recycling target) if the goal is to reduce littering (for example, of plastic bottles not covered by the current DRS scheme), or to ensure a separate capture of hazardous waste (for example, fertilisers or batteries). In particular, a DRS for additional products could operate alongside an existing EPR scheme to further enhance the collection and, thus, the recycling, reuse or capture of specific hard-to-collect products or materials. Similarly, the country could consider the potential use of additional product taxes (excises) in the long term 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, by EPR or DRS).

While information and educational tools exist in the country, their effectiveness and outreach could also be considerably strengthened, particularly with regard to influencing consumer purchase decisions through eco-labels, quality standards labels or system nudges. A more systematic mainstreaming of circular economy into educational programmes could be introduced through the adoption of circular economy modules.

Box 5.2 provides a synthesis of policy recommendations to promote circular consumption in the Slovak Republic. Annex D deep-dives into some of the key above-mentioned policy discussions, and it provides concrete suggestions on how the Slovak Republic could support a stronger sustainable consumption policy framework in the country, namely with regard to PAYT-based charges. Annex D also provides a brief discussion on eco-labels and other information and educational tools, which aim to inform and educate consumers at the point of sale and at disposal.

Box 5.2. Overview of policy recommendations to engage consumers in a circular economy

PAYT-based charges

- Expand the coverage of well-designed PAYT schemes across the country by making PAYT mandatory or by creating additional incentives for municipalities to adopt PAYT schemes.

- Move beyond volume and frequency subscription-based schemes, particularly in densely populated areas, towards sack- or weight-based schemes.

Deposit-refund schemes (DRS)

- Explore the need to implement DRS for additional products if high recycling targets are not reached by separate collection schemes alone, or if the goal is to reduce littering or to ensure a separate capture of hazardous waste.

Consumer product taxes

- Consider the need to introduce 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, by EPR or DRS).

Soft approaches

- Facilitate consumer decisions to purchase products that are more circular by informing and educating them about eco-labels, quality standards and other relevant information provided at the point of sale.
- Continue implementing measures that facilitate education and information, including system nudges on the importance of reusing, repairing, sorting and recycling products at the end of their life cycle.

Improving waste management practices, reuse and recycling

The role of waste management in a circular economy

Transitioning to a circular economy is critical to secure the supply of raw materials (by maximising the value of materials that circulate and by minimising the consumption of virgin materials) and to mitigate the environmental externalities that come from waste management (by preventing waste and by reducing hazardous substances in waste and products). Waste management has become an integral part of circular economy policy making at the EU level. The Circular Economy Package sets ambitious targets in the field of waste separation, recycling, landfilling and EPR (e.g. a recycling target of 60% of municipal waste and 70% of all packaging waste by 2030; a landfill rate of maximum 10% of municipal waste generated by 2035; and differentiated recycling targets for different packaging materials).

The review of national circular economy strategies of EU Member States has shown that waste management is an area covered in every reviewed strategy, whether explicitly as a priority area or implicitly within sectors or systems analyses. The review also found that most of the regulatory proposals spelled out within the strategies related to waste management range from:

- Adapting waste regulations and removing regulatory barriers to promote a circular economy but also to clarify the status of waste, end-of-waste criteria and by-products.
- Introducing obligations, bans and restrictions to combat food waste, promote recycling instead of incineration, or prohibit the use of plastic microbeads.
- Setting very specific waste reduction targets on, for example, food waste reduction.

Waste management, recovery and recycling are an important part of any circular economy roadmap or strategy, however, they belong to measures on the lower end of the waste hierarchy. Thus it is crucial to prioritise measures supporting waste prevention and the reuse of products and components before they become waste. This approach helps promote measures that could be applied upstream in the value chain

(see section on circular design and production) or those that support waste prevention and inner (shorter) feedback loops by consumers (see section on circular consumption patterns). The evidence (from other countries) shows that although some countries try to implement a policy prioritisation approach in their strategies based on the waste hierarchy, this may be challenging to implement in practice (for a variety of reasons). It may take some time to re-focus measures away from recycling and recovery towards waste prevention and reuse due to policy and technological lock-ins.

Pathway towards increased reuse, recycling and recovery in the Slovak Republic

The Slovak Republic has well-developed policy and legal frameworks for waste management in place, supported with quantitative targets and several policy instruments, which are aligned with the EU legislation and international good practices. Nevertheless, the country has had some longstanding challenges with waste treatment and disposal, particularly with trying to decrease its high landfill rates. However, the country has shown recent improvements. Total waste treated (both hazardous and non-hazardous) has increased, and while for most of the decade landfilling was the predominant treatment option (fluctuating from 50% up to almost 60% of waste) this trend flipped in 2018 with recovery representing more than half of all treatment options. Meanwhile energy recovery, despite the relatively small share among treatment options, has increased from 3% to 7%, which has more than doubled in terms of share. Nevertheless, landfilling and other disposal options remain the predominant treatment for municipal waste, with 49.6% of municipal waste still landfilled in 2020. This means that the country missed its EU recycling target of 50% by 2020. However, landfilling as a share of total municipal waste treatment has been decreasing. In 2020, material recovery stood at 28.5%, and composting and digestion stood at 13.7% (Eurostat, 2022[68]). Increases in material recovery have also been quite important with a 40% increase from 2017 to 2018.[4] Similarly, composting and digestion increased by 20% in the same time period.

Waste management and waste treatment efforts are currently mainly governed by the national Waste Act No. 79/2015, the Waste Management Programme 2021-2025 and the Waste Prevention Programme of the Slovak Republic for the years 2019-2025, but also by cross-cutting strategy documents, such as the Economic Policy 2030, Slovakia 2030 and the Envirostrategy 2030. These strategy documents include numerous measures affecting waste generation and management across the value chain, ranging from economic instruments (for example, increasing landfill taxes, expanding PAYT schemes, reforming the EPR system) to providing incentive subsides or strengthening information awareness. The Slovak waste legislation has been amended several times in the past few years to transpose the EU's waste legislation and to introduce new waste targets and landfill bans. The country's primary focus has been on how to achieve the EU municipal waste recycling targets, as the country was unable to achieve the 2020 recycling target of 50% by 2020. To help the Slovak Republic achieve the EU targets, the country will implement an obligation by 2023 to treat waste before it can be landfilled and to ban waste from landfilling when it can be incinerated for energy recovery by 2027.

While waste management policy instruments are numerous and wide-reaching, this chapter focuses on instruments that:

1. Provide economic incentives for those responsible for waste disposal to change their practices towards the reuse, recycling and recovery of products and materials.
2. Strengthen economic incentives to increase recycling by waste operators.

The key policy instruments to reach these two goals are outlined in Table 5.3.

[4] According to the Institute for Environmental Policy (IEP) of the Ministry of Environment of the Slovak Republic, an important part of the increase in material recovery is due to better reporting of the data. This might also partially explain the reported increase in municipal waste generation.

Table 5.3. Key policy instruments to improve waste management practices

Goal	Policy instrument	Short description
1. Provide economic incentives for those responsible for waste disposal to change their practices	*Landfill taxes*	Imposed on waste to be landfilled with the aim to increase the cost of landfilling and to divert waste to treatment options higher up on the waste hierarchy, such as towards recycling or energy recovery.
	Incineration taxes	They act similarly as landfill taxes, as they aim to divert waste disposal to treatment options other than incineration.
2. Strengthen economic incentives to increase recycling by waste operators	*Incentive subsidies for collection or use of recyclables*	They act directly on the costs and profitability of recycling and complement landfill or incineration taxes by increasing the direct economic benefit of recycling or reuse.
	EPR schemes	They have been one of the main approaches used to achieve higher rates of recycling and reuse. EPR has been discussed in this report within the context of achieving design-for-environment objectives

Note: This table does not provide an exhaustive list of policy instruments and the categorisation is not exclusive.

Incentives to move up the waste hierarchy

There are two main economic instruments aimed at changing the waste disposal practices of those responsible for waste disposal, landfill and incineration taxes. In this regard, the Slovak Republic has recently reformed its landfill taxes to provide stronger incentives to reduce landfilled waste, not least because the country is failing to hit its EU recycling and landfill targets. The landfill tax reform in 2018 gradually increased the landfill tax rate and made changes to the redistribution of the proceeds from the tax, obliging all municipalities to pay the landfill tax even if the landfill site operates on their territory (these municipalities were exempt from paying the landfill tax in the past).

The country has no incineration taxes, as the level of incineration is very low (according to Eurostat, 7% in 2018, including incineration for energy recovery), and to date there is no reason to implement such a tax instrument.

There are other government policy instruments directed at changing waste disposal practices, including tradeable landfill permits, which would cap useable landfill capacity and thus allow companies to trade landfill permits among themselves until this capacity is reached. However, in practice, such permits are not extensively used, although the UK did operate a Landfill Allowance Trading Scheme in the past. These are not further discussed in this chapter.

Instruments to increase recycling by waste operators

There are two key instruments that encourage waste operators to increase recycling: incentive subsidies and EPR schemes. The Slovak Republic has been supporting recycling activities through grants provided by the EU Structural and Investment Funds and the Slovak Environmental Fund. According to the OECD PINE database, around EUR 3.2 million in grants were disbursed for the development of waste management from the Slovak Environmental Fund in 2019 (OECD, n.d.[69]). According to the Annual Implementation Report for the Operational Programme Quality of Environment, total expenditure declared by beneficiaries in household waste management in the Slovak Republic (including minimisation, sorting and recycling measures) amounted to EUR 111 million in 2019 and further increased to EUR 134 million in 2020 (data provided by DG REGIO of the European Commission).

The Slovak EPR schemes have been evaluated as successful at reaching recycling targets. In this chapter, EPR schemes have been discussed within the context of sustainable production.

Gap analysis and policy recommendations

While the landfill tax has been reformed in 2018 (and amended in 2022 for industrial and construction waste at the time of writing this report), there is scope for further improvements in this area. Currently, the gradual increase in landfill taxes for municipal waste is capped at year 2021 in the legislation, beyond which a further increase is unclear (increased landfill tax rates for industrial and construction waste are in effect from 1 July 2022, see Chapter 6). Moreover, while all municipalities are now obliged to pay the landfill tax, those in whose territory the landfill is located still receive substantial compensation subsidies from the landfill tax proceeds (municipalities through whose territory the main transportation infrastructure passes also receive some compensation subsidies). The 2018 landfill tax reform created several incentive subsidies for municipalities to better sort their waste, as well as for producers who demonstrate lower waste generation in production processes, which is seen as positive. However, there appears to be little revenue left to pay out such incentive subsidies, as more than half of the value from landfill tax proceeds in 2019 and 2020 were redistributed back to municipalities in the form of compensation subsidies (data provided by the Slovak Ministry of Environment).

In line with an earlier OECD recommendation (2017[5]), the Slovak Republic could benefit from gradually increasing the landfill taxes for municipal waste as well, beyond the period 2021, and from decreasing or removing the compensation subsidies that municipalities receive if the landfill site is located on their territory or if major transportation infrastructure passes through their territory. This would provide additional incentives for municipalities, and those responsible for waste management, to divert waste from landfills and to make available a larger share of the landfill tax proceeds go to incentive subsidies to better sort waste or to produce less waste during production processes. Changes to the landfill tax system will need to work hand in hand with the strengthening of supporting measures, including more effective enforcement and monitoring, so as to minimise illegal waste disposal as well as enhance co-operation between municipalities on municipal waste management. Several countries have also implemented landfill bans (see CEWEP (2021[70])). The Slovak Republic is planning to introduce landfill restrictions and bans in line with the EU waste legislation.

The Slovak Republic could also implement an incineration tax in the medium to long term to avoid excessive diversion of waste from landfill to incineration. Although incineration is currently low, this might change in the future as the country is likely to invest in additional waste treatment capacities to deal with waste that was previously landfilled (this is also suggested in the WMP 2021-2025). Such a tax may include an energy tax on the use of fossil fuels or a tax on fossil CO_2 emissions from waste incineration (Sahlin et al., 2007[71]).

Moreover, the Slovak Republic needs to strengthen the effectiveness of incentive subsidies it allocates to projects, which would help increase the use of recycled materials, their recycling capacity and reuse. The evidence from the Slovak Republic suggests that financially supported projects aimed at increasing recycling capacities in the country were not sustainable in the long run (and where supported facilities were in operation only during the duration and funding of the project according to the Slovak Ministry of Environment). This issue might be linked to a more structural impediment in the Slovak Republic that renders it difficult to effectively implement European funds for research and innovation in general (on the latter see OECD (2021[72])).

Incentive subsidies in the form of grants to incentivise recycling by waste operators are particularly relevant for allowing investments to increase recycling capacity, or to overcome specific market failures, by acting as a catalyst to encourage other funders to invest (WRAP, 2021[73]). The Envirostrategy 2030 suggests to support R&D in recycling technologies, not only in the area of municipal waste but also industrial waste, as well as support the development of recycling capacities for commodities wherever recycling capacities are insufficient or lacking (Ministry of Environment of the Slovak Republic, 2019[7]). The country could also set up new dedicated funds for a circular economy, such as a fund that supports investments in textiles recycling and reuse, food waste prevention, or the recycling of plastics packaging. The newly adopted

circular economy strategy in the Czech Republic (Circular Czechia 2040) also supports investments into recycling technologies/infrastructure and reuse as one of its goals, particularly in the areas of bio-waste, textile, construction, food waste and packaging. This support is foreseen through the use of European structural funds and funds allocated to Czechia's Recovery and Resilience Plan. See Annex D for examples of public funding support to R&D and eco-innovation.

Box 5.3 provides an overview of policy recommendations on how to improve waste management that could be relevant for the Slovak circular economy roadmap. Annex D analyses landfill and incineration taxes in more detail and elaborates on the proposed policy interventions.

Box 5.3. Overview of policy recommendations to improve waste management

Tax instruments

- Gradually increase the landfill taxes for municipal waste beyond the period 2021 and reform the redistribution of subsidies from the landfill tax proceeds.
- Introduce incineration taxes to limit excessive diversion of waste from landfill to incineration plants if energy recovery is supported.

Incentive subsidies

- Strengthen the effectiveness of incentive subsidies allocated to projects that invest in recycling and reuse infrastructure.

Concluding reflections on the priority policy recommendations

This chapter explored and analysed the different policy instruments that could support the development of a circular economy along the value chain in the Slovak Republic, with a specific focus on economic instruments. Eighteen policy instruments were analysed, which have the potential to incentivise producers, consumers, public authorities, as well as waste operators, to make the shift towards more circular practices and consumption patterns.

The findings show that there is considerable scope for further development and application of economic and other policy instruments as part of circular economy strategies in the Slovak Republic. There is scope for enhancing the existing group of instruments, such as the landfill tax, PAYT-based schemes, EPR schemes as well as GPP. There is also scope for new initiatives in areas not currently covered by policy instruments, in particular, a wider use of upstream fiscal instruments to facilitate upcycling and reuse as well as the use of recycled or alternative materials, such as materials taxes on aggregates and plastics and targeted tax benefits for the sale of more circular products (for example, VAT reductions for repaired or refurbished products). A wider programme to strengthen outreach and information awareness to consumers and companies, in particular SMEs, would be beneficial in complementing the regulatory and economic incentives.

This analysis puts forward a circular economy policy package for the future roadmap consisting of four key types of policy instruments, complemented by a package of supporting measures. While these policy instruments can also support the circular economy transition in the construction sector and the food and bio-waste value chains, additional specific measures will be required for other priority areas of the roadmap. During the process of preparing legislative or non-legislative proposals to implement the future roadmap, economic as well as social impacts on businesses and consumers will also need to be assessed to ensure that the proposed policy package does not have a net negative impact on Slovak companies (including their competitiveness) nor their consumers. Typically, measures targeting local industries with

low level cross-border trade do not strongly impact on the competitiveness and employment of domestic companies and their labour force. Local industries include environment-related services, such as waste management, repair and recycling, as well as construction/renovation services. To provide sufficient time to develop the local knowledge and skills to supply more circular products, any changes to policy and legislation will need to be gradual or implemented with sufficiently long transition periods.

A multi-stakeholder policy process will also need to be in place to ensure transparent, acceptable and, in turn, effective policy design and implementation. Besides the need to consult representatives from the public, private as well as NGO sectors, the consulted stakeholders emphasised the important role inter-ministerial co-operation plays in the implementation of the future roadmap. This is particularly crucial with respect to the implementation of economic instruments, namely, some of the environmental taxes.

1. **Environmental taxes for the circular economy**. Tax instruments are a powerful tool to change industry and shift consumer behaviour in a desired direction through price signals, but these instruments also offer companies flexibility in terms of compliance by allowing them to decide on the level of compliance and thus the tax they are willing to pay for their manufactured products or services, with consumers left with the purchasing decision to accept (or not) to buy the highly taxed products or services. While some of the tax instruments may be less well established and more difficult to implement than others, their potential impact could be significant. The reform around some of the environmental taxes in the Slovak Republic will need to: (a) focus on the landfill tax and VAT in the short term; (b) consider the introduction of materials taxes on virgin aggregates and plastics; and (c) introduce incineration taxes and possibly consumer product taxes in the medium to long term (2040 being the long-term horizon). Aside from the landfill tax and incentive subsidies, the Slovak Republic has not made wider use of explicit economic instruments, particularly in the upstream part of the value chain, to facilitate upcycling, recycling, refurbishment and reuse, and thus tap into the potential development of the market for secondary raw materials. The country could also consider introducing minimum recycled content requirements within the context of plastics taxes, and possibly implement consumer product taxes for underperforming EPR schemes or DRS in the future, if required. Changes to the landfill taxes could also contribute towards expanding well designed PAYT-based charges for households across the country, as municipalities will be more motivated to encourage their residents to better sort their waste to minimise the amount of landfilled municipal waste and, hence, the cost of landfilling.
2. **Extended Producer Responsibility (EPR) schemes**. EPR approaches are well established and relatively easy to implement, which make them a good policy instrument to achieve high collection and recycling rates. Recently, governments started to implement incentive mechanisms within EPR schemes, such as eco-modulation, to extend the scope of EPR objectives from recycling towards stimulating “design-for-environment”. The country will need to reform its existing EPR system by introducing eco-modulated fees within the collective EPR schemes, and by improving enforcement and monitoring in the short term. Moreover, minimum recycled content requirements could be introduced as part of eco-modulation. In the medium to long term, the country could extend EPR to additional products, or possibly set up DRS alongside underperforming EPRs. Such an EPR policy would incentivise manufacturers to design their products in such a way that they can be more easily recycled, dismantled or refurbished, while improving separate collection rates of products that are otherwise hard to collect but which can be recycled, refurbished or reused, as well as improving the overall stability and performance of the competing collective EPR schemes. This would also contribute to the development of the market for secondary raw materials, thus supplying consumers with more circular products.
3. **Green Public Procurement (GPP).** GPP incentivises service providers to supply and invest in products and services that are more circular through the purchasing power of public authorities, which can be substantial in certain areas, such as infrastructure. Like EPR, GPP is a well-established instrument and has been introduced by many countries around the world. The Slovak

GPP reform could focus on gradually increasing the use of GPP criteria when awarding contracts and extending them to additional product groups in the short term to increase the gradual share of GPP, both in volume and value, for all public entities. The Slovak Republic could also explore the option of introducing minimum recycled content requirements within the context of GPP in the medium to long term to encourage further use of recycled materials in supplied products, and to support the development of markets for secondary raw materials (this is already planned within the RRP for the procurement of construction works, but the implementation timeline is yet to be seen). The country could also develop evaluation tools or methodologies to facilitate the evaluation of offers based on environmental criteria rather than solely on price.

4. **Household waste charges.** Household waste charges, in particular, the implementation of PAYT-based charges on mixed municipal waste, provide a strong economic incentive for households to better sort their waste. PAYT-based charges are relatively well-established policy instruments, which can take a number of forms, ranging from those that are easier and cheaper to implement to more sophisticated forms requiring substantial investment costs. The Slovak household waste charges policy could consist of extending PAYT-based charges across the country and promoting more effective forms of PAYT in densely populated areas, for example, sack- or weight-based systems. This would encourage Slovak citizens to sort their waste more, which in turn makes more products and materials available for reuse or recycling. This policy needs to be supported by an effective enforcement mechanism to minimise illegal waste disposal and fly-tipping (when people try to dodge paying higher waste charges), as well as by effective information and educational tools to change consumer behaviour towards more circular consumption and waste disposal patterns. Incentive subsidies and co-ordination support for some municipalities might also be needed to help them overcome the administrative and financial barriers of setting up such systems. The PAYT support policy might require some pilot projects as well as time to arrive at the best solution within the Slovak context. Inspiration can also be drawn from municipalities that have successfully implemented a PAYT scheme, but also from the experience of local NGOs working with municipalities on waste management.
5. **Supporting measures.** There are several supporting measures that need to be in place to facilitate the implementation and uptake of the above four types of policy reform. This package of policy instruments includes the provision of incentive subsidies, in particular, to stimulate R&D and eco-innovation, as well as investments in recycling and reuse capacities. The package further contains information and capacity-building tools, ranging from awareness-raising campaigns to SME business support to building credibility of more circular products and services using eco-labels and certificates for reused and repaired products. The country also needs to ensure that effective enforcement and monitoring systems are in place, and that the relevant stakeholders are involved in the discussions on policy design and implementation.

6 Roadmap to a Circular Construction Sector

This chapter lays out a roadmap for the Slovak Republic to develop a circular construction sector. It defines the role of the sector in transitioning to a circular economy, giving an overview of the current situation and policy framework. The gap analysis informs policy recommendations to shift away from the focus on energy efficiency or construction and demolition waste (CDW) towards the integration of circular economy principles along the entire construction value chain. Key recommendations on how to transition to a circular construction sector in the Slovak Republic by 2040 are complemented with some concluding reflections.

Role of the construction sector in transitioning to a circular economy

Rationale for a circular economy transition in the construction sector

The construction industry is one of the world's largest consumers of energy and raw materials. The sector currently accounts for about half of the total consumption of raw materials and nearly one-third of all waste. In 2017, it was also responsible for 39% of CO_2 emissions and 36% of energy consumption (IEA and UNEP, 2018[74]; Roland Berger, 2021[75]).

A circular economy transition can facilitate transformational change towards new ways of sourcing, consuming, and the end-of-life management of resources within the construction sector. Circular economy strategies, such as design for disassembly, reuse of materials and components, and extension of buildings' life through renovation, contribute to reducing the amount of resources used and the amount of waste generated during the whole life cycle of buildings. As such, they also help mitigate the related environmental pollution and the degradation of ecosystems (International Resource Panel, 2020[76]; Ramboll, Fraunhofer ISI and Ecologic Institute, 2020[77]; Material Economics, 2018[78]).

Increasing circularity of the construction sector is crucial to reducing environmental impacts and contributing to the sector's low-carbon transition. Materials production for buildings is a major contributor of GHG emissions and the main source of emissions across a building's life cycle (Material Economics, 2018[78]). One of the most important materials and contributors to CO_2 emissions is related to the manufacture, transport and use of cement/concrete, followed by the use of steel for construction (Material Economics, 2018[78]; International Resource Panel, 2020[76]). Selected circular economy actions can lead to reductions of up to 61% in materials-related greenhouse gases (GHG) emitted across a building's life cycle (in the EU-27, and the United Kingdom, by 2050 compared to the 2015 baseline) (European Environment Agency, 2020[79]).

Definition of a circular economy in the construction sector

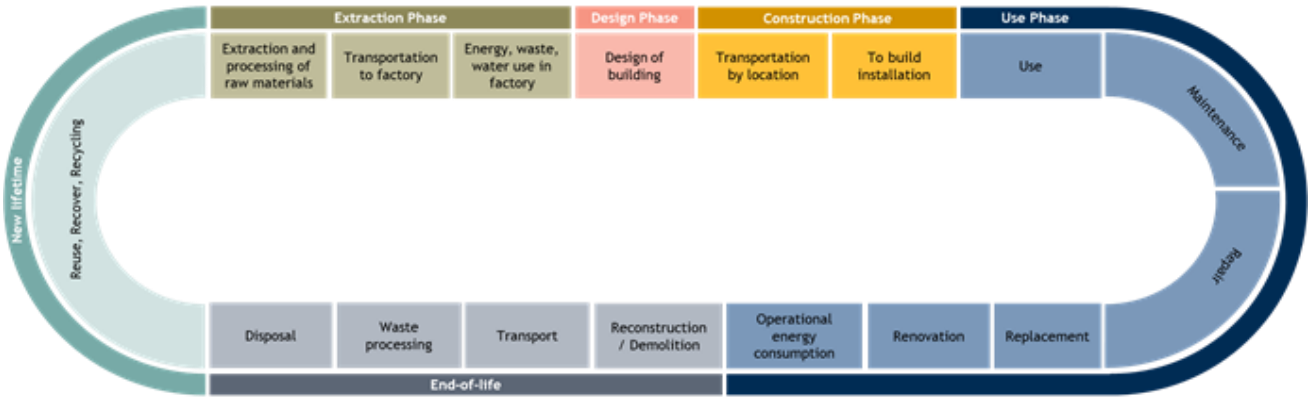
A circular building is developed, used, maintained and reused without unnecessary depletion of resources, environmental pollution or ecosystem degradation. Technical elements can be disassembled and reused to extend the lifespan of a building and its components, and biological elements can be returned to their biological cycle (Circle Economy, DGBC, Metabolic, 2021[80]).

The construction life cycle phases are illustrated in Figure 6.1 and build on the following circular economy principles in the different stages (Arup, 2016[81]; Circle Economy, DGBC, Metabolic, 2021[80]):

- **Extraction.** The sourcing of virgin materials for the production of building materials should be reduced to a minimum and substituted by secondary raw materials, with priority given to local sourcing. The extraction phase includes materials extraction and domestic materials consumption of construction materials.
- **Design.** A circular building is designed within a long-term perspective, considering both modularity and adaptability criteria, as well as energy-efficiency principles that minimise externalities. Operation and performance are embedded in the design and its processes, and open-source architectural design techniques are employed.
- **Construction.** A circular construction process accommodates for more flexibility, enabling easy remodelling of buildings at renovation and easier disassembly at a building's end-of-life. Off-site manufacturing and prefabrication help to eliminate waste from construction sites. Prefabrication decreases CDW, but also partially shifts CDW creation from construction site to factories. Novel manufacturing techniques, such as 3D printing, allow for the production of materials, components or even entire buildings at high accuracy and flexibility in design, time efficiency, lower cost and materials waste production. The transportation of construction materials prioritises distance over price.
- **Use.** Activities related to the use phase contribute to prolonging the building's life through the utilisation of internal circular resource cycles, such as waste capture and filtering, or net-energy production. The user of a circular building leases components and services instead of owning them. Through regular maintenance, optimal resource operation in buildings is ensured, while the premature destruction of building components is prevented through repair or small renovations. The flexible use and sharing of a building optimises the occupancy rate.
- **End-of-life.** Demolition is minimised through new design approaches, allowing easy access to building services, and including demountable and reconfigurable systems. Systems or models, such as Life-cycle Building Information Modelling (BIM), will enable to expand, contract or redesign buildings as well as to reconstruct and deconstruct them. Cloud-based BIM models even offer the opportunity to collaborate remotely and with more stakeholders on a project, as well as ensuring the use of up-to-date versions through frequent synchronization.
- **Lifetime** extension of construction materials, products, components and even whole buildings can be achieved through strategies such as reuse, repurpose, refurbishment, recovery and recycling. Their application ultimately maximises the value or the elements in use and respectively minimises the use of scarce primary raw materials. Such strategies link the end-of-life phase to other phases in the building's life cycle.

Several strategies can be applied along the construction life cycle to increase circularity, ranging from designing for circularity to reusing and recycling components and building materials (see Table A E.1 in Annex E). New innovative business models, enabled by digital technologies, set new norms and help disrupt linear practices. Besides unlocking potentials in materials, cost and resource savings, circular economy strategies also have a number of co-benefits. These include the mitigation of soil and water pollution and ecosystem degradation by decreasing the need for mining, or reducing the amount of plastic left to decay in landfills and waterways (Ellen MacArthur Foundation, 2015[31]; Material Economics, 2018[78]; European Environment Agency, 2020[79]). For these business models to be successful, they require enabling policies to ensure their uptake and long-term benefits.

Figure 6.1. Construction life cycle phases and circular economy



Source: Adapted from Circle Economy, DGBC and Metabolic (2021[80]).

This chapter develops circular economy policy measures for the Slovak construction sector, with a focus on buildings along the entire life cycle. The chapter identifies policy gaps and puts forward high-level policy recommendations to fill these gaps and to enhance circularity in the Slovak construction sector. For each phase, different circular economy strategies are identified. Of all these phases, the Slovak Republic places priority on the buildings use and end-of-life phases given the country's short-term objectives to reform legislation around CDW and to enhance buildings' renovations. Additionally, aspirational goals and policy recommendations for the design and construction phases of the building's life cycle in the long-term are also outlined.

Overview of the Slovak construction sector

Construction is an important economic sector in the Slovak Republic

The construction sector is an important economic sector in the Slovak Republic. It represents 7% of the country's GDP and employs 6.5% of the total workforce (Statistical Office of the Slovak Republic, 2020[82]).[5] The value added of the sector has been relatively stable in the last decade. The largest share of the value added (covering both new construction activities and renovations) is generated by buildings (37%) and civil engineering (38%), in particular, by non-residential buildings (23%) and roadworks (23%), respectively (see also Annex E) (Statistical Office of the Slovak Republic, 2020[82]).

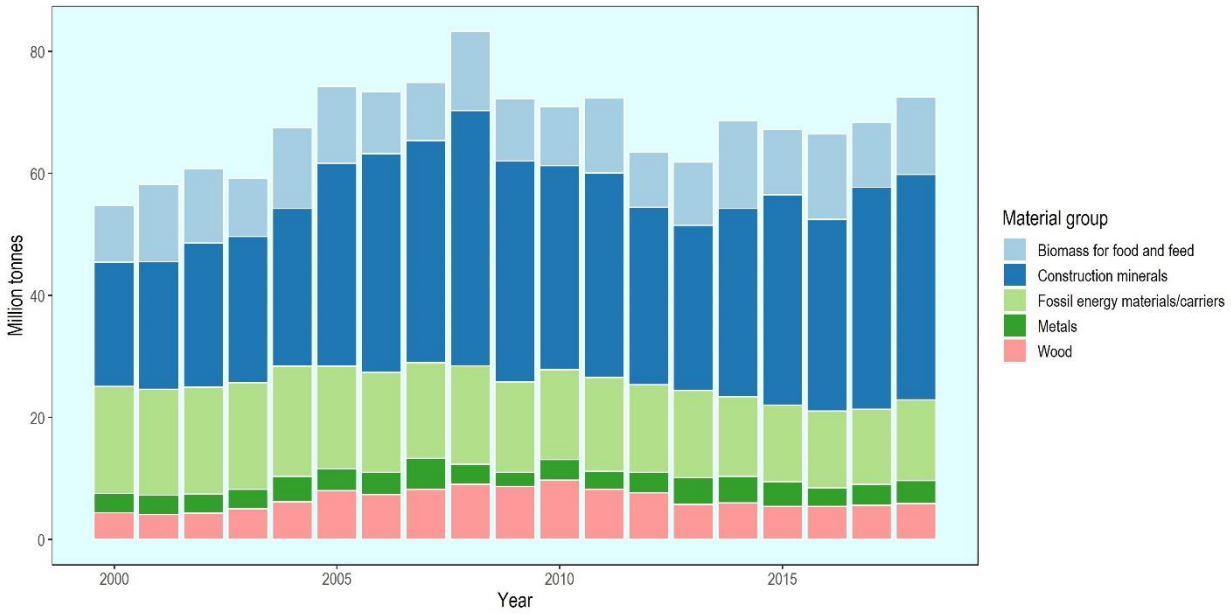
Construction accounts for more than half of domestic raw materials use

Iron ore and minerals are the two main raw materials inputs to produce construction materials and components. Sourcing of non-metallic minerals significantly contributes to the Slovak Republic's economy. In 2019, the Slovak Republic extracted 15.48 million tonnes (Mt) of construction minerals, predominantly crushed stone, followed by gravel sands and brick clays, used for domestic consumption (Škantárová, 2020[83]). The Slovak Republic also has a good availability of wood materials. However, iron ore extraction was discontinued in 2008 and the country now relies on imports (mainly of crude iron ore from Russia and Ukraine) (Kúšik, Mižák and Šoltés, 2017[84]). The level of domestic materials consumption has been on the rise since 2014. This trend was largely driven by an increase in construction materials consumption (non-

[5] Construction sector as defined by the Statistical Classification of Economic Activities in the European Community (NACE).

metallic minerals and primary metals). In 2018, the construction sector accounted for 56% of the domestic materials consumption of the Slovak economy (see Figure 6.2) (OECD, 2020[85]).

Figure 6.2. Domestic materials consumption in the Slovak Republic (2000-2018)



Note: Domestic materials consumption refers to the amount of materials directly used in an economy.
Source: Adapted from OECD (2020[85]).

Construction waste is not the largest waste source but only around one-third is recycled

The construction sector contributes a considerable amount of waste to the Slovak economy, yet it is not the largest source of waste (see Figure 2.4). While overall waste generation has been on the rise since 2012, the waste generated by the construction sector has been declining (some of this decline is due to changes in the reporting methodology). The materials composition of CDW reveals that the largest waste category (by weight) are metals and their alloys (around 45%), followed by concrete, bricks and ceramics (around 35%) (BRE, Deloitte, FCT, ICEDD, RPS, VTT, 2017[86]). In line with the general decrease in CDW, figures for construction and demolition minerals waste suggest that the overall volume of this waste category has also been declining (by 29% between 2010 and 2018) (Eurostat, 2021[87]). At the same time, almost half of the minerals waste treated from construction and demolition was disposed in landfills in 2018, constituting the second largest share among the EU Member States (after Bulgaria). Only 37% of mineral waste was recycled, ranking the Slovak Republic below the EU average and one of the lowest among the EU Member States. Around 13% of the mineral waste was recovered for backfilling (Eurostat, 2021[87]).

Existing building stock and its energy performance

The overview of existing building stock reveals that most buildings (both residential and non-residential) were built during the second half of the twentieth century, especially in the period between 1960 and 1985 (Ministry of Transport and Construction of the Slovak Republic, 2020[88]). The construction of buildings in that period was highly standardised, using concrete panels as the main construction material. Even though renovations of these buildings have been under way since the 1990s, renovation and renewal of this ageing building stock will remain the focus of future renovation efforts by the Slovak Government (Ministry of

Transport and Construction of the Slovak Republic, 2020[88]; Ministry of Finance of the Slovak Republic, 2021[89]). In 2020, over 95% of renovations were only so-called "shallow" or medium rate. By 2030 the share of "deep" renovations[6] and near-zero emission renovated buildings should increase to 20% (Ministry of Transport and Construction of the Slovak Republic, 2020[88]) and to around 29% in the case of multiple apartment buildings (information provided by the Slovak Ministry of Transport and Construction). The Long-term Renovation Strategy (LTRS) of the Slovak Republic reports on the good progress made on renovating residential buildings, while progress on renovating the non-residential building stock is uncertain due to limited data availability.

The maintenance and use of buildings are essential areas that contribute to materials efficiency as well as prolonging the lifetime of building components. Indirectly, the level of energy efficiency serves as an indication of how well buildings are maintained. According to the LTRS, in the Slovak Republic, the energy consumption in buildings was responsible for 8.54 Mt CO_2 in 2016, which represented 28% of all energy sector emissions. About two-thirds of energy consumption and emissions came from residential buildings, with the non-residential buildings responsible for the remaining one-third. The long-term objectives for energy consumption and emissions reduction for buildings in the Slovak Republic aim to reach a GHG emissions reduction of 90% by 2050 (compared to the 1990 level). In the short-term perspective, this translates into reducing the energy consumption by 15% and GHG emissions by 35% by 2030 (compared to the 2016 level) (Ministry of Transport and Construction of the Slovak Republic, 2020[88]). These reductions can be reached mainly through greening the energy supply and renovating buildings, in particular, for thermal insulation.

Regulatory frameworks for a circular economy in the Slovak construction sector

From the perspective of an EU and international best practice comparison, the current Slovak policy and legal frameworks correspond well with the obligations set out in the EU legislation (see Annex A for an overview of relevant EU policies and legislation). At the same time, the Slovak regulatory framework does not go beyond any of these obligations and has been slow in implementing EU recommendations on how to manage CDW as well as its own planned measures. Some of the relevant legislative and non-legislative measures to reach 70% recovery rate of non-hazardous CDW by 2020 were already included in the WMP 2016-2020 (including the introduction of relevant end-of-waste [EoW], specification of standards for recycled CDW and increasing the use of green public procurement (GPP) criteria in road construction). However, they have not yet been implemented (Ministry of Environment of the Slovak Republic, 2021[26]). Effective measures to manage CDW will be introduced only within the reform around CDW planned for mid-2022 within the context of the RRP.

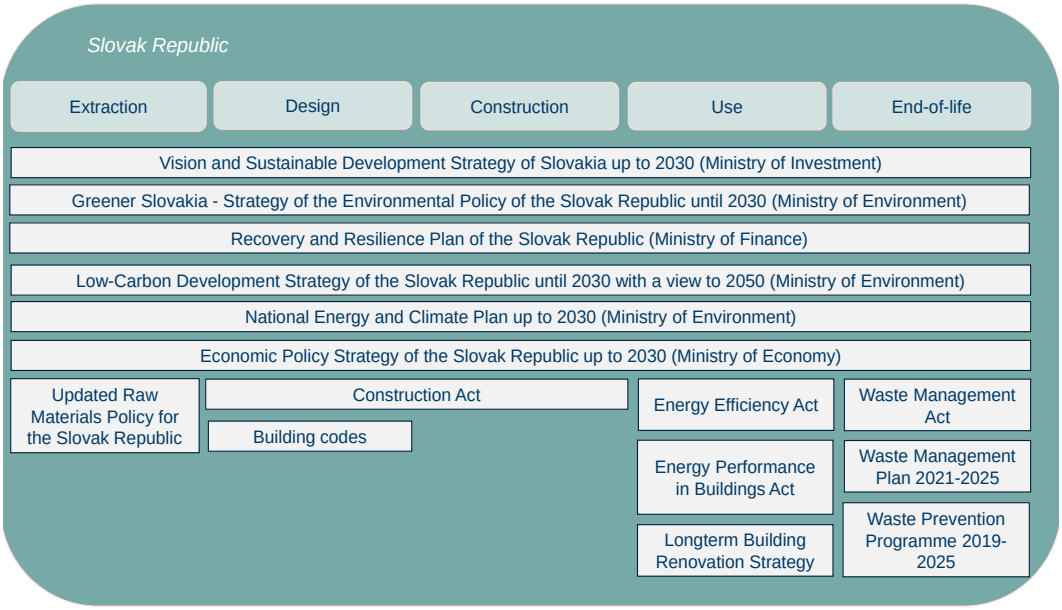
Policies focus only on energy efficiency and lately on construction and demolition waste

The Slovak Republic has developed several cross-cutting strategies and regulations, which aim to set out a vision towards climate neutrality and sustainable development. The six policies directly or indirectly related to the circular economy in the construction sector (see Figure 6.3) include the Sustainable Development Strategy to 2030 (Ministry of Investments, Regional Development and Informatization, 2020[9]), the 2030 Environmental Strategy (Ministry of Environment of the Slovak Republic, 2019[7]), the Recovery and Resilience Plan (RRP) (Ministry of Finance of the Slovak Republic, 2021[89]), the Economic Policy Strategy until 2030 (Ministry of Economy of the Slovak Republic, 2018[8]), the Low-Carbon Development Strategy (Ministry of Environmental of the Slovak Republic, 2020[90]) and the National Energy and Climate Plan (Slovak Ministry of Economy, 2019[91]). Besides the RRP, which demonstrates the

[6] In contrast to shallow and medium rate renovations, deep renovation includes both major renovation of the building construction as well as substantial refurbishment of the building's technical equipment.

country's national commitment to steer the construction sector towards a circular economy around waste management, the policy targets and goals of the other cross-cutting strategies (related to the circular economy) remain rather limited and defined at a relatively high level. Moreover, many of the circular economy objectives are being addressed by targets and policies indirectly related to the circular economy, such as those concerning energy efficiency and renewable energy.

Figure 6.3. Overview of Slovak strategies and policies relevant for the construction sector



From a life cycle perspective, the Slovak policy landscape has a strong focus on the end-of-life phase (see Figure 6.3). These policies primarily focus on CDW management. The Waste Act No. 79/2015 sets the basis for a circular economy in the end-use-phase by introducing the principles of waste management hierarchy, applicable to all sectors. It also includes a construction-specific target that demands to recover 70% of non-hazardous CDW by 2020 (derived from the corresponding EU obligation for 2020). The Waste Act also imposes a general obligation for responsible entities to reuse the produced CDW in constructions, renovations or infrastructure maintenance. At the same time, a large part of the recovered CDW still ends up as backfilling material rather than being recycled. The Waste Prevention Programme (WPP) (Ministry of Environment of the Slovak Republic, 2018[27]) sets high-level targets and goals for nine waste streams, including for CDW, among others. The most recent Waste Management Plan for 2021-2025 singles out "circular economy" as one of its key priorities and extends the 70% CDW material recovery target to 2025. Further policy reform ambitions have recently been announced for the end-of-life stage as a part of the Slovak RRP, with a primary focus on CDW management reform (see Box A E.1 in Annex E). However, other priority objectives, related to the use of buildings in the RRP, remain at the level of improving building energy efficiency and decarbonisation.

Many of the existing policy interventions and plans at the other life cycle stages introduce approaches with indirect circularity impacts. These include, for instance, policies related to the objectives of energy efficiency and renovation that are relevant for the use phase (i.e. Energy Efficiency Act, the Energy Performance of Buildings Act, and the Long-Term Building Renovation Strategy).

Circular economy principles lacking in upstream policies and legislation

The Raw Materials Policy (Ministry of Economy of the Slovak Republic, 2004[25]), regulating raw materials extraction and markets, is currently being updated. Until now, the Slovak Republic does not have a specific policy on secondary raw materials.

The common design principles and practices in the Slovak construction sector are captured by the requirements spelled out in the Slovak Construction Act, the national building codes and related sectoral legislation. One of the main policies targeting the design phase relate to energy performance standards for newly constructed and renovated buildings. In this light, the design of Slovak buildings currently prioritises energy efficiency over circular economy strategies, as the latter are not yet incorporated into the Construction Act nor the national building codes.

In the Slovak Republic, several ministries and policy drivers cover the circular economy for the construction sector. The responsibilities are largely separated along the construction sector life cycle. Responsibilities for the built environment design and construction stage, their use and maintenance, and the waste management policy making, all lie with different actors. It is therefore essential to involve all of the actors to successfully align actions and thus advance the circular transition in the Slovak Republic's construction sector.

Life cycle gap analysis and policy recommendations in the construction sector

The implementation of circular economy principles will require a whole life cycle approach, with the involvement of stakeholders from across the sector and across different parts of the government.

An overview of current Slovak policies related to the circular economy in the construction sector indicates that although the Slovak policy and legal frameworks correspond well to the obligations and the amendments set out by the EU, applying circular economy principles to the construction sector has not until now been a political priority for the country. The Slovak Government has so far prioritised energy efficiency in the renovation of buildings. Currently, it is preparing a long-planned reform around CDW (within the context of the RRP and the WMP 2021-2025). The policy's targets and goals (related to the circular economy in this area) remain at a high-level (in contrast to the indirectly related targets for energy efficiency and emissions). The end-of-life stage, with a primary focus on CDW management, remains the only short-term priority within national strategies and policies measured by a quantitative target (minimum 70% of non-hazardous CDW is recovered by 2025).

The Slovak Republic will need to implement the planned end-of-life related measures and strengthen the focus on the remaining parts of the construction sector's life cycle. This will require strengthening policies and measures on materials efficiency and extraction in the design, use and construction phases. Closer links between the end-of-life phase and other phases must also be established to close the materials cycle, for example, by making better use of existing buildings with high renovation potential or by ensuring that the construction of buildings maximises circularity opportunities.

The OECD research identified close to 30 policy recommendations that the country could implement to close the identified policy gaps and support the circular economy transition in this sector; this report puts forward 15 priority recommendations for the future roadmap. The approach taken to prioritise the recommendations included a pre-selection based on a number of criteria and a close consultation with stakeholders to select the final list of recommendations.

The next sections detail the different recommendations for the construction sector's life cycle, starting with three cross-cutting measures.

Cross-cutting measures for improving evidence-based policy making and strengthening collaboration across the sector

The role of digital technologies in addressing challenges to data collection and reporting

To better tailor and design existing and new policy measures, there is a need for systematic data collection across the sector. Data availability is essential for facilitating the transition towards a circular economy. It allows to properly plan, design and implement circular economy activities, as well as to report and monitor the progress of the transition.

Real CDW flows remain unknown due to a lack of an effective monitoring system

A recent review of the current CDW management of European countries identifies the lack of a database for monitoring CDW quantities and a clear assignment of responsibilities to control and monitor waste management as the first obstacle to a sustainable waste flow management (Giorgi, Lavagna and Campioli, 2018[92]). The Slovak Republic has also been struggling to fully launch its new Waste Management Information System (ISOH) since 2017, which should considerably decrease the administrative burden of waste management for public authorities as well as industry, as they will be able to monitor waste flows more accurately (Odpady-Portal, 2022[93]).

The lack of an effective monitoring system for waste has led to the inability of the Slovak Republic to accurately report on the CDW recovery rates, among other things. With a recovery rate of 51% in 2018, the Slovak Republic ranked at the tail end of the EU in the recovery of CDW (a decrease compared to 54% in 2016). This is partly driven by the shortcomings of the Slovak Republic's Regional Waste Information System (RISO), which is not suited for tracking material flows of waste and handling the introduction of new intermediate codes for waste disposal (Ministry of Environment of the Slovak Republic, 2021[26]). As a result, the final destination of around 40% of generated CDW in 2019 was unaccounted for (i.e. reported as being in pre-treatment and temporarily managed). This hinders the calculation of the real recovery rate for CDW and the monitoring of the real progress made with regard to the 70% CDW recovery rate target (see Box A E.2 in Annex E).

Improving the measurement and monitoring of CDW flows from producers to final waste processors requires better data collection and reporting. To boost the recovery rates of CDW, the Slovak Republic calls for better and more consistent data on the availability and utilisation of current recycling capacities for CDW, information on waste generation from different renovation activities, and their link to waste categories in line with Eurostat reporting. Collecting more detailed information on measures, and assessing their effect on the recycling of CDW, would also be beneficial. A better understanding of the recycling rates of CDW is required for estimating the expansion of waste recycling and sorting facilities. Moreover, data on capacities and their utilisation will need to be regularly updated and included within the new Waste Management Information System (ISOH) (Ministry of the Environment of the Slovak Republic, n.d.[94]). Information on waste categories arising from different renovation activities could be collected directly from the relevant companies operating in building construction and recycling in the form of a survey. The need for improved electronic data collection for a strategic planning of waste management has also been reflected within the recent proposal for the Partnership Agreement 2021–2027 (Ministry of Investments Regional Development and Informatization of the Slovak Republic, 2022[95]).

Need to understand the characteristics of the national building stock to focus policy

Besides waste flows, the design and implementation of effective policy measures (related to the promotion of more circular renovation strategies) requires **developing a comprehensive overview of the characteristics of the national building stock and its renovation needs.** In the Slovak construction sector, information on the existing building stock is fragmented and often outdated. Major gaps exist in the statistics for non-residential buildings, with the most recent data coming from 2010 through issued energy

certificates (Ministry of Transport and Construction of the Slovak Republic, 2020[88]). According to one of the consulted stakeholders, developing an overview of the national building stock is challenging in terms of feasibility and cost, especially when it comes to family homes. Moreover, information on materials and technologies is reported on a very general level. It is therefore crucial to collect and report additional and more granularly collected data to better assess the investment costs of building renovations and to design the specific policy measures accordingly. In particular, additional data is required on the total building stock for renovation (divided by type of buildings) and on renovation activities associated with a circular economy (e.g. reuse of materials or components), as well as their respective unit costs (euros per renovation activity). The overview of the building stock could start with the oldest and historical (or protected) buildings, as their renovation is scheduled for the short term.

Enhancing data availability and their reporting can be achieved through a number of strategies. Digitalisation and data management systems bring significant opportunities when it comes to facilitating reporting and the exchange, processing and management of data. Digital tools, such as materials passports and building information modelling (BIM) (discussed in a later section), provide a detailed documentation of materials, components and products within buildings' structures, and generate multidisciplinary data to create digital representations of buildings' characteristics. This enables the utilisation of buildings as material banks and facilitates a transparent flow of information between stakeholders throughout the project phases. These tools have a great potential to help the Slovak Republic preserve and upgrade its building stock, to perceive the building stock as a source of raw materials, to track information on waste generated from renovation activities, and to ultimately reuse recycled materials. In more general terms, a digitally enabled construction sector promises to build better and to more effectively tackle the issues related to waste and GHG emissions, labour shortages and productivity, as well as health. Examples of digital approaches to a circular economy in the construction sector include the Danish Strategy for Digital Construction (launched to increase the productivity and efficiency of the construction sector) (European Commission Construction Sector Observatory, 2019[96]), the Digital Transformation of the Bulgarian Industry (which also addresses the construction sector) (Ministry of Transport, Information Technology and Communications of the Republic of Bulgaria, 2020[97]), and the Dutch digital approach to circular economy in construction (discussed in Annex E). Evidence and lessons learnt on integrating digital technologies (including data acquisition, automation, and digital information and analysis) into the construction sector are collected within a recent report by the European Construction Sector Observatory (2021[98]). The EC proposed to introduce "digital product passports" in its proposal for a revision of the Construction Products Regulation (European Commission, 2022[99]).

Data collection to understand the national building stock can also be achieved through one or more existing tools, such as through energy certificates (if these are made mandatory) or through census surveys (e.g. these two tools will be used to collect additional data on the building stock by the Brussels Region (Bruxelles Capitale, 2019[100]). The outcomes of the Census 2021 in the Slovak Republic could already be integrated into existing legislation and strategies with the aim of updating the strategies (e.g. the Slovak LTRS still refers to data on the building stock collected by the Slovakia Census 2011).

Strengthening collaboration and partnerships between public and private organisations

Strengthening collaboration among the relevant stakeholders is key for transitioning to a circular economy. In particular, the building sector is fragmented, with stakeholders working in silos, and thus innovation diffuses rather slowly and predominantly focuses on energy efficiency improvements. Increased collaboration in the sector, by bringing together suppliers, designers, demolishers and waste companies, has the potential to create more financial, social and environmental value from across the entire life cycle of buildings (Leising, Quist and Bocken, 2018[101]).

To facilitate the circular transition of the buildings sector, the Slovak Republic should **strengthen the collaboration and partnerships between stakeholders from across relevant institutions**. Promoting

inter-sectoral, cross-agency and interdepartmental collaboration would help address the cross-cutting issues related to the development of new materials, the uptake of innovative circular activities and new business models, and facilitate the integration of disruptive technologies. Particular attention needs to be paid to inter-ministerial collaboration, as highlighted by the consulted stakeholders, as such collaboration is limited at present. The Slovak Republic could consider running a dedicated working group between the relevant stakeholders from the different ministries and agencies (e.g. Ministry of Environment, Slovak Environment Agency, Ministry of Transport and Construction, Ministry of Economy), the private sector (e.g. Association of Construction Entrepreneurs of Slovakia, construction companies), academia (e.g. faculties of civil engineering, of architecture and design, of mining, materials, metallurgy and recycling) and civil society (e.g. INCIEN Slovakia [Institute of Circular Economy], Circular Platform Slovakia). This working group could function as a sub-group of the existing working group responsible for co-ordinating the preparation of the future roadmap (as set up by the Ministry of Environment). A guide on setting up collaborations for a circular economy can be found in the Circle Economy's recent publication (2020[102]). Specific examples of international collaborative good practices between governments, companies and other stakeholders to address cross-cutting issues include the Dutch Green Deals for innovation in circular activities (see Annex E).

In terms of technical assistance, the Slovak Republic could support the establishment of an online platform to bring together the relevant stakeholders. Besides enabling collaborations between the public and private sector, such platforms (whether virtual or physical) may also facilitate synergies and knowledge-sharing across the different parts of the value chain. Once again, the Netherlands offers an example of a public-private discussion platform used to establish consensus on the concept of a “circular building” sector (Annex E). Other examples of platforms connecting experts and organisations, engaging stakeholders within different working groups, and promoting projects that integrate the principles of a circular economy include the Holland Circular Hotspot and the newly established Czech Circular Hotspot (INCIEN, 2021[103]; Holland Circular Hotspot, 2022[104]).

Specific measures for strengthening public-private collaboration also include financial support. For instance, dedicated publicly-funded research projects could be set up to: (a) further the reuse of CDW; (b) encourage closer co-operation between producers and their representatives with academic and research centres for the development of waste treatment technologies; (c) evaluate different international approaches applicable within the Slovak context; (d) forecast potential outcomes and impacts; (e) derive lessons learned; and (f) develop educational materials. These would help tailor better and specific initiatives in the future. The funding of such a programme could be at the national, regional or European level. For instance, the EU’s funding instrument for environment and climate action, LIFE 2021-2027 programme, foresees funding for circular economy projects within its sub-programme Circular Economy and Quality of Life (European Commission, 2021[105]; European Commission, 2021[106])[7]. On the national level, examples of state support for R&D projects and innovative business models include various programmes by the Technology Agency of the Czech Republic (Technology Agency of the Czech Republic, n.d.[107]) (see Annex E).

From extraction of raw materials to design and the construction of buildings

Construction activities have increased in the Slovak Republic during the past decade and the potential for introducing circularity into future construction projects has been identified as significant in the country by consulted stakeholders. However, common construction practices prioritise cost-efficiency, which include the application of best available techniques in the construction of buildings, yet they rarely consider circular principles. The Slovak Construction Act, which is the primary legislative basis for the construction phase,

[7] As much as 12% of projects financed during the 2014–2020 period focused on construction and buildings (European Commission, 2021[105]).

mainly serves a procedural function covering the permitting procedures for buildings construction. It ensures that building design and construction conform to the required building standards but it does not directly address the principles of a circular economy. Nevertheless, it links to legislation that directly or indirectly integrates some of the circularity principles (such as the Energy Efficiency Act or the Waste Act).

When it comes to the design phase, although the country is well aligned with the requirements of EU legislation, these mainly relate to energy efficiency considerations. The Slovak Building Code serves a procedural function, setting requirements for the design of new buildings, but it does not incorporate circularity criteria. The Slovak construction sector lacks guidance on circular design principles and on the most appropriate alternative materials to be used.

The lack of circularity in the construction and design of buildings has a magnifying impact on the extraction of raw materials for construction, the demand for which has been steadily increasing in the Slovak Republic. Moreover, the Slovak Republic does not have a secondary raw materials policy in place, neither has it introduced economic incentives to help optimise minerals extraction and use, nor have sufficient measures to support the market for secondary and alternative construction materials.

To make the extraction of raw materials, and the design and construction of buildings, more circular in the Slovak Republic will require less extraction of virgin raw materials, stimulating the use of secondary and alternative construction materials, and developing pilot projects to test and apply new design innovations.

Decreasing the extraction of virgin raw materials

To discourage the extraction and use of virgin construction materials in line with Chapter 5 on the use of economic instruments, the Slovak Republic **should consider introducing an aggregate tax**. This measure could provide an incentive to shift the composition of building materials from primary to secondary use, thereby helping reduce the environmental costs associated with quarrying and mining activities. While the country has already implemented resource fees for minerals extraction (see Box A D.2 in Annex D), these represent royalty payments (associated with resource extraction) rather than aggregates taxes. Taxes on aggregates would help internalise the externalities of materials production and use on the environment and incentivise the shift towards the use of recycled materials. More specifically, the Slovak Republic could target aggregates, such as stones, gravel and sand, which are not traded internationally and would therefore not threaten the competitiveness of domestic producers.[8] At the same time, the revenues generated from aggregate taxes could be earmarked for funding circular economy research in related pilot projects.

Aggregate levies and taxes have been introduced in a number of countries (see Annex D for a selection of good practices and a summary of lessons learned). More detail on these instruments is also provided in Chapter 5 on economic instruments. Although the evidence shows that aggregate taxes contribute to a reduction in the use of natural resources and, to some extent, encourages the use of substitute materials, additional policies are required to further drive the increase in the demand for and the supply of recycled materials (European Commission, 2011[108]; Söderholm, 2011[109]).

Stimulating the use of secondary and alternative construction materials

To further reduce the use of virgin and non-renewable construction materials, measures supporting the use of secondary and alternative construction materials need to be put in place. These include quality standards for recycled construction materials, minimum recycled content requirements for specific

[8] Implementation of aggregate taxes is a measure proposed for the medium to long term. For the exact timing of the implementation, it is important to reflect on the construction sector's market conditions. At present, the construction sector is affected by a sharp increase in prices and a shortage of a number of several raw materials. Imposing taxes on primary materials might further exacerbate the functioning of the construction market, especially for SMEs.

construction products, and mandatory GPP for construction works in combination with support for business model innovation.

Quality standards for recycled construction materials as the basis for sustainable construction

Lack of quality standards has been identified as one of the most important impediments in the marketing and use of recycled materials and construction products (Nadazdi, Naunovic and Ivanisevic, 2022[110]). Enhancing the confidence in the quality and performance of secondary raw materials in construction, thereby minimising their uses in low-grade applications (such as for backfilling), requires quality management and assurance. Standardisation is essential to assess the performance of recycled materials in construction products when they replace primary raw materials (Tam, Soomro and Evangelista, 2018[111]; European Environment Agency, 2020[112]). To provide guidance on technical specifications and standards on the use of recycled aggregates for structural applications, **the Slovak Republic will need to implement a quality standard for recycled construction materials** (as already stipulated in the RRP, the WMP 2016-2020 and the WMP 2021-2025). In particular, such a quality standard would provide metrics for performance measurements and reliable and repeatable tests and calculation procedures, which would help to ascertain impurity levels or suitability for high-grade recycling (European Commission, 2015[19]). Some of the consulted Slovak stakeholders also see technical quality standards for recycled construction materials as a precondition for a successful implementation of a mandatory GPP in the sector. The Slovak Republic could consider embedding this quality standard into its Construction Act. In the long term, this legislation could lay the groundwork for the development of a legislative-binding quality assurance system that safeguards the quality standards and their compliance.[9] Prior to the implementation of such quality standards, a feasibility study will be required to make sure that the local market can respond to and keep up with the standard.

National standards for recycled aggregates have been widely implemented across countries. An international comparison is outlined by Tam, Soomro and Evangelista (2018[111]). A specific example of quality standards for recycled aggregates in the Netherlands is reported in Box A E.5 (Annex E), and lessons learnt from implementing upcycling and reuse strategies for CDW are described in Box A E.6 (Annex E). On the European level, recycled aggregates are covered by harmonised standards (Condotta and Zatta, 2021[113]). For instance, European Standards for concrete define the performance and production criteria as well as the use of recycled materials in concrete (i.e. EN 206 [concrete], EN 12620 [aggregates for concrete], EN 934 [admixtures for concrete, mortar and grout]). However, their uses in different applications are regulated by quality assurance schemes on the national level, which outline requirements on waste acceptance and environmental issues. For illustration, the Netherlands allows for a substitution of virgin aggregates with recycled aggregates of up to half the stony fraction volume for certain applications. In Belgium, up to half of the volume of the coarse aggregate fraction may be used in new concrete aggregates under certain conditions (Vrijders, Dooms and Van Itterbeeck, 2017[114]; European Environment Agency, 2020[112]). Standards may also set limits for the content of impurities, or bricks and tiles, in recycled aggregates in concrete.

Minimum recycled content requirements to incentivise the use of recycled materials

Setting minimum requirements for more recycled materials in construction will create a market demand for recycled content. This has the potential to not only decrease the use of virgin materials and help divert CDW from landfills, it can also make the recycled aggregates more competitive. It is therefore

[9] This should build on the EU Construction and Demolition Waste Protocol, which provides a methodology for national authorities to perform audits/assessments before a demolition or renovation, with a focus on reuse and recycling. An additional element to consider is the EU Sustainable Products Initiative, which will provide aspects to potentially integrate quality standards related to recyclability.

recommended that the Slovak Republic explores the best approach to **introducing minimum recycled content requirements for specific construction products**. Such requirements could be introduced either by a direct regulation targeting construction material manufacturers, or by integrating such requirements into other policy instruments, such as GPP (as foreseen in the RRP) or materials certificates. So far, the evidence of individual countries implementing minimum recycled content requirements in construction is limited (unlike with other materials, such as plastics in packaging). This may be linked to today's limited knowledge of recycled construction products and the uncertainty around their quality and performance. As with all construction products placed on the EU market, health and safety aspects related to their use during their entire life cycle need to be considered (Regulation (EU) No. 305/2011). Recycled content requirements must be set with a view to maximising the recycled content without safety loss (this is foreseen in the proposal for a revised Construction Products Regulation). Recycling mandates have been implemented within public procurement policies in Japan (see Annex E) and in Scotland. The Scottish Government has requested all public bodies to set a 10% recycled or reused content of the total value as a minimum standard in public sector projects realised in Scotland (WRAP, 2009[115]). The EC proposes to introduce mandatory recycled content requirements for construction products and materials within the context of the revision of the Construction Product Regulation (European Commission, 2022[99]). The Slovak Republic can take their own initiative (as planned within the RRP) or wait for further EC guidance in this regard. Minimum recycled content requirements are also discussed in Chapter 5.

Green public procurement (GPP) to increase the supply of sustainable construction

The use of GPP in construction and renovation works is an established measure across European and non-European countries to stimulate the market for sustainable construction works in the public sector, including the use of secondary raw materials. This instrument has been prioritised in circular economy policies by European circular economy frontrunners, such as Belgium, the Netherlands and the United Kingdom, as well as by the EU in their 2020 Circular Economy Action Plan. To support the use of GPP in the construction sector, the EC has developed EU GPP criteria for office building design, construction and management in 2016 (under revision until 2023) (Dodd, Garbarino and Gama Caldas, 2016[116]), as well as for road design, construction and maintenance (Garbarino et al., 2016[117]). On 30 March 2022, the EC published a proposal for the revision of the Construction Products Regulation, which empowers the EC to establish mandatory GPP criteria for construction products (2022[99]). However, there is no "one-size-fits-all" approach to implementing GPP in this sector and countries have so far adopted a variety of GPP approaches as well as infrastructure delivery models (see Box 6.1 and Annex E).

In line with the overall recommendation on GPP (see Chapter 5), **the Slovak Republic needs to increase the use of GPP criteria in the construction sector to stimulate the market for sustainable buildings construction and renovation**, possibly including minimum recycled content requirements as a GPP criterion. The GPP can be facilitated by extending mandatory GPP criteria to construction and renovation works for state-level entities based on the EU GPP criteria (as has already been introduced for four other product groups and is planned within the context of the RRP) or for all public entities. The country could also take a more voluntary approach to GPP by increasing the capacity for sustainable construction of both public authorities and the construction sector (and while awaiting the revision of the relevant EU GPP criteria). The mandatory approach may take the form of compulsory technical specifications, selection criteria, award criteria, contract performance clauses or targets, as appropriate (in line with the proposal for a revised EC Construction Products Regulation). Both mandatory and voluntary approaches will require building internal capacity of all public authorities to apply and monitor the implementation of environmental criteria in public construction and renovation works, as current practices in the Slovak Republic largely fall back on awarding public contracts to the lowest price bidder. According to the Slovak authorities, to achieve a real environmental benefit through the procurement process, a thorough analysis and planning will need to be carried out prior to the procurement process itself. This is because some EU GPP criteria and methodologies cannot be applied across all construction works and need to be tailored to the specific

project. Engaging with the market in the pre-tender stage can help contracting authorities understand what should be feasible and at what associated costs (SCI-Network, 2012[118]), while peer-to-peer practitioner networks can play a critical role in GPP capacity-building (World Bank, 2021[119]).

If the Slovak Republic chooses to adopt a more prescriptive model of public procurement by legislating some minimum GPP criteria for public construction works, it can draw on international practices from, for example, Italy or Japan. For instance, within the context of the construction sector, GPP criteria in Italy (that apply to all public construction interventions) require that at least 15% of materials used in construction be certified as recycled origin (Ministerial Decree 24/12/2015).[10] The Japanese Act on Promoting Green Procurement specifies the environmental evaluation criteria applied to some construction products to be used in the procurement of public works by all government agencies, many of which are based on minimum recycled content (Annex E). When taking the mandatory approach, attention must be paid to ensure that sufficient incentives are still in place for bidders to compete on green criteria rather than solely on price (once the minimum environmental criteria are fulfilled) and that the pool of potential bidders does not become too restricted by applying overly strict selection criteria. This could be achieved by introducing mandatory green award criteria only.

Irrespective of the GPP approach taken (mandatory or voluntary), public authorities will also need to choose the type of infrastructure delivery model (Box 6.1) that best fits to implement GPP on a case-by-case basis. The decision depends on the nature of the project itself, the level of in-house expertise and the contracting authority's priorities (SCI-Network, 2012[118]), as well as on the level of internal capacity to monitor and control the public works. The most common approach in the EU (and favoured by some of the consulted Slovak stakeholders) remains the separation of design and build process, the so-called "design-bid-build" model, whereby design work is prepared initially (either in-house or with the help of a consultant) and then a construction company is contracted to build based on design work. The construction company remains responsible for the construction work (as well as the employment of sub-contractors and the procurement of materials). This has the advantage for the contracting authority to maintain close control over the process, yet it involves minimal interaction between design and build teams, and the contracting authority bears all the risk for errors and design faults. When opting for this model, it is recommended to include detailed quantitative and performance-based specifications for the procurement of construction work (SCI-Network, 2012[118]). When tendering for design services, it is advisable to request evidence of the quality of work from bidders rather than a list of relevant projects (SCI-Network, 2012[118]).

An alternative approach, often employed in public-private partnership (PPP) and concessions, is the combination of design and construction by one single contractor (the so-called "design-build" model). The contracting authority provides a project brief, sometimes with only performance-based requirements. This approach allows for greater co-operation between design and construction teams, and the contractor bears all the responsibility for the works, but more in-house expertise may be required for appropriate monitoring. Where the contracting authority has limited experience with the risks of the project, an alliance contracting model (whereby risks are shared among the contracting authority and alliance partners) may be recommended (OECD, 2015[120]).

[10] Ministerial Decree 24 December 2015 "Adoption of minimum environmental criteria for the award of design and works services for the new construction, renovation and maintenance of buildings for the management of public administration sites and minimum environmental criteria for the supply of incontinence aids".

Box 6.1. Infrastructure delivery models

Infrastructure delivery models

The existing literature highlights that several models of construction procurement exist, yet no "one-size-fits-all" model can be recommended (SCI-Network, 2012[118]). A critical aspect of the procurement model is the degree of separation and integration of design and construction works, as split responsibilities and a lack of co-operation can lead to end results that do not meet desired standards (Table 6.1).

Table 6.1. Different types of infrastructure delivery models

Model	Responsibilities and risks
Design-bid-build	• Contracting authority has completed the majority of design work (sometimes with the assistance of specialised consultants). • Government engages contractor to build, based on supplied design. • Risks associated with design faults, changing requirements and adverse site conditions are typically borne by the contracting authority.
Design-build	• Contracting authority only provides a project brief in the tender documentation, sometimes with only performance-based requirements. • Contractor engages design consultants. • Contractors bid on their developed design and lump sum construction price. • Risks associated with errors or omissions in final design, and latent conditions typically borne by contractors and design consultants. • Costs of directed variation typically borne by the contracting authority.
Construction management or general contractor	• Contractor undertakes significant part of project management role, including: obtaining development approvals; undertaking onsite investigations; finalisation of design; and developing a construction, commissioning and maintenance programme. • Assumes the risk for construction performance as the equivalent of a general contractor holding all subcontracts during the construction phase. • Contractors given incentives to manage project costs by sharing cost savings.
Alliance contracting	• Contracting authority and other alliance partners jointly develop design and share risks. • Other alliance partners may include designers, consultants, management service providers, suppliers and construction contractors. • Often considered to be of greatest value where the contracting authority has had limited experience with the risks for the project.
Public-private partnership (PPP) and concessions	• Contract between the public and private sector, which can reflect a number of different partnership models. • Private sector delivers infrastructure and services over the long term. • Some level of private financing for the project. • Project may be funded by government, user payments or a combination of the two.

Source: OECD (2015[120])

Examples of practices

Design-bid-build model. Example of the Weiz District Authority offices renovation in Austria shows that an ambitious energy target (obtaining the A+ Austrian energy certificate) was set, and a planning and design team of architects and consultants was initially procured. This team was also responsible for the preparation of detailed technical specifications for the procurement of construction work (including materials) and building services, as well as the compliance assessment of bids. Construction achieved 80% reduction in heating energy requirements.

Design-build model. In the Koemarkt renewal in Purmerend, Netherlands, a two-stage (design and build) cost-led procurement model with a maximum budget was used, with award criteria solely based on quality. The contracting authority employed a consultant for the two-stage procurement process as

it had little previous experience. The tender procedure involved several steps and, notably, the participation of the local population in choosing the winning bidder.

Construction management model. Some authorities are also seeking to integrate design and construction with building operation and maintenance, which further incentivises the optimisation of construction works, as the contracted company may benefit from greater operational efficiency. In the Jyväskylän Optimi project in Finland, a company was employed for the design, construction and operation of a school and day-care centre campus' facilities with the aim of promoting innovation and life cycle thinking in procurement. Limits were set for heating and energy, electricity and water consumption, and the service provider was liable to cover any cost exceeding those limits. If energy demand was below the set limits, the benefits were shared equally among the service provider and the contracting authority.

Source: Adapted from SCI-Network (2012[118]).

Business model innovation to support the development of secondary raw materials markets and new recovery processes and technologies

Besides economic and regulatory instruments, the Slovak Republic could stimulate the use of secondary raw materials by **encouraging business model innovation with a focus on accessing secondary materials and developing new recovery processes and technologies.** Information on economic and environmental advantages of secondary materials and new recovery processes, along with educational campaigns and training to expand the expertise of construction companies on circular construction techniques, new materials and their compatibility, can drive the uptake of new business models within the sector. The Slovak Republic's newly proposed Partnership Agreement for the period 2021-2027 (in the inter-ministerial consultation process at the time of writing) already includes some of these actions, although not specifically targeted to the construction sector (Ministry of Investments Regional Development and Informatization of the Slovak Republic, 2022[95]). In particular, the country envisages raising consumer and stakeholder awareness (on waste prevention, reuse, reparability, and sustainable consumption and production) and supporting the development of new skills for emerging sectors of the economy (including comprehensive training in new technologies, digital and circular economy, establishment of new training and education centres at universities and enterprises, and co-operation between SMEs, universities and vocational secondary schools). The Slovak Republic also envisages providing support for computerisation and digital transformation to fuel the uptake of new business models (including those of shared and circular economy) as well as the use of digital and green technology innovations within industry and services. Through targeted support for small and medium-sized enterprises (SMEs), the country hopes to stimulate the innovation potential of the circular transition through the growth and competitiveness of SMEs, and to grow innovative solutions in using more efficient resources and secondary raw materials. The specific measures put forward in the Partnership Agreement include: (a) financial support for research, development and innovation (R&D&I) in the area of circular economy; (b) support for companies' activities targeting a more efficient use of resources; (c) prolonged product life cycles; (d) new business models; (e) use of renewable resources and materials; (f) the application of eco-design principles; and (g) the development of skills and competences for a circular economy transition.

The Slovak Republic could support projects to establish decision-making tools for business managers, business support services and innovation hubs by considering specific tools to strengthen the adoption of circular activities by companies. These tools jointly enable businesses to: (a) explore new business models, technologies, products or services by embedding circular economy principles; (b) guide business managers through the actual adoption of business models; (c) encourage co-operation between public and private actors; and (d) increase the commitment by local governments, companies, civil society and academia. For example, Scotland has set up a Circular Economy Business Support Service to provide

one-on-one consultancy for SMEs across all sectors (Zero Waste Scotland, 2020[121]). Luxembourg has set up a decision-making tool (Fit4Circularity) through which it helps companies to identify and assess their growth potential and to adopt circular economy approaches and innovative business models (The Government of the Grand Duchy of Luxembourg Luxinnovation, 2020[122]). Other examples of circular economy hubs include the Holland Circular Hotspot and the Circular Flanders, a hub of the Flemish circular economy (Vlaanderen Circulair, n.d.[123]; Holland Circular Hotspot, 2022[104]), both of which share relevant knowledge, best practices and publications on circular buildings, among other things. Another example is the City of Wiltz, which was nominated the "National Hotspot for Circular Economy" in Luxembourg (Circular Cities Declaration, n.d.[124]) for having integrated the principles of a circular economy into its building regulations and for promoting the ecological construction of buildings. Examples in Belgium of specific circular activities (targeting business model innovation within the construction sector funded by grants) include a guide on circular school construction, a tool for the BIM model environment, and a project on financing circular materials differently (Vlaanderen Circulair, n.d.[123]).

Developing pilot projects to test and apply design innovations

There are a number of initiatives on the European level to provide guidance on integrated circular economy principles in design. As part of the Sustainable Products Initiative (SPI), the EC proposed a Regulation on Ecodesign for Sustainable Products to make products placed on the EU market more sustainable, extending eco-design requirements to new design principles, and aligning materials properties with the circular economy (European Commission, 2022[125]). Since the construction sector is included within the scope of the SPI, digital product passports – along with eco-design criteria related to longevity, reparability and recyclability – might become mandatory. The principles of circularity in the design of buildings are laid out in the document "Circular Economy – Principles for Building Design" (European Commission, 2020[126]). They are structured by objectives, including durability, adaptability and waste reduction, and aim to inform and support stakeholders along the entire construction value chain.

In the Slovak Republic, the design of buildings is only covered in national "building codes". However, at present, they do not yet reflect any circularity criteria. To address the missing link to circularity in the design phase, the Slovak Republic might consider **using future construction projects as pilots to test and apply circular economy principles and design innovations**. Contrary to long-term infrastructure development, pilot projects can be a quick source of learning for a large-scale deployment of circular economy practices in the future. Given the large building stock that is about to reach the end of its life or will require deep renovation in the country (Government of the Slovak Republic, 2017[127]), the Slovak Republic might take the opportunity to apply and test circular economy strategies through deconstruction and new construction pilot projects. These may focus on testing BIM, exploring the uses of materials passports, and integrating these with reversible and modular building designs.

A number of countries and municipalities have already piloted circular design principles. On the city level, evidence of successful pilot projects to test new technologies, raise awareness and encourage public procurement has been collected in a recent OECD report (2020[128]). On a national level, and in the specific context of piloting BIM technology, the UK Government established a pilot programme for the collection and analysis of BIM data in order to capture lessons learnt and to share best practices within government and across businesses. The aim of the pilot is to help improve the construction, operation and management of buildings in future projects (UK Government, 2012[129]). The Danish Government mandated BIM within public procurement projects on national, regional and municipal levels. During the preparation of regulations, they involved academia and industry through consultations and pilot projects. The Polish Government opted for an optional use of electronic data modelling tools in construction projects. Within the transport infrastructure, Poland launched two pilot projects which required the use of BIM (European Construction Sector Observatory, 2019[130]). A number of other countries have also implemented mandatory and optional measures to drive the adoption of BIM in public procurement, including Finland, France, Germany, Italy and the Netherlands. These are implemented as part of public procurement

legislation, education, training and awareness-raising, R&D support, and the development of BIM standards. More details on these measures can be found in the report of the European Construction Sector Observatory (2019[130]). In the Slovak Republic, the application of BIM in buildings is still relatively low (Kolaric, 2019[131]), but interest continues to grow. The recently established BIM association promotes and develops opportunities for the application of BIM in the Slovak Republic (EUBIM, 2019[132]; BIM Asociácia Slovensko, 2021[133]). Following international good practices, the Slovak Government could also consider launching pilot projects to speed up the adoption of BIM and to better understand the data generated and the potential for its future uses. This would also help involve local stakeholders and ensure that BIM requirements, once mandated, would be relevant for the construction industry.

Pilot projects of "materials passports" (digital product passports) have been implemented by government authorities in the Netherlands (Madaster, n.d.[134]). Municipalities within the Amsterdam Metropolitan Area applied materials passports to their buildings in order to collect data on their respective materials and their circular and financial value with the ultimate aim of introducing circularity in construction and demolition practices. Another pilot project for the sustainable design of buildings has been undertaken in Germany. This project is intended to pilot transformable and recyclable design, healthy materials and the use of materials passports within office buildings (BAMB, n.d.[135]). The concept of buildings as material banks can also be scaled up, from individual buildings to the entire building stock of a city. An example includes the project to estimate the metal content of buildings across the city of Amsterdam (Blok, n.d.[136]). Similar to these projects, the Slovak Republic could consider piloting materials passports use during the planning phase of new buildings so as to inform design for disassembly and to ensure that components can be easily and safely reused. Materials passports may also be piloted for existing buildings in order to help understand the quality and lifespan of the materials used. This would be relevant for buildings requiring maintenance and renovation, but especially for the country's large building stock that is close to reaching the end of its life. During these pilot projects, the Slovak Republic could also test different types of materials passports, which can take the form of an excel sheet, an online platform interacting with an SQL database, or even a distributed blockchain-based ledger. Nevertheless, a general best practice guide for implementing materials passports in practice has recently been published by Heinrich and Lang (2019[137]).

The Slovak Republic might further consider integrating the pilots of these digital solutions with modular and reversible building designs. Once again, a number of pilot projects implemented in other countries exist. These include the modular pilot scheme for citizen housing in the UK (Constructing Excellence, 2020[138]) and the reversible construction of buildings from an office to a shop, to an acoustic laboratory in Belgium (BAMB, n.d.[139]). More information on these pilot projects is provided in Annex E.

Use and renovation of buildings

While additional strategies exist to improve the circularity of buildings in their use phase (e.g. space-sharing strategies), the Slovak Republic could focus its efforts on increasing the use of secondary and renewable materials in the renovation of buildings and on revising zoning regulations in some cities to allow for a more intensive and flexible use of buildings.

Encouraging increased use of secondary and renewable materials (such as wood) in renovation

Extending the life of buildings through renovation has been a policy focus in the Slovak Republic for the past three decades. Renovations of the building stock have been continuously undertaken since the early 1990s. They have been primarily targeting energy efficiency by improving thermal insulation, modernising technical equipment and installing more energy efficient technologies for heating and cooling. The LTRS establishes long-term renovation objectives as a part of the EU renovation wave, while the RRP has the renovation of buildings as one of its core elements (including public buildings, government buildings [healthcare and education] and historically protected buildings). However, these documents do not

sufficiently encourage the sustainable or circular renovation of buildings[11], including the use of more secondary and renewable materials.

Renovations offer opportunities to deploy circular strategies beyond energy efficiency improvements. However, the transition towards a sustainable circular renovation of building stock currently faces political and economic barriers along with a lack of awareness (Giorgi, Lavagna and Campioli, 2019[140]). While the need for and potential of sustainable or circular renovation is acknowledged, evidence points to a lack of concrete strategies focused on improved material efficiency in renovations. Countries have so far focused only on using GPP to incentivise the use of secondary raw materials in renovation and on adopting selective demolition and waste audits before demolition and renovation to facilitate the use of such materials in renovations (and constructions) (e.g. in line with the EU Construction and Demolition Waste Protocol and Guidelines). National or regional research programmes can also support sustainable renovation by providing incentive subsidies and training. The review of national LTRS across the EU Member States confirms the currently limited focus on renovation policies beyond energy efficiency improvements, with only a couple of countries paying specific attention to sustainable renovations in their long-term renovation strategies (European Commission, 2021[141]). The key example is the LTRS of the Brussels region, in which the Brussels authorities are planning to: (a) launch a study to define a strategy for reusing building materials; (b) set up a "renovation lab" programme to support circular economy renovation projects and raise awareness; and (c) gradually implement mandatory selective demolition (through environmental permits) (European Commission, 2021[141]; Bruxelles Capitale, 2019[100]). The renovation lab initiative ("RenoLab") aims to show the actors across the construction sector, as well as the users of the buildings, the feasibility of sustainable renovation by establishing a network/platform managed by the regional agency, Brussels Environment, to share innovative practices. By launching calls for pilot projects, the initiative also aims to test and develop the tools and the techniques used in the context of sustainable renovation (Bruxelles Capitale, 2019[100]).

In the absence of well-established policy instruments to support a circular economy in renovations, **the Slovak Republic could investigate the potential of using fiscal instruments to stimulate the use of secondary and renewable materials in renovation**, in particular, through tax incentives (tax credits or targeted VAT reductions), as applied in some countries to stimulate energy efficiency improvements (European Commission, 2021[141]). Similar to the Brussels region, the Slovak Republic could establish a sustainable renovation programme supporting pilot renovation projects aimed at increasing the use of recycled or alternative materials. Such a programme could be linked to the recommendation on developing pilot projects to test and apply innovative design principles, as discussed in the previous section. Such a programme would also contribute to achieving the RRP target requiring that at least 70% of all products made of wood used in renovation comes from recycled/reused wood or from certified sustainable forestry.

Revising city zoning regulations to accommodate more intensive use of buildings

Zoning regulations are an integral part of land-use planning as they establish the rules governing the types of activities that are permitted or prohibited on a given piece of land or within a "zone". Typically, they control the development of property and its use. The need to revise the land-use regulation, including

[11] There is no agreed definition of sustainable or circular renovation. Authors of the "Handbook for housing corporations – Circular Renovation (*Handbook Circulair Renoveren Woningcorporaties* have developed their own definition of circular renovation (own translation into English): "The maintenance, renewal and reuse of building (parts – including installations), without the unnecessary need to exhaust natural resources, to pollute the environment and to damage the ecosystems. Renovating buildings in a way that is economically responsible and which contributes to the well-being of humans and animals." The three guiding principles are to minimise, use available and reuse the reusable in order to narrow, slow and close the materials cycles. The handbook was developed on behalf of the North-Holland province with financial support from the Ministry of the Interior and Kingdom Relations of the Netherlands (Stolker and Van Stijn, 2021[236]).

zoning, has received a lot of attention, in particular in Bratislava where the land-use regulation is outdated and unnecessarily limits the construction of apartments, leading to an undersupply of housing and an oversupply of civic amenities (e.g. shopping malls, hotels or offices) (see example ASB (2022[142])).

The Slovak Republic could examine the potential of revising some of the zoning codes to include more flexibility in space distribution and utilisation. The introduction of zoning codes, permitting higher density and more flexibility, can help to enhance buildings use and advance the overall circularity of cities. Flexible zoning has been introduced in Europe but also in the United States. In the United States, zoning allows for exclusive use of land for a certain land use, e.g. residential buildings, whereas in Europe, the use of land often qualifies for mixed use, e.g. residential buildings, with a possibility for retail or office space in some specific areas of that "zone" (Hirt, 2012[143]) For example, Seattle's Housing Affordability and Livability Agenda has embarked on a major initiative to rezone areas in certain parts of the city to include allowances for higher-density development as well as requirements for the inclusion of affordable housing (City of Seattle, n.d.[144]). In these areas, developers of multi-family housing will be able to build at higher densities, but they will also be required to include affordable units on site (Local Housing Solutions, n.d.[145]). Flexible zoning has also been introduced in some European cities with mixed uses of land. For instance, some city level strategies foresee opportunities for repurposing empty buildings to reduce the use of raw materials to build new buildings and extend the life of existing buildings (e.g. the city of Prato in Italy) (OECD, 2020[128]). Other cities have introduced flexible zoning, which allows for mixed uses of land to create opportunities for a more efficient use of space. For example, the area neighbouring the port in Amsterdam in the Netherlands has flexible zoning to introduce greater flexibility in the buildings' functions and to address structural vacancy. The municipality also uses flexible zoning to support the integration of circular 'hubs' for reuse and repair, or local nutrient recovery facilities within residential areas (Circle Economy, 2019[146]).

End-of-life management of waste and reuse and recycling of materials

The management of CDW in the Slovak Republic is regulated by the Waste Act, with the Waste Prevention Programme (WPP) and the Waste Management Plan (WMP) guiding the implementation of CDW goals and targets. The two main goals target a reduction in the volume of CDW (WPP) and an increase in the preparation of non-hazardous CDW for reuse and recycling, including backfilling operations, to 70% by 2025 (WMP 2021-2025). The evaluation of the WPP for 2014-2018 concluded that the first goal of CDW reduction in volume had not been met. Reducing the volume of CDW therefore remains the goal of the current WPP for 2019-2025 (although the programme fails to set a specific target for such a reduction). Moreover, according to the latest Eurostat data from 2018, the Slovak Republic only achieved 51% recovery rate of CDW (including through backfilling operations) (2022[147]). This low level of preparation of reuse, recycling and materials recovery places the country off-track in reaching the 70% target and ranks it among the worst performing Member States of the EU (Box A E.2 explains the difficulty in calculating the real recovery rate for CDW in the Slovak Republic).

To accelerate the prevention of CDW, encourage a more appropriate use and treatment of CDW and embed circular economy principles within the management of CDW, the Slovak Government is currently implementing a construction waste reform within the RRP's building renovation priority. This reform mandates selective demolition of buildings, as well as its reporting obligations before and after the demolition. Moreover, the reform introduces obligations for generators of CDW to increase recovery and recycling of non-hazardous waste to at least a rate of 70% by weight for all constructions with a built surface over 300 m^2, and increases the landfill taxes for CDW. The reform also envisages the obligation to set up waste sorting sites during constructions and demolitions. It intends to regulate technical standards defining the quality of recycled CDW and regulate the EoW status of some waste streams (Ministry of Finance of the Slovak Republic, 2021[89]). This chapter provides a more detailed insight, along with international good practices, for a number of these measures as these been prioritised for inclusion in the future roadmap.

Reducing landfilling and preventing illegal waste disposal

To reduce landfilling of CDW (including for backfilling purposes) and incentivise recycling, the Slovak Republic needs to reform its current landfill tax system (Box A D.12 in Annex D). In line with the recommendation in Chapter 5, this would also involve further increasing landfill taxes for municipal waste and revising the current system of redistribution of the proceeds from the tax. In April 2022, the Slovak Republic proposed an amendment to the Government Decree No. 330/2018 Coll., which sets the value of landfill taxes for the different waste streams and the distribution of the revenues from these taxes (in effect from 1 July 2022). This amendment increases the landfill tax rates for CDW and industrial waste gradually, from EUR 8 per tonne in 2021 to EUR 25 per tonne in 2022, EUR 30 per tonne in 2023 and EUR 35 per tonne in 2024 of construction waste (and from EUR 7 per tonne of excavated soil in 2021 to EUR 8 in 2022, EUR 10 in 2023 and EUR 15 in 2024). However, the amendment does not change the current system of redistribution of the proceeds from this tax. This may help the country to achieve the EU construction target for non-hazardous CDW reuse and recycling. An example of landfill taxes for inert or construction waste in other EU Member States is included in Annex E.

An increase in landfill taxes should be implemented in combination with the enforcement of waste management regulations so as to prevent an uptick in illegal dumping. Evidence shows that landfill taxes may provide an incentive for illegal landfilling and waste exports (European Commission, 2012[148]). In the Slovak Republic, construction waste represents the largest source of illegally dumped waste, especially waste from the building and reconstruction of private housing (OECD, 2017[5]). Therefore, in order to prevent the further rise in illegal dumping, the Slovak Republic should combat illegal landfilling and the dumping of waste through a number of different approaches implemented in parallel. These could include a combination of awareness-raising, a mandatory pre-demolition audit, and better enforcement and supervision mechanisms (including a higher probability of being sanctioned). In terms of preventive measures, the Slovak Envirostrategy 2030 outlines the intention to strengthen the co-operation between municipalities and police, clean up incriminated locations, punish offenders, monitor illegal waste incineration, and extend the responsibility of property owners for illegally disposed waste (Ministry of Environment of the Slovak Republic, 2019[7]).

European Member States implemented regulatory responses to tackle illegal dumping as a result of higher landfilling taxes. For instance, Austria organised large awareness and information campaigns, increased control and enforcement activities, and improved the electronic recording of waste streams and waste management (European Commission, 2012[148]). To fight illegal dumping from the building sector, France introduced an Extended Producer Responsibility (EPR) scheme for building construction products and materials, starting from 1 January 2022 (Box A E.12). The marketers of construction products and materials will be required to organise within streams to ensure the free recovery of sorted waste, including windows, carpets or concrete. France also intends to install new professional waste collection centres where sorted materials (by professionals) will be taken back for free (Journal Officiel de la République Française, 2021[149]; Ministère de la Transition Écologique, 2020[150]). To improve the monitoring of waste streams and prevent illegal disposals, Belgium introduced a mandatory pre-demolition inventory of the types/quantities of materials present in buildings (to identify hazardous and other waste fractions) (Giorgi, Lavagna and Campioli, 2018[92]). A number of other countries are tackling fly-tipping and large-scale illegal landfilling and illegal waste movements across borders with better enforcement, including more effective control and prosecution of abusive practices. For instance, the Czech Republic aims to improve conditions for law enforcement authorities to prevent and combat waste-related crime through a short-term national strategy. This aims to improve co-operation among the environmental law enforcement agencies, strengthen their qualification, improve the regulatory environment, and build public awareness of waste-related matters (Ministry of the Interior of the Czech Republic, 2019[151]). In terms of specific punitive regulations, offenders are often pursued and they also have to pay the landfill tax (Fischer, Lehner and McKinnon, 2012[152]; European Commission, 2011[153]).

Removing legal obstacles for using recycled materials and increasing the use of recycled and reused CDW

In order to strengthen the recycling and subsequent reuse of CDW at the end-of-life phase of a building, besides increasing the landfill taxes for CDW, the Slovak Republic introduced legislation removing legal obstacles for using certain recycled construction materials and mandating selective demolition for larger construction sites (envisaged in the RRP). Additionally, it could also consider implementing an EPR scheme for specific construction products.

Removing legal obstacles through the adoption of EoW criteria

Reducing legal uncertainties regarding waste treatment not only helps fight against waste violations it also contributes to increasing the safe use of secondary raw materials. In particular, EoW criteria establish rules on when waste ceases to be waste and when it attains secondary raw material or by-product status (EU Waste Framework Directive 2008/98/EC). The revised Waste Framework Directive recommends the implementation of EoW criteria to promote a level playing field for secondary raw materials (EU Waste Framework Directive 2008/98/EC). On the EU level such criteria have been adopted for certain waste streams (including iron, steel, aluminium and copper scrap and glass cullet), whereas individual Member States may decide to grant a by-product status to additional waste streams. This can be done either through the introduction of binding national criteria or through single case decisions. Moreover, when designing EoW criteria, it is important to adapt these to local needs and regulations. Legislation granting EoW status for various construction and building materials currently exists in Austria, Belgium, Bulgaria, Croatia, the Netherlands and the UK. The specific CDW types targeted by these countries include bricks, tiles, building waste, building and demolition wood, inert waste, concrete rubble and various slags, to name a few (European Commission, 2020[154]).

The Slovak Waste Act 79/2015 Coll. defines materials and products that are not considered as waste at their end of life but as by-products (including uncontaminated soil and other naturally occurring materials excavated during construction works). To further increase the reuse of materials from CDW, **the Slovak Republic needs to implement EoW criteria for some additional construction and building materials**. According to some of the consulted stakeholders, EoW criteria should be developed for stones and milled asphalt. The CDW reform under the RRP (which will to come into effect from 1 July 2022) covers uncontaminated soil, milled asphalt mixture and construction materials (Ministry of the Environment of the Slovak Republic, 2022[155]). At the time of writing this report, construction materials have not been specified in detail. This could possibly include concrete, bricks and tiles, which, according to the statistics, represent the second largest category of CDW (BRE, Deloitte, FCT, ICEDD, RPS, VTT, 2017[86]). Subsequently, the obtained aggregates could then be considered for uses in building and construction works, especially for road construction, bound surfaces or concrete and asphalt mixes. A specific case study on mineral CDW, used as building material under EoW status, has been analysed in a recent report (European Commission, 2020[154]). An earlier report by the Joint Research Centre (JRC) of the European Commission developed a general methodology for determining EoW criteria as well as potential criteria for pilot case studies, including aggregates and metal scrap (Delgado et al., 2009[156]). The different definitions, uses, restrictions and technical standards, which the Slovak Republic could build upon in the development of the EoW criteria, are summarised in Annex E.

Mandatory selective demolition

While CDW prevention is targeted through design and material choices in construction, the Slovak Republic can increase the recovery of high-quality fractions from CDW and their high-grade recycling by **introducing a mandatory selective demolition, including a system of inspection/audit before and after demolitions take place** (as already foreseen by the CDW reform). Through selective demolition, the country can recover pure waste fractions, free of contamination and impurities, for recycling and reuse.

The pre-demolition audit will help identify hazardous materials for removal prior to the demolition and thus facilitate the assessment of their recycling potential. The waste sorting may take place either directly at demolition sites or at dedicated sorting facilities for mixed construction waste. The inventory of materials and elements can be facilitated by digital product passports (as discussed in a previous section) and by photographic documentation (as already foreseen in the WMP 2021-2025). A systematic enforcement of mandatory selective demolition rules is necessary to ensure its uptake and compliance.

In the EU, the revised Waste Framework Directive has recommended the implementation of selective demolition (EU Waste Framework Directive 2008/98/EC). A number of countries, including Belgium, Denmark, Finland and Sweden, have already established legal requirements for materials and their specific separation of CDW at the demolition site (European Environment Agency, 2020[112]). In Nordic countries these requirements are applied to wastes such as brick/tiles, concrete, glass, paper, plastics, insulation (Wahlström et al., 2019[157]). Some examples are outlined in Box 6.2. The sustainability of selective demolition depends on several factors, such as the logistical and economic aspects of local markets for recycled materials, the possibility of dismantling, disassembling and subsequent reuse of the materials, as well as political aspects, such as regulations or incentives (Pantini and Rigamonti, 2020[158]). Moreover, selective demolition requires additional time, space and skilled labour that can be seen as constraints in some cases. To help identify the materials at source, monitor sorting processes and involve reuse and recovery channels for deconstruction materials, the Slovak Republic should consider implementing a selective demolition certification system, establish a collaboration platform and introduce technical standardisation. Examples of such initiatives implemented in Austria, Belgium and France are reported in Box 6.2. In addition, Annex E describes an international good practice on how to identify waste from the demolition and refurbishment of buildings.

Box 6.2. Good practice examples of selective demolition

Selective demolition enables the removal and safe handling of hazardous substances, facilitates reuse and high-quality recycling, and contributes to the establishment of sorting systems for a number of materials, such as wood, mineral fractions, metal, glass, plastics and plaster (EU Waste Framework Directive 2008/98/EC). The process consists of four phases: (a) identification of hazardous materials and decontamination; (b) deconstruction; (c) dismantling and demolition; and (d) sorting.

When successfully applied, selective demolition can recover high-quality materials for reuse or recycling such that only a small fraction of rejects and hazardous waste would have to be disposed.

- In Denmark, bricks from old buildings are carefully dismantled and reused, saving on both energy and use of virgin materials. Based on Life-cycle Assessment methods, the estimated savings in GHG emissions is on average around 0.5 kg CO_2-eq per brick. In order to overcome price differences between virgin and secondary materials, the reusable bricks market had to be supported by the Danish Environmental Protection Agency. Reclaimed bricks are also common in Belgium, which are often used for aesthetic purposes (European Environment Agency, 2020[112]).
- An experimental project to renovate a site in Greater Paris offers an example of selective deconstruction in a confined space. The project took six months of deconstruction work and achieved an almost 75% recovery rate and the separation of nine waste flows for reuse and recycling (Recycling Today, 2013[159]).

Demolition inventory

Tracimat is a traceability system composed of online tools and databases. Developed in Flanders (Belgium), it provides quality assurance for the selective demolition process, including the following elements: pre-demolition inventory; monitoring and supervision of flows; and a certification system for

CDW materials from the selective demolition. This certificate guarantees that the CDW has been separately collected and passed through a tracing system. The resulting aggregate can subsequently be treated as “low environmental risk material” with a significant cost reduction for the recycling plants (European Commission, 2016[160]; Hradil et al., 2019[161]).

The Brussels region also plans to draft and implement regulations that require a pre-demolition inventory as part of their LTRS (Bruxelles Capitale, 2019[100]). The region plans to gradually impose this obligation by starting with larger demolition sites (e.g. larger than 2 000 m^2) to smaller sites (e.g. larger than 500 m^2), and from public buildings to private buildings. The operationalisation and monitoring of selective demolition will be achieved by setting minimum rates of recycled and reused materials (using their BAMB tool to set the percentages).

Valorisation chain

Established in France, Democles is a collaboration platform that brings together stakeholders from across the value chain. It aims to improve waste management practices in heavy rehabilitation and demolition projects by providing an overview of the valorisation chain of non-stony material fractions (such as flat glass, plasterworks, mineral wool). It also provides information on the acceptance criteria of individual materials fractions, as well as serving as a guide on the integration of waste requirements in tenders and framework contracts for demolition works (Hradil et al., 2019[161]).

Technical standards

Introduced by Austria, the technical standard ÖNORM B 3151 defines the actions for the design and execution of selective demolitions and outlines the essential steps from pre-demolition audit to mechanical deconstruction. It describes the process of investigation of harmful substances and contaminants, and their removal before the actual demolition of the construction structure. As a result, the remaining waste streams become pure, making their recycling process more efficient (Hradil et al., 2019[161]; Office of the Provincial Government of Styria, 2020[162]).

Extended Producer Responsibility (EPR) for construction products

An EPR for the built environment can help shift some of the costs of managing the high volume of construction waste and incentivise design changes that facilitate the reuse or better recycling of CDW. Modulated EPR fees could encourage several design considerations that can improve end-of-life outcomes for buildings and materials, including: (a) modular building designs that facilitate reuse; (b) the use of materials passports; (c) ease of disassembly; (d) the use of recycled or reused secondary materials; or (e) the deployment of life cycle assessments (LCAs) to inform design choices (Benachio, Freitas and Tavares, 2020[163]).

The design of EPR for the built environment poses challenges. One challenge for EPR implementation in the construction sector is the long lifetime of buildings, roughly 60-90 years (Pomponi and Moncaster, 2017[164]). In addition, a building can have multiple ownership or purpose changes during its lifespan, which further complicates design for reusability. Furthermore, CDW constitute materials streams at a scale that exceeds waste volumes of other products for which an EPR has traditionally been applied (Pomponi and Moncaster, 2017[164]). The EPR initiatives addressing this waste stream have occasionally failed, notwithstanding the development of a number of studies and pilot projects on this subject (e.g. in Canada) (EPR Canada, 2017[165]).

Despite these challenges, a small number of countries have considered the implementation of EPR in this sector. France introduced an EPR scheme for marketers of construction products and materials for the building sector (the manufacturers of windows, carpets or concrete) from 1 January 2022 (Box A E.12 in Annex E). The measure expands existing collection points that freely take back building materials waste

from professionals and establishes schemes for waste recovery from the crafts industry and private individuals (Ministère de la Transition Écologique, 2020[150]). Japan's EPR law for construction materials (Construction Material Recycling Law) dates back to 2001 and includes the setting of recovery targets for concrete, wood and asphalt concrete (Ogushi and Kandlikar, 2007[166]). For these three materials, the law requires contractors to sort out and recycle CDW generated in a demolition or to use recycled CDW in construction works, while meeting certain thresholds (i.e. in size or value) (Ministry of the Environment Government of Japan, n.d.[167]). The law also provides obligations around demolition. Norway has implemented a mandatory take-back scheme for double-glazed windows with sealant containing polychlorinated biphenyls (PCBs) (OECD, 2011[168]).

The Slovak Republic could consider expanding EPR to construction products or specific renovation waste in the future (e.g. flooring, dry walls, window glass, brick, asphalt roofing and engineering/treated wood). Evidence on the implementation of such schemes is currently limited, but more examples of international good practices might come to light in the future. In France and Japan, these schemes also aim to tackle the illegal disposal of construction waste, which might be an important benefit for the Slovak Republic to consider given its ongoing challenges in this regard.

Concluding reflections on the key policy recommendations

This chapter explored and analysed the various policy instruments that could enhance the circular economy transition in the Slovak construction sector as well as the different phases of the building's life cycle, prioritising 15 policy recommendations (Box 6.3) (see also Annex E). The findings show that there is considerable scope for modifying existing instruments, including the GPP, the landfill taxes, or the thematic focus of incentive subsidies to enhance or introduce incentives for circularity in building construction and renovation. There is also scope for introducing new policy instruments, in particular those targeting the upstream parts of the building's life cycle (extraction, design and construction), including quality standards for recycled construction materials as well as aggregates taxes, but also those targeting the downstream stages (end-of-life, reuse and recycling), such as mandatory selective demolitions, additional EoW criteria and EPR for some construction products or materials. Besides these policy instruments specific to the different parts of the building's life cycle, there is also a need for better data collection to understand the existing building stock (residential, non-residential and its renovation needs) as well as the CDW flows until their final destination (to understand the real recovery rate of CDW). A closer engagement with relevant stakeholders from the private sector through multi-stakeholder collaboration could also help policy makers design and implement more effective policies.

Box 6.3. Overview of policy recommendations to shift towards a circular construction sector by 2040 in the Slovak Republic

Strengthening evidence-based policy making and multi-stakeholder collaboration

- Improve the measurement and monitoring of CDW flows from producers to final waste processors.
- Develop a comprehensive overview of the national building stock and its renovation needs.
- Strengthen the collaboration and partnerships between stakeholders from across the value chain.

Policy recommendations related to extraction, design and construction phases

- Consider introducing an aggregates tax to discourage the extraction of construction minerals.

- Introduce a quality standard for recycled construction materials.
- Introduce minimum recycled content requirements for specific construction products.
- Increase the use of GPP criteria in the construction sector to stimulate the market for the construction and renovation of sustainable buildings, possibly including minimum recycled content requirements as a GPP criterion.
- Encourage business model innovation for accessing secondary materials and for developing new recovery processes and technologies.
- Use future construction projects as pilots to test and apply circular economy principles and innovations.

Overview of buildings use and renovation-related policy recommendations

- Investigate the potential of using fiscal instruments (tax benefits or subsidies) to stimulate the use of secondary and renewable materials in renovations.
- Examine the potential of revising some of the zoning codes to include more flexibility in space distribution and utilisation.

Overview of policy recommendations related to end-of-life, reuse and recycling

- Gradually increase the landfill taxes (in place from July 2022), and reform the redistribution of proceeds from the landfill tax in combination with greater waste management enforcement.
- Remove legal obstacles to the use of recycled materials by implementing EoW criteria for some additional construction and building materials (in place from June 2022).
- Introduce mandatory selective demolition, including a system of inspection/audit before and after demolitions take place (in place from June 2022).
- Consider expanding EPR to construction products or specific renovation waste.

The analysis puts forward a circular economy policy package for the construction sector, whose priority for the future roadmap consists of six policy actions, which are already planned within the RRP reform around CDW (they were partly put in place during the time of writing this report), and nine additional policy actions across three types of policy instruments, split into potential short- and medium-to-long-term measures (Table 9.3 and Table 9.4). The suggested short-term measures connect well to existing efforts and policies (namely the RRP), thus representing next steps towards circularity in the construction sector that are already planned or could be integrated within existing policy instruments (e.g. the incentive subsidies under the Partnership Agreement 2021-2027). The long-term policy measures define more advanced steps, requiring more strategic considerations, preparation and changes at the governmental level, and mostly targeting the upstream part of the building's life cycle. These are required to unleash the full potential of the circular economy in the Slovak construction sector.

From a circular economy perspective, policy actions targeting extraction, design and construction aimed at CDW prevention should be prioritised over policies targeting buildings use and renovation, and the end-of-life phase, including reuse and recycling. By applying this waste hierarchy, only when CDW prevention cannot be achieved and the lifetime of a building cannot be extended (e.g. through repurposing or renovation), reuse and recycling strategies need to be implemented to re-integrate construction materials into the economy.

7 Roadmap to Circularity in the Food and Other Bio-waste Value Chain

This chapter provides an overview of the food and other bio-waste value chain and its circular economy potential in the Slovak Republic from the perspectives of primary plant and animal (feed) production, food and non-food production, processing, distribution and consumption, as well as the management of food waste and other bio-waste. It also identifies the most important levers to help the Slovak authorities transform the food and bio-waste value chain into a more circular sector. This chapter does so by analysing the existing circular economy-related policy landscape in the Slovak food and bio-waste sector by identifying ten potential focus areas for improvement and by suggesting concrete policy recommendations for the future roadmap (or other relevant policy documents) to address the identified areas. The recommendations are also enriched by findings from relevant international good practices.

Definitions and concepts

Defining food waste and bio-waste

The analysis in this chapter adopts the legal definitions of food waste and bio-waste, as specified in the revised EU Waste Framework Directive (rWFD) (EC/2018/851), to define food waste and bio-waste. Legal definitions of both food waste and bio-waste build on the definition of "waste" as specified in the EU Waste Framework Directive (WFD) (EC/2008/98), as amended by Directive EC/2018/851 (revised WFD), and on the definition of "food or foodstuff", as specified in the EU Regulation on the general principles of food law (EC/2002/178)[12]:

- **Food waste:** "[...] all food as defined in Article 2 of Regulation (EC) No. 178/2002 of the European Parliament and of the Council that has become waste" (EC/2018/851, art. 3.4.a).
- **Bio-waste**: "[...] biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants" (EC/2018/851, art. 3.4).

[12] **Food or foodstuff**: "[...] means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. 'Food' includes drink, chewing gum and any substance, including water, intentionally incorporated into the food during its manufacture, preparation or treatment. It includes water after the point of compliance as defined in Article 6 of Directive 98/83/EC and without prejudice to the requirements of Directives 80/778/EEC and 98/83/EC". 'Food' shall not include: (a) feed; (b) live animals unless they are prepared for placing on the market for human consumption; (c) plants prior to harvesting; (d) medicinal products within the meaning of Council Directives 65/65/EEC (1) and 92/73/EEC (2); (e) cosmetics within the meaning of Council Directive 76/ 768/EEC (3); (f) tobacco and tobacco products within the meaning of Council Directive 89/622/EEC (4); (g) narcotic or psychotropic substances within the meaning of the United Nations Single Convention on Narcotic Drugs, 1961, and the United Nations Convention on Psychotropic Substances, 1971; (h) residues and contaminants" (EC/2002/178, art. 2).

Prior to 2018, there was no official EU definition of food waste other than being included in the definition of “bio-waste”, as defined in the WFD. The current legal definition of food waste implies that food waste is any food that has become waste under the following conditions:

- It has entered the food supply chain.
- It has then been removed or discarded from the food supply chain or from the final consumption stage.
- It has been destined to be processed as waste.

Food waste can comprise items that include parts of food intended to be ingested (edible food) as well as parts of food that are not intended to be ingested (inedible food) (European Commission, 2021[169]). The WFD and its amending Directive from 2018 (EC/2018/851) do not set out decisive criteria for determining the meaning of the term “discard”. Within the corresponding Delegated Decision establishing a common EU methodology to measure food waste adopted on 3 May 2019 (European Commission, 2019[170]), it becomes clear that the destination of the discarded food residues supports the definition of food waste. When applying the waste hierarchy to food, residual resources from the food value chain, which are used as animal feed or bio-materials, are not considered as waste (Figure 7.1).

Food versus bio-waste value chains

While food waste and other bio-waste share a common starting point from biomass materials, their value chains do not entirely overlap. Bio-waste, as became clear from its definition, includes food waste but also organic waste from gardens and parks, which does not belong to the agri-food system (e.g. cut grass from roadsides can be viewed as bio-waste). Other bio-waste from the landscaping chain has a very specific origin and will not enter the food system in any way.

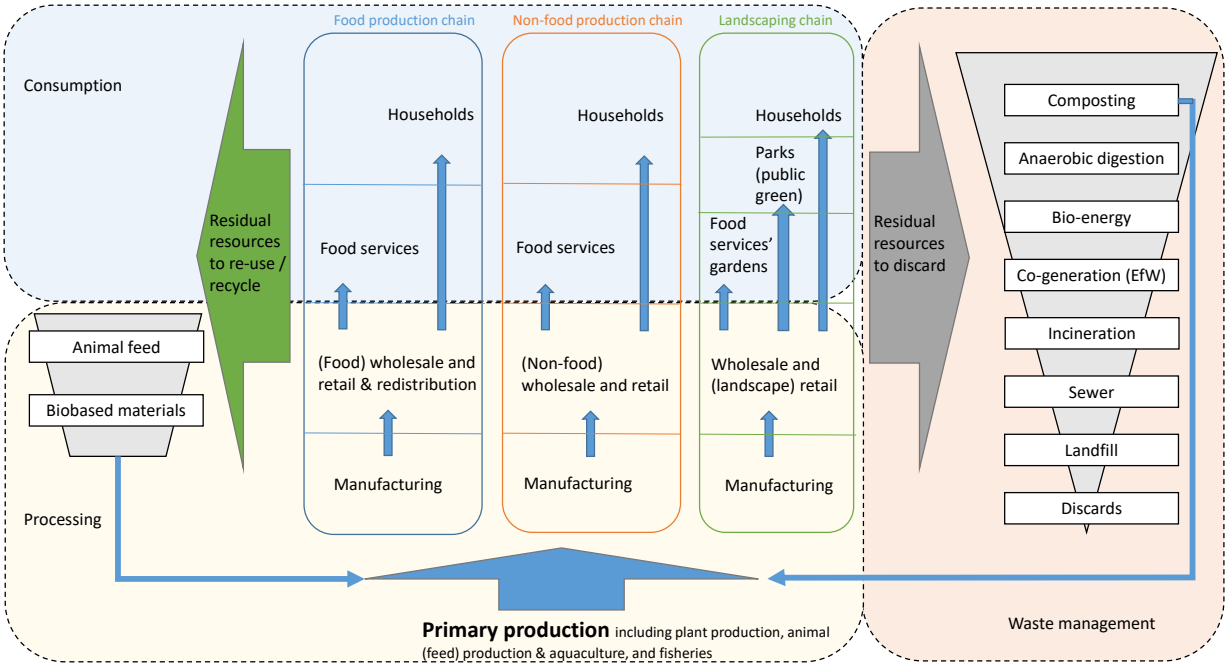
The processes along the food and other bio-waste value chain include (Figure 7.1):

- **Primary Production**. Plant production, animal (feed) production and aquaculture, and fisheries (raw materials of animal or vegetable origin).
- **Manufacturing**. A series of industrial activities aimed at processing, conversion, preparation, preservation, certification and packaging of fresh and processed foodstuffs. Related manufacturing includes the chemical industry, the energy industry and the packaging industry (secondary sector).
- **Wholesale and retail**. Wholesale includes the business of selling goods in large quantities to retailers. Retail is the sale of goods or services from a business to a consumer for their own use.
- **Redistribution**. Process whereby surplus food (that might otherwise be wasted) is recovered, collected from donor organisations and provided to people, in particular to those in need via backline (e.g. food banks) and frontline (e.g. charities) organisations.
- **Food services**. Preparation and serving any meal outside the home. For the landscaping chain, food services contribute to the flow of resources and bio-waste not through the preparation and serving of meals themselves but through their interior and exterior green spaces and decoration.
- **Households**. Storing, preparing and consuming meals at home. For the landscaping chain, households contribute to bio-waste through their interior and exterior green spaces and decoration.

Food waste and other bio-waste are those residual resources (intermediary state of resources between the intention to discard and the allocation of destination) that are allocated to waste management, including composting, anaerobic digestion, bio-energy (e.g. biodiesel), co-generation (EfW), incineration, sewer, landfill and discards. If residual resources are re-used or recycled, via animal feed or bio-based materials, they are not considered as waste. Food waste can only be derived from residual resources that are originating in the food production chain. Bio-waste encompasses food waste and additionally includes the residual resources directed towards waste destinations within the other biomass chains (non-food production chain and landscape chain). The non-food production chain includes, for example, the use of

dedicated crops for bio-materials, biofuels or pet-food, which are then used within a similar chain of actors. However, the “consumption” stage within non-food and landscape does not involve ingestion by humans.

Figure 7.1. Schematic visualisation of actors, processes and flows of resources in the food and other bio-waste value chain in the Slovak Republic

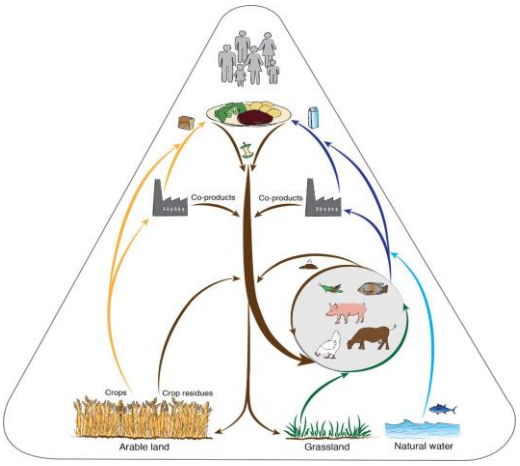


Role of the bio-economy in transitioning to a circular economy

The EU’s Circular Economy Action Plan defines circular economy as an economy “where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised” (European Commission, 2020[3]).

Enabling a circular economy means bridging gaps between loops that could not be closed before. The transition to a circular food and bio-waste economy is essential for a sustainable future. A circular bio-economy uses fewer natural resources, has lower emission levels, and will improve the nature-inclusivity and biodiversity of the food system compared to current systems. Any circular (bio-) economy approach is characterised by the measure of inclusiveness of value chains and partnerships, the setting of appropriate objectives and envisaging an appropriate long-term vision with a credible time horizon, coupled with concrete targets in the shorter term. However, the food and bio-waste sector is different from other material resources due to its signature “perishable” characteristic. Metal can be re-melted and it will stay metal but closing the loop for organic materials involves shifts in substance and composition within the agri-food cycle. The circular bio-economy is based on three leading principles:

Figure 7.2. Visualisation of a circular food system



1. Circular food systems are built on plant-based biomass obtained from land and water.
2. By-products from plant-based biomass, known as waste flows, are to be avoided. If this is impossible, they must be redirected back into the bio-economy, with healthy soil as a priority. Furthermore, they can be used as biomaterials or animal feed.
3. The function and role of animals is to return biomass that is unfit for human consumption back to the food system.

Source: Van Zanten, Van Ittersum and De Boer (2019[171]).

The food system is one of the most frequently targeted priority areas in national circular economy strategies given its high consumption of land, water and energy, as well as its large production of waste (Salvatori, Holstein and Böhme, 2019[32]). Within the EU's Circular Economy Action Plan and the European Green Deal, food waste and the sustainability of the food system are indicated as priority areas.

The available estimates show that the levels of food waste and other bio-waste generated annually in the EU and its Member States are cause for concern**.** Bio-waste accounts for more than 34% of the municipal solid waste generated, amounting to 86 million tonnes in 2017 in the [then] EU-28 (European Environment Agency, 2020[172]). Around 88 million tonnes of food waste were generated in 2012 across the food value chain, representing approximately 20% of all food produced within the EU. Its associated costs were estimated at EUR 143 billion in 2012 (Stenmarck et al., 2016[173]). The most recent estimates of European food waste levels reveal that 70% of EU food waste originates in the household and the food service and retail sectors, with production and processing sectors contributing the remaining 30% (Stenmarck et al., 2016[173]). Moreover, food waste is inextricably linked to the pressures associated with finite natural resources, the state of the environment and climate change. It also represents significant financial costs and losses, as food waste is produced for human consumption but is never actually consumed.

Circular economy strategies applied in the food and bio-waste system generally consider all stages of the value chain:

- Starting from the primary sector with land and water use, and opportunities for using recycled fertilisers or organic farming techniques.
- Moving on to processing and manufacturing with a focus on, for instance, efficient energy use and packaging.
- Moving on to distribution with sustainable transport and stocking practices.
- Ending with a shift in consumer behaviour towards more circular consumption patterns, including shaping choices around consumption and waste disposal practices.

Moving from a linear food system towards a circular agri-food system poses challenges to all stakeholders of the system. It requires a shift in strategic attention from the "back-end" of the system, i.e. waste management, towards the "front-end" of the full agri-food value chain, from production to consumption and beyond, including how resources are produced, used and redirected ("re-fed") back into the system. A country can take many directions to successfully close the bio-economy loops and to minimise food waste and bio-waste.

Overview of Slovak food waste and bio-waste generation and treatment

Even though efforts have been taken within the EU and the Slovak Republic to establish baseline data on food waste since 2010, the available estimates are often debated due to the many gaps in primary data collection and data quality issues. The systems behind the collection of and reporting on waste statistics were traditionally designed not to accommodate dedicated food waste and other bio-waste data. It was not until 2018 that the EU adopted an official legal definition of food waste within the revised WFD (rWFD), and it was not until 2019 that the EU adopted a common EU methodology to measure food waste. Consequently, the baseline data on food waste, based on the EU common methodology, was collected for 2020, but will only be reported to the European Commission from 2022 (Box 7.1).

Box 7.1. Developments in measuring food waste in the EU

The first preparatory study on food waste across the EU-27 countries was only published in 2010 (Monier et al., 2010[174]), which defined food waste as a subset of bio-waste, containing raw or cooked food materials, and food loss before, during or after meal preparation in the household, as well as food discarded in the process of manufacturing, distribution, retail and food service activities. The methodology used also excluded agricultural food losses, which have been left out of the EC waste legislation since the 1970s, as these residues were considered to be part of the agricultural policy and legislation.

In 2018, the EC published a “monitoring framework for the circular economy” (European Commission, 2018[175]), which included an indicator on food waste. However, methodologies for collecting the data and calculating the food waste based on the indicator, which was submitted to Eurostat, differed among the Member States as they were free to choose their own methodology to report on the food waste indicator. The differences between Member States may be significant, as methodologies may disclose by-products, green waste or tobacco in the data in some cases, or data could be missing for some sectors in some Member States.

An EU legal definition of food waste was only adopted in the revised Waste Framework Directive in 2018, followed by the Delegated Decision establishing a common EU methodology to measure food waste adopted in 2019 (EC/2019/1597). According to these two pieces of legislation, the Member States need to monitor and assess the implementation of their food waste prevention measures in line with the common EU methodology for 2020 data onwards, with a first reporting to the EC by mid-2022. The Delegated Decision lays down a format and quality check report for reporting the data on the levels of food waste generated in Member States. Eurostat, supported by the EU Platform on Food Losses and Food Waste (European Commission, 2016[176]), has developed a questionnaire and a guidance document (European Commission, 2021[169]) to help Member States’ experts with measuring their national food waste levels. The guidance document lays down important information on reporting food waste data, including an overview of best practices, as well as standards and guidelines for waste composition analysis.

The Slovak Republic collects and reports on the different fractions of biodegradable municipal and industrial waste, including separately collected biodegradable municipal kitchen and restaurant waste, separately collected biodegradable municipal green waste, and biodegradable waste emanating from the different industries (Ministry of Environment of the Slovak Republic, 2021[26]). However, these data do not differentiate between generated food waste and other bio-waste.

Estimates indicate similar patterns of food and other bio-waste generation in the Slovak Republic as in other EU Member States – but more recent data is lacking

The Slovak Republic has no recent publicly available estimates of food waste generation as a separate fraction of biodegradable waste. Based on the latest and most complete publicly available estimates to date in Monier et al. (2010[174]), which uses 2006 waste management data as the reference year, the amount of food waste per capita in the Slovak Republic amounted to approximately 109 kg per capita per year across the food value chain and approximately 25.2 kg per capita per year at the household level (Table 7.1). Compared to the EU-27 average, the Slovak Republic recorded a relatively larger share of food waste from the production sectors and a lower share from households. The share of food waste from retail and from food services and restaurants is comparable to the EU-27 average (Table 7.1). Annex F reports on some additional available household food waste estimates for a number of EU Member States from several sources. As the methodologies to measure household food waste levels differ per study, comparisons of food waste levels between the studies cannot be made. More recently, the EU FUSIONS project collected publicly available food waste data from across the EU Member States (typically with 2012 as the reference year), but the data provided by the Slovak Republic were largely incomplete or missing (Stenmarck et al., 2016, p. 64[173]).

Table 7.1. Food waste estimates in the Slovak Republic

Based on Eurostat data, 2006 reference year

Sectors	Sub-sectors	Food waste (kg)	Source	Food waste (% per sector)	Source	Food waste (kg/cap./yr.)	Source
EU-27							
Manufacturing		34,755,711	a	39%	b	70	b
Households		37,701,761	a	42%	b	76	b
Other		16,820,000	a	19%	b	n.a.	n.a.
	Retail	*4,463,874*	*	*5%*	*b*	*8*	*b*
	Food service /catering	*12,498,846*	*	*14%*	*b*	*25*	*b*
Total		89,277,472		100%		179	c
Slovak Republic							
Manufacturing		347,773	a	59%	g	65	d
Households		135,854	a	23%	g	25	e
Other		105,000	a	18%	g		
	Retail	*47,895*	*f*	*8%*	g		
	Food service/catering	*64,564*	*f*	*11%*	g		
Total		589,000	a**	100%	g	109	g
		596,086	f***				

Notes: "a" page 12 (Monier et al., 2010[174]); "b" page 13 (id.); "c" page 11 (id.); "d" page 48 (id.); "e" page 56 (id.); "f" page 59 (id.); "g" calculated by Wageningen Food & Biobased Research based on available data from page 12 and/or page 59 – 100% is based on other sectors excluding retail + food service/catering; * calculated from b; ** rounded, actual sum = 588,627; *** total sum when using page 59 data.
Source: Adapted from Monier et al. (2010[174]).

Regarding municipal bio-waste, the Slovak Republic generated a slightly lower level of municipal bio-waste per capita and a slightly higher share of bio-waste in municipal waste compared to the EU-27 averages in 2017 (European Environment Agency, 2020[172]). There are also different estimates of the composition of bio-waste in mixed municipal waste. Nevertheless, bio-waste fractions within municipal waste remain

significant (Euractiv, 2021[177]). Measuring bio-waste, including food waste coming from the industry, is also challenging. Eurostat reports on a number of waste categories, which could be classified as bio-waste, for the different economic activities (the economic activities are reported under the NACE classification codes) (see Annex F). While a comparison between EU Member States and the EU-27 average is difficult due to data gaps and possible under-reporting and estimation flaws, the Slovak Republic generates more waste per capita from agriculture, forestry and fishing than the EU-27 average or its Visegrad 4 (V4) peers (Czech Republic, Hungary and Poland). This is evident, in particular, for vegetal wastes, animal faeces, urine and manure, and waste excluding major mineral wastes. Conversely, the generation of animal and mixed food waste, vegetal waste, and waste excluding major mineral waste from the manufacture of food products, beverages and tobacco products, is comparable to the per capita levels found in the Czech Republic but is lower compared to the per capita levels of its other V4 peers or the EU-27 average. Table 7.2 shows the available estimates of bio-waste generation in the Slovak Republic.

Table 7.2. Municipal bio-waste data

Indicator	Slovak Republic	EU-27 average	Source
Municipal bio-waste (2017)	150kg/capita	180kg/capita	European Environment Agency (2020[172])
	42% share in municipal waste	37% share in municipal waste	European Environment Agency (2020[172])
Separately collected municipal green waste (2018)	200 000 tonnes (9% of total municipal waste)		Ministry of Environment of the Slovak Republic (2021[26])
Separately collected biodegradable municipal kitchen and restaurant waste (2018)	19 000 tonnes (1% of total municipal waste)		Ministry of Environment of the Slovak Republic (2021[26])
% share of bio-waste in mixed municipal waste	6% food waste and 39% other bio-waste (total 45%) (2018-2019)		ENVI-PAK (Vandák and Krasnec, 2019[178])
% share of bio-waste in municipal waste	Around 20-25% kitchen bio-waste (2021) and around 40% total bio-waste)		INCIEN (Euractiv, 2021[177])

The Slovak Ministry of Environment also reports on biodegradable industrial waste for the different industries. In total, around 1.3 million tonnes of biodegradable industrial waste was generated in 2018 (Ministry of Environment of the Slovak Republic, 2021[26]). This included biodegradable waste from agriculture and forestry (around 500 000 tonnes, of which 400 000 tonnes came from animal faeces, urine and manure), the wood and paper industries, and the different food and beverages industries. These data also do not differentiate between food waste and other bio-waste.

But the country is lagging behind its EU peers in diverting food waste and other bio-waste from landfills

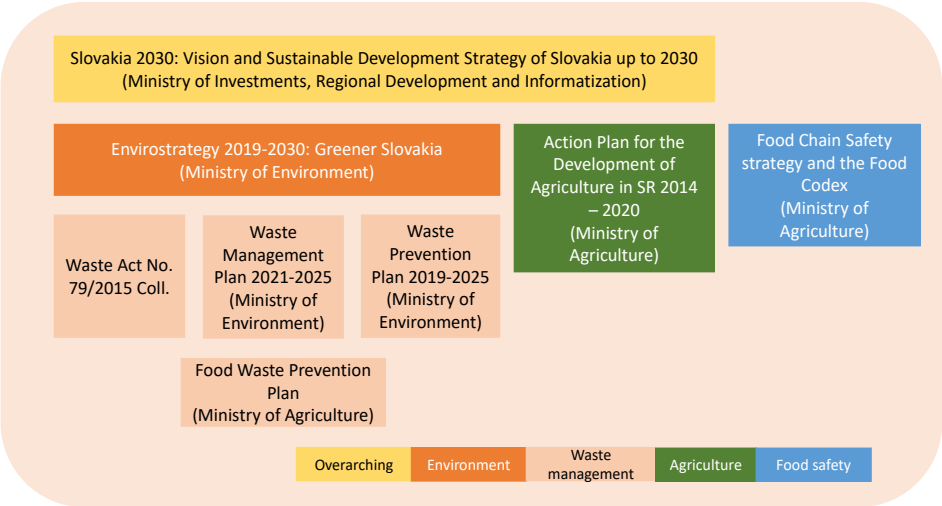
When it comes to the management of food waste and other bio-waste, the Slovak Republic is lagging behind its EU peers. This is particularly the case for municipal waste where, in 2020, 49.6% ended up in landfills compared to the EU average estimate of 23% (Eurostat, 2022[68]). As food waste and other bio-waste is a major waste stream in municipal waste in the Slovak Republic (and across European countries), an improved separate collection and recycling of bio-waste will be crucial to achieving the overall EU recycling targets for municipal waste by 2035 (European Environment Agency, 2013[179]). Recent data show that the country recycled (by composting or anaerobic digestion) only 59 kg per capita of biodegradable municipal waste in 2020 (an increase from 39 kg per capita in 2018) compared to an EU-average estimate of 90 kg per capita (Eurostat, 2021[180]).

Slovak policy and legal context relevant to food and bio-waste

The Slovak Republic has adopted a number of strategies and pieces of legislation relevant to the food and bio-waste value chain (see Figure 7.3). These are aligned with the relevant EU legislation and policy (see Annex A for an overview of the relevant EU legislation) and include a number of additional national targets and obligations (outlined below) adopted by the Slovak Republic to help the country meet the EU targets and goals.

- Reduce the share of biodegradable municipal waste within mixed municipal waste to 25% by 2025 (Ministry of Environment of the Slovak Republic, 2021[26]).
- Increase the separate collection rate of municipal waste to 60% by 2025 (Ministry of Environment of the Slovak Republic, 2021[26]).
- Decrease by 50% the amount of mixed municipal waste by 2025 compared to 2016 (Ministry of Environment of the Slovak Republic, 2018[27]).
- Decrease by 60% the amount of biodegradable waste in mixed municipal waste by 2025 compared to 2016 (Ministry of Environment of the Slovak Republic, 2018[27]).
- Implement mandatory separate collection of biodegradable municipal waste by mid-2021, and the latest by 2023 (by all municipalities).
- Ban waste for landfilling that has not been treated by 2023 and that can be incinerated for energy recovery by 2027 (Waste Act No. 79/2015).

Figure 7.3. Overview of Slovak regulatory framework for the food and bio-waste value chain



Biodegradable waste, including food waste, are high on the waste management policy agenda

As food and other bio-waste represent a significant loss of valuable resource with high economic, environmental and social impacts, it has become urgent to meet the food and other bio-waste EU targets as a policy priority. The cross-sectoral nature of food and other bio-waste underscores the need to target all levels of the food value chain, from producers and consumers to waste management, so as to ensure maximum impact and collaboration between government, and private and societal stakeholders.

The Slovak Republic has in place a regulatory framework in the areas of food safety, agriculture and waste management to address food waste and biodegradable waste in general (see Figure 7.3 and Box A F.1 in

Annex F), and to help the country fulfil the relevant EU obligations. The Slovakia 2030 Sustainable Development Strategy up to 2030 (Ministry of Investments, Regional Development and Informatization, 2020[9]) is the key overarching strategic document outlining key changes and measures to achieve sustainable development in the Slovak Republic by 2030, including the protection and development of resources (in waste and agriculture). The Envirostrategy 2030 (Ministry of Environment of the Slovak Republic, 2019[7]) aims to achieve better environmental quality and a sustainable circular economy. One of its goals is to limit biodegradable and food waste production by 2030 in line with the EU's Circular Economy Action Plan and UN SDG target 12.3 (by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses). The Waste Management Plan 2021-2025 (Ministry of Environment of the Slovak Republic, 2021[26]) and the Waste Prevention Plan 2019-2025 (Ministry of Environment of the Slovak Republic, 2018[27]) introduce specific targets and obligations for biodegradable waste with the overall aim to increase the recycling of municipal waste and prevent waste in accordance with the waste hierarchy. It is the first time that the Slovak waste management strategies address the topic of food waste as an important waste stream. The Waste Act No. 79/2015 Coll. has gone through a number of amendments, which introduced additional obligations on municipalities and other actors in the waste management services to increase the recycling and recovery rates of biodegradable waste, including food waste, and to limit the landfilling of such waste. The specific national Food Waste Prevention Plan presents a national long term plan to prevent and decrease food waste and food losses in the Slovak Republic along the entire food value chain (Ministry of Agriculture and Rural Development of the Slovak Republic, 2016[28]). The key objective of the Action Plan for the Development of Agriculture 2014-2020 (Ministry of Agriculture and Rural Development of the Slovak Republic, 2014[181]) is to create sufficient resources and favourable conditions for livestock production and high-yielding crop production, and to ensure the prerequisites for their further development, effectively increasing the performance of the Slovak agriculture and food industry, including higher employment.

In addition to these directly relevant national strategic programmes related to food and other bio-waste, food safety is another important policy area to mention within this context. This includes the Food Chain Safety Strategy (Slovak Republic, 2013[182]) and the national Food Codex. These policy instruments aim to provide for the safety of the entire food chain, starting with plant and animal production systems (phytosanitary and animal health), to food safety aspects, including safety requirements, risk assessment and testing, and the co-ordination of activities by competent authorities. Typically, food that is deemed unfit for human consumption on the basis of health and safety standards will leave the food value chain and, consequently, is not considered as waste, in the strictest sense, even though from a legal point of view it is classified as food waste and it will be discarded as such. From the EU perspective, food safety is of primary importance with regard to food and human consumption. Any measure taken to prevent or reduce food waste should not lead to unsafe food or feedstuff.

The existing regulatory framework for bio-waste offers a wide range of measures, but most are not yet fully implemented

The review of the above regulatory framework for food and bio-waste identified more than 40 measures spanning the entire food and other bio-waste value chain (Table A F.3 in Annex F). These measures cover a wide range of topics, including animal feed, food safety, food donation, but also instrument types, such as date marking, capacity-building, economic incentives, educational programmes, information provision, monitoring requirements, separate waste collection and legislation. The measures have been classified into six main areas based on earlier work by Wageningen University & Research (WUR) and its contributing partners, including FUSIONS 2015 (Vittuari et al., 2015[183]), REFRESH 2018 (Wunder et al., 2018[184]), EC Guidelines on food donation and food redistribution project 2020 (European Commission, 2020[185]) and Changing the Rules of the Game 2020 (Bos-Brouwers et al., 2020[186])). The areas of work include: (a) target setting and monitoring; (b) cross-sectorial voluntary collaboration and multi-stakeholder

partnerships; (c) prevention measures; (d) consumer behaviour; (e) animal feed; and (f) recycling and waste management. Of the 40 measures identified, almost half (19) were prevention measures, followed by 8 target setting and monitoring measures, 6 consumer behaviour measures, and 6 recycling and waste management measures. Only a couple of measures relate to collaboration among stakeholders and focus on the management of animal feed.

More importantly, only four measures were assessed as fully implemented with a monitoring framework in place. These measures relate to food safety (the adoption of the Food Chain Safety Strategy and the Food Codex) and to food waste prevention (identifying the causes and opportunities of food waste and putting food waste prevention on the policy agenda). The majority of measures (26) were assessed as partially implemented, meaning that a measure has been identified but is not yet in effect, or that a measure is at a very preliminary stage of implementation. This includes measures related to the quantification and analysis of food waste, collaboration and co-operation among stakeholders or the separate collection of bio-waste, among others. The implementation of several measures in the areas around animal feed or food waste prevention has not yet begun.

Stakeholders raise concerns about the effectiveness of the Slovak regulatory framework for achieving existing targets

Within the context of the analysis, 11 stakeholder interviews[13] and a stakeholder webinar (with around 30 participants) took place to collect views on the current state of the sector, among other things, and on the effectiveness of the Slovak regulatory framework for food and bio-waste to reach the relevant EU targets. While the stakeholders felt that the country had made considerable progress over the last decade in increasing the level of sorted food waste and other bio-waste, and in diverting such waste away from landfill to composting, the stakeholders raised concerns about the prospects and the readiness of the country to achieve the relevant EU targets. The key barriers were identified around the need to make the legislation more coherent and more responsive to the needs of industry and municipalities, as there was an apparent lack of inter-ministerial co-ordination and approach to consider the views of the relevant stakeholders in the design of legislation and policies.

The stakeholders expressed their concern about the Slovak Republic achieving the relevant EU targets without additional changes to the existing regulatory framework. The stakeholders were of the opinion that the regulatory framework needed to support more investments in waste management infrastructure, for example, public funding and shorter planning procedures for new installations, possibly with a revision of the Environmental Impact Assessment Act to allow for faster procedures in infrastructure projects, as well as financial support for new technologies, including renewable energy technologies. In addition, the market demand for the digestate coming from the production of bio-gas, as well as compost, need to be considered in the regulatory framework when setting up measures to increase their production. Municipalities thus have a key role to play in food waste prevention strategies and therefore also require better instructions and documentation to develop communication and incentive programmes for their residents, as they do not necessarily have the capacity to do this work themselves. The stakeholders also felt that the food donation regulatory framework and the current system of waste reporting could be improved, for example, by simplifying the recording and reporting of waste data or the rules related to food donations.

Gap analysis and policy recommendations along the value chain

Ten key areas for improvement were identified thanks to the analysis of the existing regulatory framework for the food and other bio-waste value chain in the Slovak Republic, the stakeholder consultation, and the

[13] Respondents included representatives of the industry (manufacturing sector, retail, and food services), waste management, municipalities, NGO and academia.

evidence gathered from identified examples of international good practices (Annex F). The ten identified policy gaps and the related policy recommendations are structured along the food and bio-waste value chain, but they also include areas that cut across the entire value chain.

The waste hierarchy, as used by the European Commission, is also applied in this chapter to prioritise the policy recommendations. This hierarchy prioritises waste prevention over food donation, animal feed, anaerobic digestion, composting, incineration and landfill.

Towards a more participative and evidence-based policy framework

International best practices often refer to the Target-Measure-Act approach to developing strategies and roadmaps (Flanagan, Robertson and Hanson, 2019[187]). Multi-stakeholder collaboration across the full value chain is also at the core of a successful food and bio-waste strategy for a circular economy. Evidence shows that joint vision and joint action are needed to create commitment and to achieve the overarching goals and targets, as the underlying causes and challenges of bio-waste are complex and interlinked with other issues related to food health and safety as well as to food resilience and security. In such an intertwined value chain, each stakeholder has a role to play but cannot act without collaborating with other relevant actors. Making progress towards targets and monitoring is also crucial in policy making. Without a solid base of evidence on food waste and other bio-waste it would be difficult to identify and intervene in the areas that government need to address.

The Slovak Republic has to some extent taken up measures in its food and bio-waste regulatory framework to support cross-sectoral and multi-stakeholder collaboration as well as target-setting and monitoring (Table A F.3 in Annex F). However, the vast majority of these measures are at their early stage of implementation and additional efforts will need to be undertaken in these areas to support the implementation of circular economy strategies in the Slovak food and bio-waste value chain.

Stimulating multi-stakeholder collaboration across the food and other bio-waste value chain

The Food Waste Prevention Plan as well as the Action Plan for the Development of Agriculture 2014-2020 recognise the need for co-operation between actors in the food chain and government authorities, namely with regard to reducing and quantifying food losses and food waste. Such co-operation is also envisaged in the form of a National Platform on Food Losses and Food Waste (Ministry of Agriculture and Rural Development of the Slovak Republic, 2016[28]). While this national platform was established in 2016, with the aim of supporting the implementation of the Food Waste Prevention Plan[14], the platform's actions and outcomes are not yet visible and further efforts are needed in this area. Some of the consulted stakeholders also showed interest in enhancing collaboration across the food and bio-waste value chain, in particular, with government authorities. The need to strengthen inter-ministerial collaboration between the Ministry of Environment and the Ministry of Agriculture and Rural Development of the Slovak Republic was specifically highlighted by a number of stakeholders.

The Slovak Republic will need to strengthen multi-stakeholder collaboration across the entire food and bio-waste value chain, including with relevant experts, knowledge institutes and ministerial departments. This could be achieved by making the national platform on food losses and food waste more publicly active or by creating a dedicated stakeholder sub-group for the food and bio-waste sector within the broader circular economy stakeholder group set up for the preparation of the future roadmap (suggested by some of the consulted stakeholders). The broader stakeholder group could discuss the alignment of cross-cutting strategies and activities from sectoral and material resources perspectives or identify potential bottlenecks and conflicting ambitions. The food and bio-waste sub-group could further

[14] The platform was established by decision of the Ministry of Agriculture and Rural Development of the Slovak Republic based on point D. 1 of the Government Resolution No. 467/2016 of the Government of the Slovak Republic.

discuss the implementation of existing and planned measures, whose implementation would benefit from improved collaboration on issues of communication, financing and legislation in line with food and bio-waste objectives, though separate discussions and negotiations would have to take place between the relevant ministries (the Ministry of Environment and the Ministry of Agriculture and Rural Development).

In line with activities of the EU Platform on Food Losses and Food Waste, the sub-group could be further split into task forces addressing and further developing specific activities, for example, on monitoring, business engagement within and across value chain segments, consumer behaviour or legislation/regulatory barriers. The food and bio-waste sub-group should have a balanced representation across the value chain and stakeholder type, for example, it could include a mix of associations, large companies, SMEs, NGOs, knowledge institutes, or representation from various relevant ministries as well as regional or municipal government. Some of the consulted stakeholders recommended that the food and bio-waste sub-group be assigned a formal status and legal mandate to cover the whole period until 2030 as well as receive funding to support the professional organisation of the sub-group.

To build partnerships that drive change, the Slovak Republic can tap into the guidance provided by the EU REFRESH project (2019[188]), if possible with the support of (international) experts with experience in building voluntary agreements. In the featured 5-step model, stakeholders can work together to achieve real change more rapidly and cost-effectively (see Box A F.4 in Annex F).

Addressing challenges in measuring food waste and other bio-waste

As highlighted in this section on Slovak food and bio-waste generation and treatment, major data gaps and data quality issues exist in this area. Under the relevant EU reporting obligation (Box 7.1), all EU Member States need to report on food waste data for 2020 by June 2022. In this regard, countries, including the Slovak Republic, have started to introduce initiatives that would help measure food waste and address the existing data challenges. The majority of identified cross-cutting policy instruments in the Slovak Republic focus on target-setting and monitoring, including those listed in the national Food Waste Prevention Plan (Table A F.3 in the Annex F). The identified measures include those around the development of methodologies and procedures as well as measures to establish and acquire funds for the collection of accurate data on food and other bio-waste. To achieve these objectives, the Slovak authorities have supported a number of studies and initiatives in recent years, including a household food waste diary study in which a group of 456 respondents self-recorded their daily amount of discarded food in a diary over a period of one month (NPPC, 2017[189]), as well as further efforts led by the Food Research Institute of Slovakia to develop quantification methods to estimate the levels of food waste generated and avoided, and the final destination of food waste if it cannot be avoided. As most measures in this category have not yet been fully implemented, this amplifies the urgent need to improve data collection, quality and reliability.

Although the Slovak Waste Act No. 79/2015 includes a definition of food waste since 1 July 2020, a key challenge is the absence, to date, of a dedicated food waste category within the existing national statistical data collection. This means that further statistical estimations have to come from available data, such as municipal waste statistics collected by the Slovak Statistical Office. This challenge is not unique to the Slovak Republic, as almost all EU Member States will need to increase their efforts to produce the required reports on food loss and food waste levels in line with the revised WFD requirements, as described in the Delegated Decision to the revised WFD.

The Slovak Republic needs to stimulate the collection of more data in order to obtain a highly granular understanding across the food waste and other bio-waste value chain. Measures that result in better measurements, reporting and other statistical information across the value chain are greatly valued by stakeholders. The stakeholders consulted even wished to go beyond voluntary reporting (as is the current practice in the underlying EU legislation) to ensure data transparency through mandatory reporting (Table A F.5 in the Annex F). Improved data collection can be enhanced by: (a) improving reporting methodologies; (b) creating a waste catalogue containing multiple criteria, including waste compositional

data, environmental impact and other sustainability indicators; (c) installing a competent authority for the collection, validation and public reporting of data; and (d) stimulating benchmarking, transparency and the levelling of information asymmetries across ministries and the value chain segments.

Collecting data on such a highly granular level to report on primary production, processing and manufacturing, retail and other food distribution outlets, restaurants and food services, as well as households, will require additional collaborative efforts with the concerned stakeholders. To date, organisations such as INCIEN (Institute of Circular Economy) and Free Food (NGO) have been contributing to data collection from households, restaurants and the food services sector in the Slovak Republic.

Experience with other Member States on food waste data collection has shown that the implementation of data collection measures is not an easy task and will take several years to be fully established. Besides the known barriers related to quality, level of detail, validity and representativeness of data, the stakeholders need to be committed, show willingness and wish to prioritise the development of data retrieving systems, sharing data with the appropriate authorities. Examples from other countries indicate that countries lack the will to measure food waste owing to: (a) low awareness of the issues; (b) no perceived benefits; (c) knowledge, capacity and funding gaps; and (d) not knowing how to use the data. In addition, stakeholders do not want to share data, nor see any benefit in doing so, for reasons of confidentiality and a perceived loss of strategic advantage. Several examples of international practices can be found in the Eurostat guidance on the reporting of data on food waste and food waste prevention (European Commission, 2021[169]) and on the EU Platform on Food Losses and Food Waste (the sub-group on food waste measurement) (European Commission, 2016[176]). An analysis of the challenges encountered in these initiatives indicate a lack of common standards in the measurement and reporting of food waste and loss, the high costs associated with waste compositional analysis, an underestimation in self-reporting of household food waste, high drop-out rates, and issues related to the representativeness of sample sizes, among others.

To implement the above described recommendations, the Slovak Republic could benefit from learning from the challenges encountered in other Member States, and from reviewing and applying the mentioned resources in their efforts (see also Box A F.6 in the Annex F).

The development of an integrated quantification approach and methodology covering the full value chain from primary production to households, including bio-waste destinations, in line with EU methodology, is also needed. Requirements that determine a successful implementation could include:

- A binding industrial commitment with signatories covering a representative portion of the Slovak economy and significant market share.
- Utilising a highly granular methodology, specifying a set of standard product categories and bio-waste destinations and developing a set of (sub) sector-specific templates.
- Applying appropriate quantitative measurement methodologies, including mass balancing and compositional analysis.
- Appointing an independent scientific body that works closely with industry and competent government authorities to co-ordinate and support measurements and monitoring that annually reports information on an aggregated level to comply with EU and national requirements, as well as creating industrial sector benchmarks that support the identification of hotspots within product categories and supply chain segments.

Much effort will be needed to create a valid and representative baseline on food waste and other bio-waste quantities in the Slovak Republic. In the long term, the country can also invest efforts in the quantitative evaluation of the impact of measures and interventions with regard to volume, and environmental, economic and social parameters. This evaluation of interventions has been described by the Joint

Research Centre of the EC and is promoted by the EU Platform on Food Loss and Food Waste (European Commission, 2016[176]).

Strengthening the circular economy policy framework for food producers and retailers

Governments could take numerous actions to strengthen their circular economy policy frameworks for food producers and retailers.[15] During its first mandate, the EU Platform on Food Loss and Food Waste developed a set of recommendations for Member States and segments of the value chain to address food losses and food waste (Annex F). Several of the recommendations addressed the primary sector, the manufacturing sector, the retail sector, the food services sector, and food donations. The key instruments could be structured along four main goals (see Table 7.3).

Table 7.3. Key instruments to support a circular economy in food production and distribution

Goal	Policy instrument	Short description
1. Ensuring food safety, including appropriate date marking	Regulatory instruments (requirements)	Aimed at providing for the safety of the entire food chain, starting with plant and animal production systems (phytosanitary and animal health), towards feed safety and food safety aspects, including requirements, risk assessment and testing, and the co-ordination of activities by competent authorities. From the EU perspective, food safety is the primary priority with regard to food and human consumption. Any measure that is taken to prevent or reduce food waste should not lead to unsafe food or feedstuff.
2. Preventing food waste along the food production chain	A variety of instruments	Aimed at reducing side flows at source throughout the food value chain, including preventing food overproduction (better planning of supply and demand). Often economic instruments (e.g. green public procurement, tax incentives and subsidies) are needed to stimulate resource efficiency and food waste prevention in food production and distribution parts of the value chain. Information instruments are also needed.
3. Facilitating food redistribution of unsold food	A variety of instruments	Aimed at redirecting unsold food towards redistribution/donation measures to people in need via social entrepreneurs or charitable organisations. There are often legal barriers, including those related to safety concerns, to donate unsold food to charitable organisations for further human consumption. Economic instruments to stimulate food donation are also needed (e.g. value added tax reduction for such activities).
4. Stimulating market uptake of side-flows valorisation for other applications	Regulatory instruments (requirements)	Aimed at stimulating market uptake of side flows valorisation towards high-level applications, including for animal feed or production of bio-based materials. There are often legal barriers to processing unsold food for animal feed or other applications.

It is apparent when assessing the extent at which these four goals are captured by the Slovak policy landscape that policy instruments related to food safety are fully implemented within the Slovak regulatory framework as these relate to the EU legal requirements (e.g. EU General Food Law and the WFD). Nevertheless, the planned revision of the date marking labels (i.e. the removal of the "best before" date as proposed by the Envirostrategy 2030) might need to be reconsidered. While the current Slovak policy landscape recognises that food waste prevention and reduction measures are needed to reduce environmental impacts related to food waste generation, most Slovak legislation and policies focus on food waste management and on facilitating food donations. This can be seen from the introduction of separate collection obligations and landfill bans, and from the recent revisions of legislation on food donations. From the viewpoint of waste prevention and reduction, better "end-of-pipe" management does not prevent or reduce food and other bio-waste. A major challenge for the Slovak Government will be to create a positive normative environment for businesses to become waste-free as the normal way of doing business. This means stakeholders viewing the existence of side flows as an entrepreneurial opportunity to create new

[15] Gap analysis and policy recommendations related to production activities focus only on food and kitchen waste, as other bio-waste (i.e. biodegradable garden and park waste) is less relevant for this segment of the food and bio-waste value chain.

business models for the circular economy instead of a necessary cost. In order to achieve a circular economy, companies need to transit from linear to circular ways of thinking. The Slovak Government can contribute to this new approach by facilitating the actions driven by business stakeholders and NGOs in the food value chain in combination with more top-down oriented support to organise cross-sectoral collaboration to identify and promote the development of new business opportunities. The next sub-sections dive into each of the four goals to identify measures the country could take to provide such support.

Understanding food health and safety in relation to food waste generation and reduction

The analysis of the Slovak policy landscape has shown that national health and safety regulations are in line with EU obligations and standards. As health and safety regulations can play a double role in safeguarding food, but also in reducing food waste, addressing the setting of norms (including tolerance levels on the level of contamination allowed in food) and regulatory standards, as well as managing compliance with them, becomes crucial. Due to technological progress, the detection methods to track contaminants, and other risks related to food safety, has become increasingly sensitive to the point where it has become increasingly rare not to detect any contaminants or encounter other food safety issues. In other words, if tolerance levels remain very low and the detection of contaminants markedly improves through cutting edge technology, then the scientific basis of tolerance levels might need to be reconsidered, otherwise an excessive number of non-compliant readings could result. Moreover, compliance officers should be able to harmonise decisions with respect to food safety hazards and not be dependent on various interpretations of the same standards.

A health and safety regulation that could potentially greatly reduce food waste when adjusted is date marking. Date marking is predominantly aimed at ensuring that food is safe to eat (in the case of “use by” date) or that its quality is assured (in the case of “best before” date). Date marking is linked to food waste when consumers interpret “best-before” to mean “use-by” date, discarding the food product too early even though it is still safe to eat. A market study on date marking and food waste prevention (European Commission, 2018[190]) estimates that up to 10% of the 88 million tonnes of food waste generated annually in the EU is linked to date marking, in particular, to the consumer misinterpretation of the meaning "use by" and "best before" dates. Consequently, the European Commission will propose a revision of EU rules on date marking by the end of 2022, as called for by the new Farm to Fork Strategy. In doing so, the European Commission aims to prevent food waste linked to the misunderstanding or misuse of these dates, while ensuring that the proposed changes meet the information needs of the consumer without jeopardising food safety.

The Slovak Republic may wish to reconsider the announced plan to remove the “best before” date and to fully replace it by the “use by” date for foodstuffs that may still be suitable for consumption if stored well. This measure is proposed in the Envirostrategy 2030 as a means to reduce food waste, as food can often still be fit for consumption even after the “best before” date. However, from a legal perspective, this measure appears to be inconsistent with the EU Regulation (1169/2011) on the provision of consumer information, which requires that most pre-packed foods display 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”) (see Box A A.1 in Annex A). As of 1 June 2022, a new legal amendment to the food law should come into force, allowing the sale of certain foodstuffs (if well stored and labelled) beyond its “best before” date, in addition to food donations. However, this amendment does not eliminate the “use by” date marking, which is likely to create confusion at the consumer level with associated risks for people’s health.

More attention to and stronger incentives for food waste prevention are needed

Several food waste prevention measures for producers are in place or planned within the existing policy documents (Annex F), but most relate to the provision of information (e.g. the organisation of information

seminars, the development of guidelines and the provision of professional advice) and to the review of legislation to identify unnecessarily stringent standards that result in food waste. The Slovak Agricultural Plan aims to put in place several economic incentives (e.g. incentive subsidies) to encourage food processing companies to modernise, which would also create incentives for investments in innovation and research. Nevertheless, the country would also benefit from the introduction of more action-oriented measures, which are currently absent from the relevant Slovak regulatory framework or have not yet been fully implemented.

Considering international food waste prevention measures (Annex F), the **Slovak Republic could strengthen the use of economic instruments to provide food producers with incentives to reduce side flows (i.e. by-products or residues) at source and to make stronger use of recycled materials**. The existing Slovak policy framework, including its planned measures, provides starting points for government funding and investments to stimulate a more efficient use of food resources. A regulatory framework can facilitate market development towards circular food solutions in a number of ways, for example, by stimulating GPP of food products and catering services in school canteens and state-owned facilities, such as ministerial canteens and army messes (Box A F.5 in Annex F). Another way could be to use taxation instruments to stimulate the use of recycled materials over 'virgin' materials (e.g. in food packaging) by either applying negative incentives (e.g. taxing less desirable options) or positive incentives (e.g. rewarding desirable options by lowering VAT) to make such applications more economically attractive. In addition, facilitating the use of entrepreneurship funds or start-up support programmes, in combination with showcasing social entrepreneurs that utilise side flows into reprocessed food products via national communication channels (e.g. awards or online promotions), will also strengthen the market development of commercially viable new business models. Lastly, providing scientific and innovation subsidies that target resource efficiency and food waste prevention/reduction measures could also provide the needed economic incentives for producers. Such subsidies could target investment funds towards start-ups and SMEs.

While there is limited experience across advanced economies in using some of the measures (e.g. the use of VAT or other taxes on virgin materials), the use of GPP and financial instruments to support innovation in the food system are well established. The Slovak Republic could focus on economic and financial instruments in the first instance.[16]

However, to implement an effective solution to food waste prevention in the country also requires an understanding of the key challenges. Several challenges potentially lead to food waste and food losses, including planning issues (timing, buying the right amounts of the right quality in line with their intended use), storing issues (shelf life, storing technology, packaging, warehouse capability, logistics), production issues (efficient processing technologies for cutting/washing/cooking/drying, portioning, packaging), consumption issues (desired quality and composition, taste, portion size), or technical issues (are technical solutions currently sufficient or do they require adjustments [or even new designs] of the operations and supply chain?). In the coming years it will be important to not only pay attention to scaling up the bio-gas facilities to deal with bio-waste but also to identify options (with help from stakeholders) on how to prevent and reduce food waste.

Consider other measures to support food donations that are not mandatory

In line with the waste hierarchy, where food surpluses cannot be avoided, the second best option is to prioritise food redistribution for human consumption before food is directed towards animal feed applications. Facilitating food donations is high on the wish list with regard to production measures, which is also reflected in the Slovak policy stocktake analysis. Although the primary objective of food donation is

[16] The Slovak Republic is planning to elaborate a GPP methodology for the food product group in collaboration with the Ministry of Agriculture and Rural Development in 2022.

not food waste reduction but to ensure the availability of good and healthy food to people from vulnerable groups, the potential to divert unsold products to these end-consumers does coincide with food waste prevention goals.

The analysis of the Slovak policy landscape identified a number of existing and planned measures to facilitate the donation of food for charitable purposes. Food donation is exempted from VAT if the value of the donated product is lower than EUR 17 per piece (Value Added Tax Act No. 222/2004). The food legislation was amended in 2016 to accommodate the possible donation of food after the date of minimum durability (i.e. the "best before" date) based on the proposal by the Ministry of Agriculture and Rural Development (Amending Act No. 376/2016 Coll.) for registered organisations, taking effect from 1 January 2017. Lists have been published by the State Veterinary and Food Administration in the Slovak Republic (SVFA) and the Public Health Authority of the Slovak Republic, including a register of charitable organisations that are allowed to redistribute foodstuff that has passed the "best before" date. These foodstuffs are not allowed to be sold by food business operators after their expiry ("use by") date and the date of minimum durability (however, from June 2022 this may change, see below), but they may be transferred free of charge (i.e. donated) by the operator, when deemed safe, to a person engaged in an activity from a charitable organisation. Requirements regarding the storage and transport are indicated, including separate storage, with no changes to prepacked products, and delivery to end-consumers without delay. The food safety liability is transferred from the operator to the charitable organisation from the time of receipt of the food product until it is made available free of charge to the final consumer.

In addition, since 1 January 2020, the value of food donations to NGOs or other social enterprises can be considered a deductible tax expense by companies, irrespective of the presence of the date-marking label on the foodstuffs. Before then, only foodstuffs labelled with a date of minimum durability could benefit from this tax advantage if donated to the Slovak Food Bank (Amending Act No. 301/2019 Coll.).

In 2019, an act was approved that obligated restaurants and supermarkets, with a floor area greater than 400m^2, to donate all their unsold food products (those fulfilling food safety requirements). The act was originally planned to enter into force by 2020 (Amending Act No. 478/2019 Coll.). However, it was first postponed to 1 January 2024, to alleviate the additional burden on businesses during the COVID-19 pandemic, after which it was cancelled. In June 2022, a new legislative amendment is expected to enter into force, which would allow companies to sell food after the date of minimum durability instead of donating it, but this amendment has been met with opposition from some key players in the market.

As mandatory donations may lead to additional challenges, the Slovak Republic may wish to reconsider the introduction of such measures in the future and instead strengthen tax advantages and simplify regulatory requirements to improve the donation of unsold food to charitable organisations. Mandatory food donations have been implemented in a number of EU Member States (e.g. France and the Czech Republic), where similarly – as in the proposed Slovak legislation –retailers with a floor area greater than 400m^2 are obligated to donate unsold food to charities. The evidence suggests that mandatory donations may lead to logistical problems for both retailers and charitable organisations, as the receiving organisations need to have a sufficient organisational and operational capacity to process an increased amount of donations (European Commission, 2020[185]). According to some of the consulted stakeholders, this is also the case in the Slovak Republic. In addition, a business model that depends on free donations might not be viable in the long term. There can also be reputational concerns with surplus food being seen as 'dumped' to food banks, whose clients also want to benefit from healthy food options and not see the food as a leftover solution for the industry. For these reasons, the country should not consider mandatory donations from retail or food services to food banks and other charitable organisations to avoid shifting the food waste burden to other players in the value chain. Donation is one option, but it is not the only way to reuse unsold products. A balance between commercial repurposing and charitable donation can therefore co-exist.

Some of the stakeholders also pointed out that the current legislation in the Slovak Republic does not address food redistribution with no "best before" date marking (e.g. non-packaged food, in particular, fruit, vegetables and bread), which makes up an important share of unsold food. This means that a large quantity of unsold food is diverted away from donations.

To address some of these issues, the recommended EU guidelines on food donation and redistribution (European Commission, 2017[191]) provide information on how to interpret and apply relevant legislation related to food donation. The key measures facilitating food donations include tax advantages, such as the reduction of VAT on donated products (Box 7.2), measures related to food safety and hygiene requirements, and settling the issues of product liabilities or date marking. These guidelines are also available in the Slovak language and could be further developed into a dedicated national guidance document or an action programme, explaining relevant legislation and operational practices in a more user-friendly language and format (e.g. infographics, videos and training documentation). Preparation of such a document would benefit from collaboration with national food banks and charitable organisations, as well as with the food industry, retail and food services.

The announced preparation of a legislative proposal to allow companies to sell food after the date of minimum durability instead of donations can be a sensitive topic. On the one hand, the seller will need to assume product liabilities that run until the expiry date with the producer, which might be appropriate if the envisioned legislation can solve the issue of liabilities. On the other hand, in conversations with retailers and food banks, using/donating food beyond the expiry date is often seen as disrespectful towards both clients and customers in that there is a connotation of sub-standard quality. Thus, even if allowed, more incentives are needed to make the measure effective.

Box 7.2. Examples of potential additional fiscal measures to stimulate food donations

The Slovak Republic already implements a number of fiscal advantages to stimulate food donations (i.e. no VAT on food donations less than EUR 17 per piece of product and the possibility to treat the value of the donated food as a deductible tax expense). Additional fiscal measures adopted across the EU Member States include:

- To consider the monetary value of the donated food to be close to its "best before/use by" date and thus low or zero, equating to a very low or no VAT payable on the donated food (irrespective of the original value of the food product) (e.g. in Austria, Denmark, Germany, Italy and Slovenia).
- To offer corporate tax credits on food donations (e.g. in France 60% and in Spain 35% of the net book value of donated food can be claimed as a corporate tax credit that can be deducted from the corporate revenue tax).
- To offer an enhanced tax deduction where donors can deduct more than 100% of the value of the food at the time of donation (e.g. Portugal has in place an enhanced tax deduction of up to 140% if the food is used for a social purpose and limited to 0.008% of the donor's turnover).

Source: Adapted from European Commission (2017[191]); EU Platform on Food Losses and Food Waste (2019[192]).

Stimulating the market uptake of new valorisation options for side flows (i.e. by-products/residues) from the value chain

If unsold food cannot be prevented or redistributed/donated and is unfit for human consumption, it may still be valorised, including for animal feed or the production of bio-based materials. While the Slovak policies propose the possibility of further exploiting food losses and wasted food as feed, in accordance with the legislation in force, legal barriers exist at the EU level to use side flows from certain origins (retail, food

services and households) or from certain content (e.g. containing animal by-products) as animal feed. In 2021, some restrictions regarding the use of Processed Animal Proteins (PAP) as animal feed covered by the "feed ban" were lifted (European Commission, 2021[193]). Other changes to EU animal feed policy are expected in the coming years.

Until these changes take place (and the Slovak Republic could play an active role to promote such changes), **the country can actively engage and support stakeholders from animal (feed) production to map the available and suitable surplus resources as animal feed that are allowed under the current EU legislation**. In addition to the surplus resources, which are already being converted into animal feed, there are those that are allowed (but are not used) and those that are not allowed but could potentially be used once the EU legal restrictions are lifted, thereby providing numerous options to valorise food surplus into feed. This valorisation could be applied, for example, not only for livestock but also pet food. Examples of measures to support the valorisation of side flows towards high-level applications, such as for animal feed or the production of bio-based materials, include identifying suitable and allowed side flows from the food industry or developing an action programme with stakeholders from the animal production system (farmers and feed industry) to organise logistics and processing. The Slovak Republic could also actively join EC working groups on animal feed legislation to further explore the potential of lifting legal barriers against stringent food safety criteria. The country could also fund supporting research, including: (a) public-private partnership projects with industry; (b) create working groups of interested, front running Slovak stakeholders to develop pilot demonstrations on circular animal feed; (c) promote the creation of a dedicated brand or certificate for circular food products from redirected side flows; and (d) inform the public on their sustainability value to create market demand.

Examples of international good practices in this regard include public-private funded research studies into using food 'waste' as feed from nutritional, food safety, climate/environment, social acceptability and business model perspectives (only Wageningen University & Research is involved in four such studies). The Food Waste Free United Foundation founded the "Circular Feed Centre" that unites Dutch stakeholders to pilot best practices on waste streams that are currently legal but underutilised. The uptake of such initiatives by the EU Member States can help encourage an EU-level reform of regulations that govern the use of animal by-products.

Engaging consumers more in circular food and other bio-waste practices

Circular food systems are directly influenced by consumers and their behavioural decisions (i.e. in terms of what they buy and discard). Consumers therefore play a crucial role in food waste generation and food waste reduction strategies. Similarly, as with activities related to food production, policy instruments directed at consumers and their behaviour can facilitate a number of goals, including food waste prevention and better food waste management, leading towards higher recycling and composting rates of biodegradable municipal waste (Table 7.4).

Table 7.4. Key instruments to engage consumers in more circular food and other bio-waste practices

Goal	Policy instrument	Short description
1. Encouraging consumers to reduce their food waste	Economic instruments and information tools	Aimed at reducing food losses and food waste at source in households, for example, by purchasing no more than needed (better household food management, including measures that build competences in planning, storing and preparation of food in households). Often information tools are needed to inform and educate consumers about food waste prevention strategies (e.g. campaigns and awareness-raising events, education and date marking). Economic instruments, such as pay-as-you-throw (PAYT) based charges for municipal waste, can also provide incentives for households to sort better and thus reduce their mixed municipal waste.

2. Increasing separate collection and sorting of bio-waste, including home composting by households	Economic instruments and information tools	Aimed at incentivising consumers to sort their bio-waste into containers designated for that purpose, which can then be diverted into suitable recycling and recovery applications and away from landfills. Appropriate waste collection infrastructure needs to be in place (e.g. bins or bags), combined with economic incentives to sort the municipal waste (e.g. PAYT), and information tools to raise awareness and educate consumers.

The Slovak Republic has introduced policy instruments directed at consumers to target both food and other bio-waste prevention as well as appropriate waste management practices, including separate collection of bio-waste and home composting. While instruments supporting these goals are in place, the incentives they provide could be strengthened.

Improving the effectiveness of food waste reduction instruments directed at consumers

Analysis of the Slovak policy landscape revealed that most consumer-focused instruments targeting the prevention of food waste and other bio-waste are information-based supports, such as campaigns, education and other awareness-raising tools (Table A F.3 in Annex F). The current strategies focus on common priority areas, such as date marking, social norms and marketing standards. This includes the plan to help consumers better understand the use of date marking (specifically the difference between "use-by" and "best before" dates) by implementing information campaigns and measures aimed at shifting consumer behaviour towards food waste prevention, or to introduce a positive form of motivation (i.e. rewards instead of penalties) that can have a more lasting and far-reaching effect on society than simply providing information and incentives. Furthermore, educational programmes are announced to increase awareness levels among consumers.

The rationale behind such policy choices appears to be, first, that consumers need to be made aware of the problem and their role in it, and, second, once knowledge and skills on food waste prevention is in place (such as portioning, storing and planning), behavioural changes will ensue. However, scientific research indicates that awareness and knowledge alone are not enough to lead to behavioural change and that motivation and opportunity also play an equal role (van Geffen, van Herpen and van Trijp, 2019[194]). Information campaigns are only likely to have an indirect effect on reducing food waste, whereas targeted action, such as to increase the separation of municipal bio-waste at source or economic incentives might lead to more rapid change. Furthermore, announced educational programmes are currently only focused on the separate collection of bio-waste fraction in households or tips to prevent food waste at home, but they are not targeting, for example, out-of-home consumption/dining in restaurants and hotels, catering and other food services.

Considering the large scope for the implementation of additional action-oriented measures for both consumers and households, and **in line with the proposals made by relevant stakeholders, the Slovak Republic needs to improve the effectiveness of its food waste and bio-waste prevention measures at the level of consumers**. Utilising reference materials from international best practices (Annex F), combined with advice from (international) experts on consumer behaviour and the involvement of retail and food services, would help target consumer campaigns and interactive events around action-oriented policy measures. In addition to the creation of the materials, attention must be focused on the target groups and the opportunities for dissemination. The Slovak authorities may wish to organise sessions with (international) experts and behavioural scientists to design campaigns and customise available materials for specific Slovak target groups among professionals and citizens. The Slovak authorities could also collaborate with the food industry and the non-governmental sector on promoting food waste reduction strategies directed at consumers. This could be aimed at changing marketing practices and tactics, which often influence consumers to purchase products in bulk (e.g. price promotions for large packs, buy-one-get-one-free deals or larger servings) without informing or educating consumers about expiry dates (Schneeman and Oria, 2020[195]).

There are many relevant campaign examples in the EU (e.g. on date marking), including communication materials prepared by the EC, which can be used in the Slovak context. International good practices (Annex F) show that information tools and measures to educate and raise awareness about food waste reduction need to consider such aspects as consumer behaviour, motivation, and opportunities in the design of campaigns and events. This could be done, for example, through the integration of behavioural insights, the use of influencers, or through targeted promotions/events by the food industry. An example is the food waste-free week/month campaigns organised in the Netherlands in collaboration with stakeholders from the value chain that drew public and media attention. Other examples include the Dutch consumer campaign on date marking that uses insights on the use of social norms from the REFRESH project ((n.a.), 2020[196]), and the guide produced by the World Wildlife Fund (2017[197]), which has encouraged participation in food waste reduction programmes in the hospitality sector. There is also the guidance developed in the United Kingdom for manufacturers on how to develop food promotions that will not contribute to increased food waste (WRAP, 2015[198]) (see also Annex F). The UK guidance includes such recommendations as integrating waste prevention into promotion planning, adopting standard operating practices, and strengthening communication on waste prevention with supply chain partners at all stages in the management of promotions. As there is scant evidence currently on the effectiveness of these types of instruments, new scientific insights on consumer behavioural change are recommended to design intervention studies aimed at consumers. This not only ensures that awareness and knowledge levels are raised, but also that elements that drive motivation and opportunity contribute towards effective measures.

Economic instruments, such as PAYT-based charges for household municipal waste can also lead to food waste reduction and prevention outcomes as they motivate consumers to reduce the amount of waste they discard (Schneeman and Oria, 2020[195]). PAYT-based charges are discussed in the following section.

Supporting separate collection of biodegradable municipal waste and home composting

From mid-2021, by the latest the end of 2022, municipalities in the Slovak Republic are obliged to separately collect biodegradable municipal waste. For a successful separate collection of bio-waste in municipalities, citizen co-operation is crucial. Municipalities need to be informed about the urgency of waste collection as well as the actions they can contribute. Collection schemes should be easy, accessible and with a high service level. The current Slovak policy landscape recognises the need for awareness-raising and public information and, as such, the country has developed appropriate information instruments.

Households are currently encouraged to sort their bio-waste or to compost, primarily thanks to awareness-raising measures, such as information and educational campaigns, and through showcasing good examples from practice, both from the Slovak Republic and from abroad. The Slovak Republic is also working on the national educational programme on the prevention of biodegradable waste and food waste for individual target groups (citizens, self-government and state administration) (Table A F.3 in Annex F). However, some stakeholders raised concerns about the lack of sufficient support for home composting in the Slovak Republic (e.g. through subsidy programmes) and an absence of a system of controls at the level of municipalities as well as households.

The Slovak Republic can improve its communication and outreach strategies to increase separate collection of municipal bio-waste and home composting by further developing information materials, designing campaigns and sharing best practices through a platform/online portal. There are many examples from international good practices that can be used for this purpose, ranging from targeted campaigns and training, economic incentives (sale of home composters at an advantageous price, or discounts) to reward schemes (Box A F.7 in Annex F). By sharing good practices through a platform, the relevant municipalities and their waste management organisations can help to create a harmonised approach across the municipalities in the country. Differences between municipalities can lead to waste “tourism” or black landfills (illegal dumping of waste). Within the consumer-oriented campaigns,

the country can also pay particular attention to creating a new social norm of sorting bio-waste and home composting by using insights from behavioural research. The online portal should have a clear, designated scope and build on existing inventories and information channels. The resources (and their disclosure) should be easy to search and to find relevant information, as well as the sharing of best practices and guidance materials. This will contribute to the design and implementation of interventions from stakeholders.

The country also needs to allow for flexibility in organising the separate collection of biodegradable municipal waste, including flexible fees and collection schemes for household waste, through, for example, a much wider application of PAYT-based schemes for separate waste collection. The Slovak Republic already implements or plans to implement various economic and financial instruments to stimulate both capacity development (e.g. through incentive subsidies) as well as incentives for separate waste collection and waste prevention (e.g. through PAYT-based charges for households and incentive subsidies for municipalities). The stakeholders consulted for this chapter would welcome such policy instruments. Negative side effects, such as illegal dumping or the contamination of separated fractions with undesirable materials, also need to be considered by policy makers (OECD, 2006[63]). Chapter 5 on the use of economic instruments provides a more in-depth analysis of PAYT-based schemes.

Separate waste collection at source contributes to better waste management, but it does not necessarily reduce the amount of waste produced. It does however allow municipalities to reach goals that are higher up in the waste hierarchy, shifting away from landfill and incineration. Efforts to promote separate waste collection should therefore be integrated with actions that reduce the generation of waste itself.

Improving bio-waste management practices by waste operators and closing the bio-waste cycle

Governments have a number of options to influence food waste and other bio-waste management practices of waste operators and to close the biological cycle of biodegradable materials through processes like composting and anaerobic digestion. These options include introducing legal restrictions and bans, supporting processing and recycling technologies, or removing regulatory obstacles (Table 7.5).

Table 7.5. Key policy instruments to improve food waste and other bio-waste management practices

Goal	Policy instrument	Short description
1. Introducing legal restrictions and bans on bio-waste	Regulatory instruments	Aimed at regulating bio-waste management by obliging waste generators and waste operators to divert bio-waste from landfills. Examples include mandatory separate collection of municipal bio-waste and a landfill ban on bio-waste.
2. Supporting processing and recycling technologies	Economic and financial instruments	Aimed at stimulating investments into processing and recycling technologies. This can be done by incentive subsidies directly, or indirectly, by landfill and incineration taxes. Legal requirements also play a role.
3. Removing regulatory obstacles and strengthening the bio-waste regulatory framework	Regulatory instruments	These include removing legal barriers to waste management (e.g. by removing conflicting permitting and registration requirements) and strengthening the bio-waste regulatory framework (e.g. by introducing relevant legislation and standards for composts).

Legal restrictions, obligations and bans on bio-waste management dominate the current Slovak policy landscape. In line with the EU legislation, the Slovak Republic introduced separate waste collection obligations (mandatory separate collection of biodegradable municipal waste by mid-2021, and the latest by 2023), landfill targets (the landfill rate of municipal waste must be less than 10% by 2035) and landfill bans (ban on landfilling waste that has not been treated by 2023). The overall aim of these measures is to improve the separation of waste at source, decrease landfilling and increase recycling, namely, of

municipal waste, and in turn to achieve the relevant EU waste targets. While these measures are yet to fully take effect, they already have important implications for municipalities and the waste management industry. First, they will require additional investments into waste infrastructure to increase bio-waste processing and composting capacities across the Slovak Republic. Second, they will require a regulatory reform to remove any legal obstacles to bio-waste management, and to set conditions for the production and use of compost and digestate as outputs from the bio-waste processing and composting facilities. The consulted stakeholders emphasised both of these needs, which are discussed in the following sub-sections.

Strengthening financial support for bio-waste processing and recycling technologies in line with circular economy objectives

The consulted stakeholders underlined the need for sufficient financial support for processing and recycling technologies to cope with the increased amount of biodegradable waste that will be diverted away from landfills as a result of the new legal restrictions and bans. Some of the stakeholders would also like to see stronger financial support for biofuel/bioenergy production and storage (Table A F.5 in Annex F). While the Ministry of Environment has recently increased the allocation of subsidies from the Operational Programme Quality of Environment for the construction of bio-waste processing and composting facilities, as well as simplified the rules for applying for such subsidies (Odpady-Portal, 2022[199]), a similar subsidy programme from the Ministry of Agriculture and Rural Development for farmers is still required according to one of the consulted stakeholders.

The Slovak Republic may wish to consider the synergies and complementarities of existing subsidy schemes operated by the different relevant ministries and possibly support additional actors in the bio-waste value chain. This may help ensure that adequate bio-waste and composting facilities are being built, not only to accommodate the needs of the municipalities but also of other actors across the value chain. By promoting anaerobic digestion (AD) and composting (including the composting of digestate), particularly unavoidable organic waste and bio-waste other than food waste bio-waste, the country can move away from landfilling of organic waste (a valuable resource rich in carbon and plant nutrients) and towards closing the biological cycle by using compost and processed digestate as a soil nutrient in agriculture.

However, to achieve the ambition of a circular bio-economy, the Slovak Republic will need to refocus its efforts from bio-waste treatment (AD or composting) towards strategies aimed at higher levels of the waste hierarchy (bio-waste prevention and reduction, and the bio-based economy). The Slovak policy landscape does not indicate how potentially contradicting targets, namely, food waste reduction and bio-energy ambitions, are addressed. For instance, large financial investments into AD capacity can reduce landfill rates but it can also lead to less efforts in resource efficiency due to technological lock-ins when investments into developing new applications (that contribute to waste prevention and the development of a bio-based economy) become less attractive than AD or incineration. In this case, energy transition targets are competing with resource efficiency ambitions.

Developing a supportive regulatory framework for the production and use of compost and digestate

The second key issue identified by stakeholders highlights the need to close the biological cycle of bio-waste by supporting composting and anaerobic digestion in the Slovak Republic's agricultural sector. In the EU, compost is mostly used as organic fertilizer and soil improver in agriculture and horticulture (50%), landscaping and green areas (30%), growing media (e.g. for growing [potted] plants) and export (20%) (European Environment Agency, 2020[172]). Compost plays an important role not only in closing the bio-waste cycle by circulating it back into the soil but also in mitigating climate change impacts (compost stores more CO_2 than the atmosphere and terrestrial vegetation combined (Gilbert, Ricci-Jürgensen and Ramola,

2020[200]). Digestate, on the other hand, can be classified as an organic fertilizer, with its main benefit being a short-term supply of plant nutrients. In addition, biomethane generation during AD processes is an additional valuable source of renewable and carbon neutral energy. The digestate can then be further composted to obtain an organic fertilizer (Gilbert, Ricci-Jürgensen and Ramola, 2020[200]).

The country may want to investigate opportunities to stimulate the creation and further development of market demand for compost and digestate materials in agriculture, and to develop a supportive regulatory framework. The separate collection of organic waste is crucial for its recycling through composting or AD and the generation of quality fertilizers and soil improvers, as well as limiting contamination with heavy metals and impurities (discussed in the previous section) (Gilbert, Ricci-Jürgensen and Ramola, 2020[200]). The capacity and technological requirements for composting and bio-gas facilities must be set optimally. Bio-gas plants must be technologically adapted to collect and process bio-waste, have specialised vehicles, and a logistically sophisticated digestate management system. To close the bio-waste cycle, compost and digestate produced from bio-waste should be of good quality so that it can be used as soil improver or fertiliser (European Environment Agency, 2020[172]). The market for organic fertilisers can also be strengthened (e.g. through increased organic farming). The Slovak Republic has already announced the preparation of a legal amendment introducing requirements for bio-waste processing and composting facilities, as well as for their outputs (including a quality label for compost) in its Waste Management Plan for 2021-2025 (Ministry of Environment of the Slovak Republic, 2021[26]). However, this legislation is not yet in place. Unlike some European countries (e.g. Austria, Italy), the Slovak Republic also does not require the production of composting digestate. As a result, almost all bio-gas plants tend to focus on producing electricity with suboptimal heat recovery and without the use of biodegradable waste (typically using maize silage) according to some of the consulted stakeholders. In this regard, the consulted stakeholders noted that improving institutional collaboration across relevant ministries, and the alignment of complementary support schemes (such as for the instalment of both bio-waste recovery and composting plants for farming), appear crucial. Additional issues specific to the Slovak context include the development of legislation on compost and digestate, the introduction of legal requirements on composting digestate[17] following bio-energy recovery, and the establishment of quality standards and classifications (as foreseen in the WMP 2021-2025). Some stakeholders also flagged that this legislation will need to take into account the latest knowledge about soil and compost microbiology, as well as about the practice of regenerative agriculture.

The proposed legislative framework could follow the example of best practices by leading countries such as Austria or Slovenia (Box A F.8 in Annex F). The proposed framework will need to define requirements not only for the quality of the output product but also for the quality of inputs and the production processes, as inputs and the technological processes are the most important conditions for the final quality of compost. It is also necessary to establish several quality classes of composting (Austrian Ministry for Agriculture and Forestry, 2009[201]). The evidence from other countries confirms that a policy mix of measures is needed to manage bio-waste effectively, consisting of improving separate bio-waste collection (avoiding plastics pollution), implementing national standards for compost and digestate quality, and improving quality management systems (including a positive-list, checklist, product control and application recommendation, which are certified by, for example, the ECN-QAS quality label) (European Environment Agency, 2020[172]).

[17] Composting and anaerobic digestion (AD) may be carried out as mutually exclusive processes, whereby AD produces bio-gas alongside digestate, which can be directly used as organic fertiliser. However, to further enhance benefits to the soil, the residue from AD may be composted through aerobic post stabilisation (Gilbert, Ricci-Jürgensen and Ramola, 2020[200]). Some European countries (e.g. Austria, Italy) introduced mandatory post-treatment requirements for the application of digestate on land (International Solid Waste Association, n.d.[237]). A range of technologies has been developed for digestate processing and full-scale implementation, proving the ability to produce marketable end products (although further technical development is required to minimise operational costs (European Environment Agency, 2020[172])). The term “compost” thus often refers to both compost produced directly from aerobic bio-waste treatment and composted digestate from AD (Commission of the European Communities, 2008[238]).

According to the EEA analysis, of the countries surveyed, 24 have national standards for compost quality, set either in legislation, standalone standards or under development, while a few countries/regions have developed quality standards also for digestate (e.g. Denmark, Flanders [Belgium], Germany, Sweden and the United Kingdom) (2020[172]). The European Compost Network has also released guidelines (2022[202]) to help Member States meet the WFD 2024 deadline for implementing separate bio-waste collection and to improve the quality of compost for agricultural use (for examples see Box A F.8 in Annex F). For municipal waste, pollution with plastic packaging materials is a key component that needs to be addressed, preferably at the household level, as removal during treatment is both expensive and limited in its effect (see the case of Germany in Box A F.7 in Annex F).

Concluding reflections on the key policy recommendations

This chapter analysed the Slovak policy landscape and the different policy instruments that could support the development of a circular economy in the Slovak food and bio-waste value chain. The analysis identified 10 key areas for improvement, leading to 11 policy recommendations (Box 7.3).

Box 7.3. Overview of policy recommendations to shift towards a circular food and bio-waste value chain in the Slovak Republic by 2040

Cross-value chain measures

- Further stimulate multi-stakeholder collaboration across the entire food and bio-waste value chain (e.g. by forming a dedicated stakeholder sub-group within the broader circular economy stakeholder group) and between the relevant ministries.
- Improve data collection to produce a highly granular understanding of food waste and other bio-waste across the food value chain (e.g. by improving reporting methodologies, by creating a waste catalogue containing waste compositional data, and by setting up a competent authority for data management).
- Develop an integrated quantification approach and methodology, covering the full value chain from primary production to households, including bio-waste destinations, in line with EU methodology.

Production related measures

- Reconsider the planned removal of the “best before” date from food labelling.
- Consider strengthening the use of economic instruments to provide food producers with incentives to reduce side flows at source and to make stronger use of recycled materials (e.g. by GPP and incentive subsidies for innovation and research).
- Focus on strengthening tax advantages and simplify regulatory requirements to increase donations of unsold food to charitable organisations.
- Engage and support stakeholders from animal (feed) production to map the availability of suitable surplus resources and their suitability as animal feed, as allowed under the current EU legislation (e.g. by research, public private partnership or a working group).

Consumption related measures

- Strengthen information and education tools on household food prevention strategies, and the sorting of household bio-waste and home composting.

- Expand the coverage of well-designed PAYT schemes across the country to reduce and better sort food waste and bio-waste from households.

Waste management related measures

- Possibly extend financial support for bio-waste processing and recycling technologies to farmers and other actors in the food value chain.
- Develop a supportive regulatory framework for the production and use of compost and digestate in agriculture.

The findings show that there is considerable scope for further development and application of information tools and educational measures, economic and financial instruments, as well as regulatory measures. The Slovak Republic could modify some of the existing instruments, including GPP, incentive subsidies, campaigns or PAYT schemes to enhance existing incentives for the circular food and bio-waste value chain. There is also scope for introducing new policy instruments, namely, those targeting food waste prevention, including campaigns based on behavioural insights and innovative tax credits or VAT reductions. In addition to these policy instruments, specific to the different parts of the food and bio-waste value chain, there is also a need for better data collection to understand the food waste flows across the value chain. A closer engagement with relevant stakeholders from across the ministries, as well as the private sector, through a multi-stakeholder collaboration could also help policy makers design and implement more effective policies. Some of the measures coincide with measures proposed for other priority areas of the roadmap (e.g. suggestions around VAT reduction, GPP and household waste charges, as well as fiscal incentives for research and innovation).

While some of the measures need to be implemented in the short to medium term to fulfil legal obligations and targets (e.g. waste targets and food waste data), other measures aim towards a shift to a circular food and bio-waste economy in the longer term by implementing food waste prevention and valorisation strategies (see the proposal for an implementation plan in Table 9.6 and Table 9.7). For some measures (e.g. information and communication tools or multi-stakeholder collaboration), many examples and guidance documents already exist in EU Member States, which provide the Slovak Republic with valuable examples to support the design of additional campaigns, events and collaboration venues (these are “low-hanging fruit” measures).

8 The Climate-Circular Economy Nexus

The purpose of this chapter is to explore and analyse the linkages between the circular economy and greenhouse gas (GHG) emissions in the Slovak Republic. Global estimates on current and projected levels of GHG emissions linked to materials management activities, as well as the decarbonisation potential of circular economy activities, are presented. Despite differing modelling methods, highest decarbonisation potential is typically found in heavy industry sectors (construction and manufacturing in particular), agriculture and food value chains. The chapter further outlines estimates of GHG emissions related to materials management activities in the Slovak Republic together with assessments of the emissions abatement potential of selected sectors, notably, the construction sector and the food and bio-waste value chain. The concluding remarks summarises key findings on the climate-circular economy nexus in the Slovak Republic.

Links between GHG emissions and circular economy

The links between circular economy and climate change mitigation spurred interest among policy makers. The European Green Deal (European Commission, 2019[2]) and its new Circular Economy Action Plan (European Commission, 2020[3]) explicitly establish a relationship between a circular economy transition and the achievement of a European carbon neutral economy by 2050.

At the national level, several EU Member States have integrated, or plan to integrate, circular economy aspects into their national integrated energy and climate plans up to 2030. The Slovak Republic's Integrated National Energy and Climate Plan for 2021 to 2030 already does so to some extent, as it includes references to a circular economy as a means to achieve carbon neutrality in the country. Moreover, countries worldwide are exploring the options to integrate circular economy into their Nationally Determined Contributions reports of the Paris Agreement (International Resource Panel, 2020[76]; United Nations Development Programme, 2020[203]).

A body of literature also emerged in recent years, which, on the one hand, explored the links between materials/goods and GHG emissions, and on the other hand, the potential of materials efficiency and other circular economy strategies to contribute to climate change mitigation.

The first research strand **links current and projected GHG emissions to materials management activities**.[18] This research provides insights into the GHG emissions associated with the production,

[18] Materials management-related GHG emissions, as defined in OECD (2012[205]), include those associated with the production, consumption and end-of-life treatment of physical goods in the economy. Relevant activities include the extraction and harvesting of resources, the production of goods (including crops and food), the transportation of goods,

consumption and waste management of goods, materials and infrastructure. To give a few examples, already in 2009, the United States Environment Protection Agency quantified potential GHG emissions associated with domestically produced goods and services (U.S. EPA[204]). The OECD developed a methodology to assess the percentage of national GHG emissions associated with materials management activities, and analysed the GHG abatement potential of improved municipal waste management practices in 2012 (OECD[205]). Other widely cited studies in this area include a recent report on resource efficiency and climate change by the International Resource Panel (IRP) of the United Nations Environment Programme (UNEP) (2020[76]) as well as the OECD's *Global Material Resources Outlook*, which estimated materials use and GHG emissions to 2060 (2019[1]).

Some high-level key findings of the first research strand on the links between GHG emissions and materials management activities are given below (see Box 8.1 for specific examples and data sources):

- A large share of national, European and global GHG emissions are related to materials management activities. The estimates vary from around 45-67% of the total emissions, depending on the geographical scope, the methodological approach (including the scope of activities and materials associated with materials management) and the time period of the analysis.
- The majority of materials management-related emissions are linked to the production of materials, goods and infrastructure (which include an estimate of the energy needed to manufacture these products and materials).
- Only a small share of emissions relates to waste management services. However, the existing estimates only account for direct emissions[19] from waste disposal. The overall GHG footprint of waste becomes much larger when the GHG estimate considers production and use-phase related emissions of a product/material before it becomes waste. With regard to landfill, an area of concern is the under-reporting of methane emissions, potentially due to leaks. A recent aerial survey of methane emitters in California found that landfill sites were the largest methane emitters on a per site basis and that the actual direct emission rates from landfills were well above the U.S. Environment Protection Agency's estimates (Duren et al., 2019[206]).
- Most of the methodologies take a production-based[20] rather than a consumption-based perspective to allocate emissions to materials management activities. The production-based perspective does not take into account emissions that occur prior to the import of materials and products and those that occur post-export of products, while this is the case in the consumption-based perspective.

---

the use and consumption of goods, and the recycling, recovery or disposal of waste. The emissions resulting from the relevant source activities can be influenced by integrated materials, product and waste management policies that address environmental impacts over the entire life cycle of materials and products. Some of the other sources define and scope such emissions as emissions associated with the production of goods (Ellen MacArthur Foundation and Material Economics, 2019[208]) or with resource extraction and processing (IRP, 2019[207]).

[19] Direct emissions are from sources coming from the reporting entity. Indirect emissions are a consequence of the activities of the reporting entity, but they come from sources of another entity (Greenhouse Gas Protocol, n.d.[240]). Examples from waste management include emissions from landfills (direct emissions) or from waste transport by another entity (indirect emissions).

[20] A production-based perspective allocates emissions to the location where the emissions physically occur (Wood et al., 2018[241]), i.e. to domestic production and households. Such emissions do not take into account those associated with imported materials and intermediate and final products, and emission savings related to exports. A consumption-based perspective allocates emissions to the location where the materials and products are finally consumed by industries, governments and households (IRP, 2019[207]).

Box 8.1. Linking GHG emissions to activities related to materials management

The **OECD** (2012[205]) estimates that 55-65% of national emissions arise from materials management activities. The largest share of these emissions relates to the production of goods and fuels. A minor share is attributed to direct emissions from waste disposal practices (landfilling).

The **OECD** (2019[1]) projects materials management activities to be responsible for two-thirds of GHG emissions in 2060, mainly coming from the combustion of fossil fuels for energy from agriculture, manufacturing and construction.

The **International Resource Panel (IRP)** (2019[207]) estimates that natural resource extraction and processing up to "ready-to-use" materials and fuels, including waste disposal processes in the extraction and processing phase ("cradle-to-gate"), account for approximately 50% of global GHG emissions.

Material Economics and the **Ellen MacArthur Foundation** (2019[208]) use findings that estimate that around 45% of global GHG emissions in 2010 came from the production and use of goods and the production of food. The remaining 55% of global emissions were energy related. The 45% estimate includes land management but excludes fuel extraction, refining, processing and transportation. Around half of the 45% are emissions associated with materials production in industry, with the other half attributed to agriculture, forestry and other land uses.

The **IRP** (2020[76]) reported, based on Hertwich (2019[209]), that the production of materials (including the mining, energy, transport and industrial processes required to produce them) contributed almost one-quarter (23%) of global GHG emissions in 2015. An estimated 80% of emissions from materials production were associated with materials use in construction and manufactured goods.

The **United Nations Development Programme (UNDP)** study (2017[210]) estimates that materials management activities account for up to two-thirds (67%) of global GHG emissions.

Eurostat of the European Commission develops estimates of carbon footprints by final use of products for the EU (2021[211]). This consumption-based approach (rather than production-based) associates GHG emissions with the final EU domestic consumption. In 2019, around 23% of the EU-27 CO_2 footprint was linked to materials and manufactured products, 12% to construction and real estate and 24% to private households (out of which around 42% for residential heating/cooling, and 58% for private passenger transport and other activities).

Note: The findings are not comparable across sources as the estimates are based on different methodologies.

The second research strand **quantitatively assesses the potential of circular economy activities to reduce GHG emissions**. This research provides estimates on the decarbonisation potential of circular economy activities, in particular, on the potential of a circular economy to contribute to the achievement of the 1.5°C target set out in the 2015 Paris Agreement. A key publication within the context of the 1.5°C climate target was a study by Material Economics, a Swedish think tank (2018[78]).

Even though the available research is relatively limited to the assessment of specific sectors or materials (see section on Decarbonisation potential of a circular economy in selected priority areas), the studies aggregate the estimates for the different sectors and materials to provide insights into the overall decarbonisation potential of a circular economy. The findings are summarised below (see Box 8.2 for examples of estimates and relevant studies).

- There is an overall agreement in the literature that a circular economy transition, namely, its focus on increasing material efficiency, could create substantial GHG abatement potential. A circular

economy transition creates emission reduction opportunities related to materials management by increasing resource efficiency and by maintaining the value of materials and products in the economy.

- The reviewed studies confirm unanimously the positive benefit of a circular economy transition to reduce GHG emissions. However, the estimated benefits vary greatly in size according to the scope of the analysis (geographical, sectoral, and material-related) and modelling assumptions. Most of the estimates relate to the year 2030 or 2050. Examples provided in Box 8.2 show a variation from around 20% to 60% emission reduction potential by 2050 (this is a relatively large variation of estimates due to the differing methodologies and assumptions used in the studies).
- The literature emphasises that circular economy policies are a necessity to close the emissions gap between the emissions that can be potentially reduced, through traditional decarbonisation policies (this includes increasing energy efficiency, the share of renewable energy sources, and the deployment of carbon capture and storage technologies), and the emission cuts that are needed to achieve the goals set by the Paris Agreement and to reach climate neutrality by 2050. According to the relevant literature, there will be no climate neutral economy by 2050 without measures to transition to a circular economy, as a large share of GHG emissions are linked to materials management (Ellen MacArthur Foundation and Material Economics, 2019[208]; Circle-Economy, 2021[212]).
- Sectors with the highest GHG emissions abatement potential are typically heavy industry sectors (construction and manufacturing in particular) but also agriculture and the food value chain (in particular within regenerative farming practices and food waste prevention). Most of the relevant research focuses on quantifying the decarbonisation potential of circular economy solutions applied to buildings, passenger cars and waste.
- The literature review further shows that researchers and modellers use differing methods to quantify the climate benefits of a circular economy transition. The studies reviewed made use of macroeconomic and Input-Output modelling methods, Life Cycle Analysis (LCA), Materials Flow Analysis, emissions factor-based calculations or a combination thereof.

Box 8.2. Assessing the circular economy (CE) potential to reduce GHG emissions

Material Economics and the **Ellen MacArthur Foundation** (2019[208]) project that CE strategies in five key areas (cement, aluminium, steel, plastics and food) could eliminate 45% of the emissions associated with the production of goods in 2050 (the production of goods being equivalent to 45% of total global GHG emissions in 2010). This leads to an estimate of a circular economy GHG abatement potential of around 20% of global GHG emissions in 2050.

Material Economics, in their earlier work (2018[78]), estimate that measures to transition to a circular economy could cut emissions from heavy industry by 56% by 2050 (296 Mt CO_2e out of a projected 530 Mt CO_2e). Measures to achieve this reduction include increased recycling, improved yields, design of lighter products, product sharing and more intensive use of buildings and cars. All GHG reductions are related to the application of CE measures to four materials: steel, cement, aluminium and plastics.

According to the **Ellen MacArthur Foundation** and **McKinsey** (2015[213]), applying CE measures in the mobility, food and the built environment could reduce EU CO_2 emissions by 48% by 2030 and by 61% by 2050.

The **Netherlands Organisation for Scientific Research** (**TNO**) (Rietveld et al., 2018[214]) quantifies the GHG emission abatement potential of the national CE programme in the Netherlands. The results estimate that the CE programme could contribute to 18% of the 2050 emission reduction target.

Cambridge Econometrics (BIO Intelligence Service, Cambridge Econometrics and European Commission, 2014[215]) projects that a 50% improvement in resource productivity by 2030 could deliver a 25% reduction in GHG emissions in the EU in its most ambitious scenario.

Circle Economy (2021[212]) calculates that the global economy is only 8.6% circular, and hence there is great potential for the circular economy to contribute to the achievement of the Paris Agreement target. The circularity share is defined as the share of cycled resources back to the economy out of the total resources entering the economy. The report claims the latter goal can only be achieved by way of a circular economy.

Note: The findings are not comparable as the estimates are based on a different scope of the analysis and on different assumptions.

Estimates of GHG emissions related to materials management in the Slovak Republic

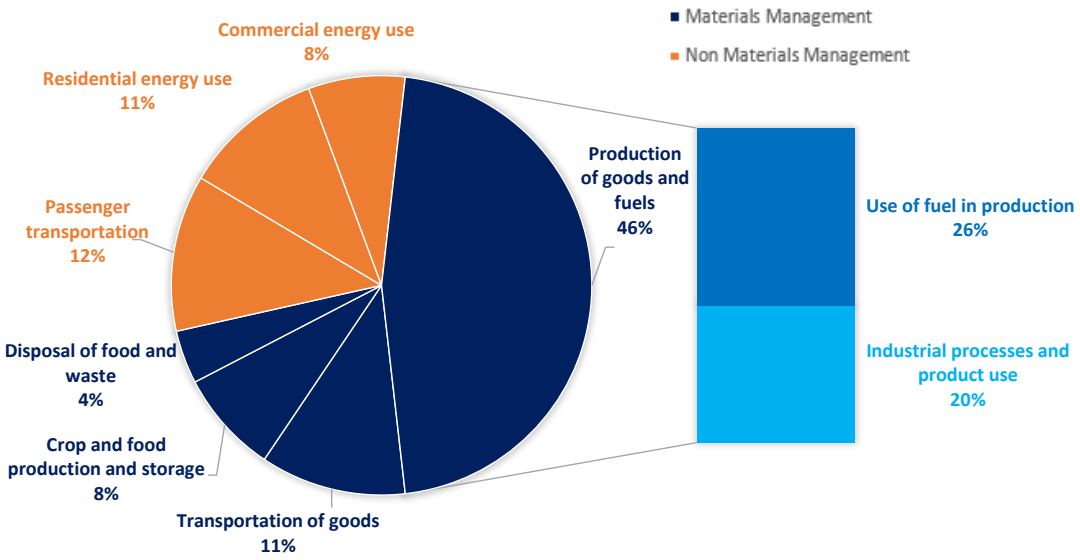
This section reports on the findings of the application of OECD methodology (2012[205]) (see Annex G) to estimate current national GHG emissions related to materials management activities in the Slovak Republic. The OECD ENV-Linkages modelling tool was used to project the share of Slovak GHG emissions associated with materials management activities by 2050. The OECD estimates that around 70% of the country's emissions originated from materials management activities in 2019, with materials management activities projected to account for around 65% of total emissions by 2050. This suggests that there is a significant potential opportunity for the circular economy to contribute to the reduction of GHG emissions in the Slovak Republic, namely, with regard to the production of goods and fuels.

Current situation

The results show that out of the 70% of emissions related to materials management, the vast majority (around 67%) are associated with the production of goods and fuels. This is an equivalent of approximately 46% of the overall country's GHG emissions. Out of the 30% emissions related to non-materials management, 60% are associated with residential and commercial energy use and 40% with passenger transportation (see Figure 8.1). Around 57% of emissions associated with the production of goods and fuels relate to the use of fuel in production processes (i.e. mostly fuel combustion in manufacturing industries and construction), while the other 43% relate to industrial processes (mainly in the metal, mineral and chemical industries) and product use. The highest share of production-related emissions is associated with steel and cement production. Only 4% of the country's GHG emissions are associated with the disposal of food and waste (emissions related to materials management). However, the disposal and waste category considers only direct emissions associated mainly with methane emissions from degrading waste in landfills (OECD, 2012[205]).[21] Annex G presents the approach used to map GHG emissions from the United Nations Framework Convention on Climate Change (UNFCCC) inventories to the materials and non-materials management activities for the Slovak Republic.

[21] Emissions from waste incineration with energy use are included in the energy sector-related emissions (Slovak Hydrometeorological Institute and Ministry of Environment of the Slovak Republic, 2020[239]).

Figure 8.1. GHG emissions related to materials and non-materials management in 2019 in the Slovak Republic



Note: Emissions from Land Use and Land use Change and Forestry (LULUCF) are excluded from the analysis.
Source: The methodology developed in OECD (2012[205]) was applied using the GHG data from UNFCCC national inventory submissions (last inventory year 2019) (United Nations Climate Change, 2022[216]).

These results are largely aligned with the results in previous OECD work, which applied this methodology to four countries (Australia, Germany, Mexico and Slovenia) (2012[205]). The OECD study revealed the following:

- Around 55-65% of national emissions arose from materials management activities.
- Emissions associated with the production of goods and fuels were the main emissions source.
- Emissions associated with passenger transportation were larger than the emissions associated with the transport of goods.
- Emissions associated with the disposal of food and waste were the smallest portion of each country's total emissions.

The Slovak Republic's emissions related to materials management are estimated at 70% for 2019, which is slightly above the 65% upper bound estimate from the previous OECD study (2012[205]) as well as above other existing global estimates according to the literature. As the methodology uses a production-based perspective, this higher estimate appears to be the result of the country's strong manufacturing sector (motor vehicles and steel production) and the country's export orientation. For example, fuel combustion in manufacturing industries and construction in the Slovak Republic accounted for around 24% of energy-related emissions in 2019, whereas this share was only 15% in the EU (United Nations Climate Change, 2022[216]). Almost half of Slovak GHG emissions related to industrial processes and product use in 2019 were associated with the metals industry. This was the case only for 22% of the corresponding emissions in the EU (United Nations Climate Change, 2022[216]). Emissions from fuel combustion in manufacturing industries and construction, as well as emissions from the metals industry, count towards emissions related to materials management, whether the products and materials are aimed for domestic use or export.

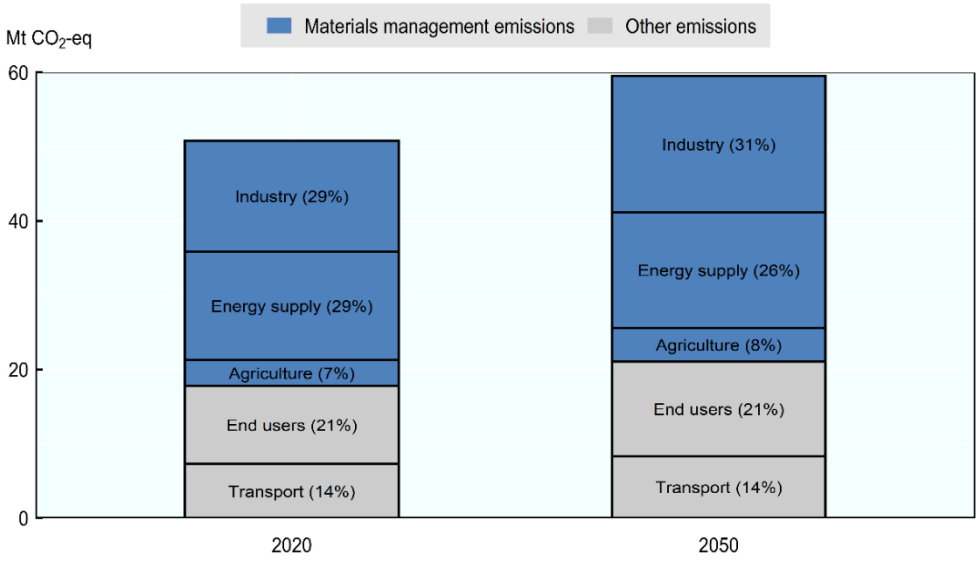
Projections

The OECD differentiated between global GHG emissions related to activities from materials management and non-materials management in their recent *Global Material Resources Outlook to 2060* (2019[1]). The Outlook projected that materials management activities would be responsible for around two-thirds of global GHG emissions, mainly coming from the combustion of fossil fuels for energy and from the agriculture, manufacturing and construction sectors.

The OECD used the same modelling approach to derive baseline projections to 2050 for the Slovak Republic (see Figure 8.2). The results show that the country's GHG emissions associated with materials management activities are projected to increase from 33 million tonnes (Mt) CO_2e in 2020 to over 38 Mt CO_2e in 2050 with their share in overall emissions remaining constant at around 65% of total national emissions.

Figure 8.2. GHG emissions related to materials management in 2020 and 2050 in the Slovak Republic

Emissions in CO_2e.



Note: Based on previous OECD (2012[205]) work on materials management within OECD countries, emissions are differentiated between those linked to materials management and those that are not. Due to a specific sectoral categorisation in OECD ENV-Linkages model, the materials-based sub-categories do not fully correspond to the categories used in OECD (2012[205]).
Source: OECD ENV-Linkages model.

The highest share of emissions associated with materials management activities are linked to "industry" (rising from 29% in 2020 to 31% in 2050) and "energy supply" categories (going from 29% in 2020 to 26% in 2050) (see Figure 8.2). To a large extent, these two categories reflect emissions from the production of goods and fuels. Emissions linked to the "end users" category is important because it is associated with non-materials management activities (21% in both 2020 and 2050). This includes emissions related to households and all services. All services were included (except transport services) in the end users category, including services related to waste and water management. These are classified as non-materials management activities in the model. The results are aligned with OECD estimates for 2019, as detailed in the previous section.

Decarbonisation potential of a circular economy in selected priority areas

There are significant opportunities in a number of sectors to reduce GHG emissions. Sectors with the highest GHG abatement potential in terms of volumes of CO_2e include construction, manufacturing and agriculture. Quantitative estimates of the potential for emissions abatement are limited and differ depending on the methodology used. The following sub-sections provide more detail on the two sectoral priority areas addressed in the Slovak circular economy roadmap.

Construction/buildings

The circular economy in the construction sector, namely, in buildings, offers a significant potential to reduce GHG emissions, as steel and concrete are among the most emissions-intensive materials used in construction. Reducing the demand for such materials could considerably cut GHG emissions (International Resource Panel, 2020[76]; Ramboll, Fraunhofer ISI and Ecologic Institute, 2020[77]; Material Economics, 2018[78]).

The vast majority of existing emissions reduction estimates relate to buildings, the most important product of the construction sector (International Resource Panel, 2020[76]). Looking at the whole building life cycle, studies estimate a potential annual reduction in GHG emissions of around 34-40% in 2050 from materials efficiency and circular economy strategies (see Table 8.1).

Moreover, every building's life cycle stage – from design, production and use to demolition and waste management – is projected to offer a rich opportunity for greater circularity and emissions reductions (European Environment Agency, 2020[79]). Table 8.1 presents examples of quantitative estimates from the literature for the different circular economy activities along the building's life cycle. There are no country specific estimates for the Slovak Republic.

Table 8.1. GHG abatement potential related to circular economy in buildings – estimates

Life cycle	Circular activity	GHG abatement potential (reduction in emissions) (compared to the study's baseline)	Source
Entire life cycle	Material efficiency strategies along the whole building life cycle (construction, operation and deconstruction of residential buildings)	35-40% emissions reduction in 2050 in the G7 compared to their 2050 baseline	International Resource Panel (2020[76])
	Reducing the use of concrete, cement and steel in the building sector over a building's life cycle	61% (130 Mt CO_2e) in 2050 in the EU compared to 2015 values	Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77])
	Several circular economy activities in the construction sector (incl. modular design, use of lighter materials (more wood), reduced use of steel, recycling of unreacted cement, new cement production methods etc. and increased utilisation of buildings through sharing activities)	34% (80 Mt CO_2e) in 2050 in the EU compared to projected 230 Mt CO_2e linked with construction, out of which abatement of 55 Mt CO_2e related to the CE in buildings and 25 Mt related to CE applied to the cement in the construction sector	Material Economics (2018[78])
	Circular economy applied to four key materials used in buildings (steel, plastics, aluminium and cement)	38% reduction in 2050 globally compared to their CE scenario	Ellen MacArthur Foundation and Material Economics (2019[208])
Production (extraction, design and construction phases)	Product design (reduce overspecification of concrete and steel, design for building lifetime extension and disassembly)	Around 21% in 2050 in the EU	Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77])
	Designing buildings using less material	8-10% in 2050 in the G7 for residential buildings	International Resource Panel (2020[76])
	Production processes (innovative cement types, lower clinker share, use of timber in residential buildings)	Around 30% in 2050 in the EU	Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77])
	Material substitution (less steel, more recycled	1-8% in 2050 in the G7 (through	International Resource Panel

	construction materials, wood, etc.)	more use of sustainably harvested timber instead of steel)	(2020[76])
	Materials efficiency (less waste, less over-specification, use of high-strength materials)	10% reduction in 2050 in the EU	Adapted from Material Economics (2018[78])
	Design to eliminate waste in buildings Design to eliminate waste in construction	19% reduction in 2050 globally 4% reduction in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])
Consumption (use phase)	More intensive use of buildings (space-sharing, multi-family homes) (reduced floor area by 20%)	Up to 70% in 2050 in the G7 for residential buildings	International Resource Panel (2020[76])
	Increased sharing of buildings (through reduced floor area by 5%)	6% reduction in the EU in 2050	Adapted from Material Economics (2018[78])
	Sharing business models (peer-to-peer sharing, office sharing, better urban planning, repurposed buildings and multi-purposed buildings)	6% reduction in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])
	Optimising use of space in buildings	Around 10% in 2050 in the EU	Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77])
Waste management (end-of-life phase), and recycling and reuse	Improved CDW management (reduction of waste, reuse of building materials, recycling materials)	14-18% in 2050 in the G7 for residential buildings (improved recycling)	International Resource Panel (2020[76])
	Increased reuse of building materials, and increased recycling of the materials for the construction of buildings.	17-32% reduction in emissions in the EU, compared to baseline emissions (current emissions)	Deloitte (2016[217])
	Reuse of building components and materials CE applied to cement in construction	9% reduction in 2050 6% p.a. in 2050 in the EU	Adapted from Material Economics (2018[78])
	Reuse CE applied to cement	6% in 2050 globally 6% in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])
	Reuse structural concrete elements, CE for cement using innovative technology, reuse structural steel	Around 25% in 2050 in the EU	Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77])

Note: Different studies rely on different modelling assumptions and baseline scenarios. For example a 61% reduction in 2050 in the EU estimated by (Ramboll, Fraunhofer ISI and Ecologic Institute (2020[77]) is not comparable to estimates by Material Economics (2018[78]) as Ramboll et al. compare to current values (year 2015), while Material Economics compared to a 2050 baseline scenario.
Source: Adapted from the different sources indicated in the table.

Eliminating waste and reducing the amount of key building materials are key activities in the building/construction design and production processes that appear to have the most promising GHG abatement potential. Reusing building materials and components at the end of a building's life cycle, as well as increasing recycling of construction and demolition waste, are key activities related to waste management. The research indicates that the main focus should be on steel and cement (for use in concrete) as they are key carbon-intensive building materials, as well as on plastics and aluminium. However, some of the materials efficiency strategies linked to these building materials could come at a relatively high marginal cost compared to, for example, space-sharing strategies (Material Economics, 2018[78]).

There is less agreement in the relevant research on the GHG abatement potential of circular economy activities related to the consumption (or use) phase of buildings. Available research indicates that more intensive use of buildings, i.e. increased occupancy of buildings or decreased space/area per person, could have a significant potential to reduce emissions. This is mainly by reducing the demand for floor space per person, which in turn decreases the energy needed for heating and cooling, the demand for new construction (and thus construction materials), and the generation of waste (International Resource Panel, 2020[76]). Activities such as space sharing appear to come at no net cost and could even deliver a positive economic benefit (Material Economics, 2018[78]). However, the uptake of such activities heavily depends on consumer preferences and choices, as well as on the potential to reduce the floor space per person (this potential varies per location). For example, citizens would need to shift their choices towards

increased sharing of their homes (e.g. through peer-to-peer platforms offering unused rooms or living spaces for rent) or towards living in smaller places. Policy could still play a role, although limited, by providing some supporting measures and incentives.

Applying these findings to the Slovak context, circular activities in each phase of a building's life cycle could bring about the following potential GHG emission reductions:

- **Production/Extraction, design and construction phases**. Product design choices and material substitution appear to be key activities that could reduce the country's emissions in the sector. Slovak GHG inventories show that manufacturing of iron and steel and non-metallic minerals, together with emissions linked to the metal and mineral industries, account for an important share of the country's total GHG emissions.[22] The key circular economy strategies could include reduced over-specification of building materials, design for disassembly, the use of wood and other lighter materials, but also increased digitalisation of the construction process with a building information modelling system. However, further research should examine the GHG abatement benefit also within the context of new construction relative to the need for strategies aimed at the existing building stock. Data from 2014 show that the share of residential buildings in the total residential building stock built after 2010 was only 1.5% in the Slovak Republic, and that around 1.3% of the residential building stock is undergoing major renovation every year (European Commission, n.d.[218]). Similar percentages for new construction and renovation were used to estimate the GHG abatement potential in buildings by Material Economics in its study (2018[78]). Both the construction of new buildings and building renovation can incorporate materials efficiency and circular economy strategies.
- **Consumption/Use phase**. Circular activities related to the use phase are mainly associated with a more intensive use of buildings, i.e. space sharing or increased occupancy per m^2. The GHG abatement potential heavily depends on the extent to which floor area per person could be decreased. According to the latest available data, the Slovak Republic has one of the lowest availabilities of housing in EU and OECD countries in relation to its population (less than 400 dwellings per 1000 inhabitants compared to around 600 dwellings in France, Greece and Switzerland) (Cár, 2015[219]; OECD, 2022[220]), and one of the lowest sizes of housing per person in the EU (1.2 rooms per person compared to the EU average of 1.6 rooms in 2020, and the highest average household size in the EU with 2.9 persons per household in 2020) (Eurostat, 2022[221]). This existing housing situation limits the scope for further increases in the intensity of use of private dwellings within the Slovak context. Instead, the focus could be on revising the zoning laws in some cities to allow for the construction of more densely populated living areas (one of the recommendations proposed in Chapter 6 on the construction sector). The potential to apply space-sharing strategies in the Slovak Republic appears to be higher for non-residential buildings. Further research could explore to what extent office space in the Slovak Republic could be shared or repurposed, and to what extent working from home could reduce office space. As much as 40% of office space is estimated to be underutilised across European cities (40%) (CBRE, 2015[222])
- **Waste management (end-of-life phase), and reuse and recycling.** Improving recycling, recovery, reuse and upcycling of construction and demolition waste could deliver GHG abatement as a significant potential exists in this area in the Slovak Republic. The recycling and recovery rate of construction and demolition waste in the Slovak Republic, including backfilling operations, was only 51% compared to the EU-28 average of 90% in 2018 (Eurostat, 2021[223]). The new Waste Management Action Plan for 2021-2025 sets a recycling and reuse target of 70% by 2025,

[22] A small caveat should be added here to clarify that the GHG inventories take a production-based approach, which account for emissions linked to exports but not to imports. For example, even if circular economy strategies help to reduce emissions from steel production in the Slovak Republic, there are still emissions from the export of steel produced in the country.

including construction and demolition waste used for backfilling. This area is also a priority in the Slovak Recovery and Resilience Plan. Key strategies to decrease GHG emissions in this area could include, for instance, strengthened markets for reuse of structural segments, and switching from demolition to deconstruction to be able to use more secondary construction materials and components.

To conclude, the assessment indicates that the Slovak Republic may want to focus on production and waste management-related circular economy strategies in the construction sector to benefit from the strategies' GHG abatement potential. Circular product design in buildings has been assessed to lead to a decrease of approximately 20% in EU GHG emissions, while the adoption of more circular production processes is expected to bring about 30% GHG emissions savings in the EU, according to the literature. Improved management of construction and demolition waste was estimated to account for around 14%-25% GHG emissions reduction in the G7 countries, which is in particular linked to increased reuse of building materials and components, and to the use of recycled materials. Less evidence exists on the potential of consumer-related circular economy strategies. The Slovak Republic may want to conduct further research into the potential of space-sharing strategies in non-residential buildings.

Food and bio-waste value chain

Using circular economy practices to reduce emissions generated by the food and other bio-waste value chain is crucial for tackling climate change. Food production (in particular beef production, excess tillage and overuse of fertilisers), the food logistics chain (processing, transportation and refrigeration) and food waste generation create substantial GHG emissions, some of which can be avoided. More regenerative farming systems (e.g. closing nutrient cycles and reducing non-sustainable fertiliser use) and a more effective use of the food that is produced could significantly cut down the emissions related to the food system (Ellen MacArthur Foundation and Material Economics, 2019[208]; Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment, 2015[213]).[23] Circular food interventions may be applied to most contexts, but countries can focus on different priority areas to achieve such emissions cuts (Lembachar and Sutherland, 2021[224]).

The calculation of the emissions and their abatement potential associated with the food and bio-waste value chain becomes more complex as soils are an integral part of the carbon cycle, which both emits and fixes carbon at the same time (Ellen MacArthur Foundation and Material Economics, 2019[208]). The literature is less extensive in this area than, for example, for the construction sector. A recent study by the Ellen MacArthur Foundation and Material Economics estimates a potential global net annual reduction in GHG emissions of around 49% in 2050 from the application of circular economy strategies in the food and bio-waste value chain (see Table 8.2). This net reduction includes additional climate benefits related to carbon sequestration (i.e. carbon removal from the atmosphere). However, each part of the food and bio-waste value chain provides a number of opportunities. Table 8.2 provides quantitative estimates from the literature for the different circular economy activities.

Table 8.2. GHG abatement potential related to circular economy in the food and bio-waste value chain – estimates

Value chain	Circular activity	GHG abatement potential (reduction in emissions) (compared to the study's baseline)	Source
Entire value	Shifting to more nature-enhancing farming systems and making more effective use of the	49% net reduction (emissions minus carbon sequestration*) in 2050 globally	Ellen MacArthur Foundation and Material Economics

[23] Food waste also generates emissions both direct (during decomposition), and indirect (associated with processing, transport, storage and overproduction) (Ellen MacArthur Foundation and Material Economics, 2019[208]).

chain	food that is produced	compared to their CE scenario	(2019[208])
	Emphasising the importance of local food supply chains and reduced food waste; closing nutrient loops; valorisation of resource consumption and losses in natural capital; and shifting the tax system against finite resources (lower taxes on secondary materials and increased on primary).	20% by 2030, 61% by 2050 in the EU compared to baseline year 2012 (baseline scenario)	Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment (2015[213])
Production	Regenerative agricultural practices (managed grazing and regenerative cropland techniques, incl. organic farming)	34% annual net reduction in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])
	Food waste reduction (via consumer, retail, and supply-chain waste/loss reduction, or the valorisation of unavoidable food waste), packaging solutions (reducing packaging and improving the preservation of food), and nutrient recycling (nitrogen, phosphate and potassium in particular)	12-14% in the EU compared to current levels	Deloitte (2016[217])
Consumption	Food waste and bio-waste reduction (includes mainly food waste prevention strategies by households)	12% annual reduction in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])
Waste management and closing the biological cycle	Composting (>70% organic material recovery potential)	3% annual reduction in 2050 globally	Adapted from Ellen MacArthur Foundation and Material Economics (2019[208])

Note: Different studies rely on different modelling assumptions and baseline scenarios.
* Carbon sequestration is a carbon removal process of CO_2 from the atmosphere.

Based on the estimates in Table 8.2 (available estimates largely focus on the agri-food system), the most promising circular economy activities, which mitigate GHG emissions in the food and bio-waste value chain, appear to be related to agricultural practices. Upscaling regenerative agricultural practices to produce food could substantially decrease GHG emissions from farming. Comparing food waste prevention with food waste disposal strategies and implementing food waste prevention strategies upstream (in food production) appear to have a much larger GHG abatement potential than food waste (and other bio-waste) downstream strategies (e.g. composting). Other research finds that even a small reduction in food waste (through prevention strategies) can result in large amounts of avoided emissions, greatly outweighing the benefits of recycling strategies (de Sadeleer, Brattebø and Callewaert, 2020[225]). This implies that in addition to focusing on the way food waste is managed, policy makers should also focus on the way food waste is prevented in order to benefit from larger GHG reductions.

With regard to the Slovak food and bio-waste value chain, the GHG abatement potential from applying circular economy strategies remains unclear. Only around 8% of the country's GHG emissions were linked to crop and food production and storage (excluding the Land Use and Land use Change and Forestry [LULUCF] sector) (see Figure 8.1).[24]

This percentage does not take into account direct emissions related to the management of food waste and other bio-waste (disposal of food and waste accounted for another 4%). Moreover, part of the emissions associated with the transportation and production of food might be accounted for in the categories of transportation and production of goods and fuels rather than in the category of crop and food production and storage. This would likely slightly increase the overall share of emissions related to the food and bio-

[24] According to one of the stakeholders, the largest share of these emissions consists of methane, which is mainly related to the size of the livestock (which has already been declining over a longer period of time). Reducing emissions from this source may need to be carefully considered to avoid any unintended consequences on the land and soil, or from the need to import certain food products.

waste value chain in the Slovak Republic in the country's total emissions and include emissions that could be avoided.

The Slovak Republic could consider the following circular economy practices along the food and bio-waste value chain to reduce the country's GHG emissions associated with this sector.

- **Production**. A change in farming practices is likely to offer the highest GHG abatement potential according to the literature, but further research would be needed to estimate the potential in the Slovak Republic. The net emissions reduction potential from these strategies are likely to depend on the share of cropland suited to the regenerative farming practices in the Slovak Republic as well as on the current and potential use of such practices in the future. Support for local production and yard sales is also expected to decrease emissions related to the food logistics chain. Organic waste could be reduced in production processes, with organic waste used as feedstock in other parts of the economy. Food and other bio-waste prevention strategies in the primary production sector are also likely to have a higher GHG abatement potential compared to food and other bio-waste disposal strategies. As a result, the Slovak Republic may wish to strengthen the policy focus towards implementing food waste prevention in addition to food waste recycling strategies.
- **Consumption**. Circular economy activities related to consumption mostly relate to shifts in consumer behaviour and practices. This includes shifting diets towards more plant-based ingredients, shifting consumption towards local products, and shifting behaviour towards less food waste and improved sorting of bio-waste. Behavioural change is a recognised crucial strategy for emissions reduction in the food value chain (Springmann et al., 2018[226]). Behavioural interventions were rolled-out across a number of countries to support food waste prevention strategies (OECD, 2017[227]). Further research would need to investigate to what extent Slovak consumers currently adopt sustainable food behaviour and to what extent they are willing to do so in the future if the Slovak Government introduced additional policies.
- **Waste management and closing the biological cycle**. The most important strategies in waste management include an increase in composting, in other recovery practices for food and bio-waste, and in the separate collection of kitchen and garden waste from households. However, as the literature estimates, these strategies appear to have a relatively low climate mitigation benefit compared to strategies in other parts of the food and bio-waste value chain.

To conclude, the relatively limited evidence suggests that the Slovak Republic may need to conduct additional research into the GHG abatement opportunities of a circular economy transition in the food and bio-waste value chain (this may require additional data collection). The available estimates indicate that regenerative farming practices have a significant potential to reduce GHG emissions (around 34% global reduction potential according to the available literature), followed by food waste reduction strategies (around 12% reduction potential globally and in the EU). Increased composting appears to have a relatively low GHG abatement potential (only around 3% globally) compared to strategies at the higher level of the food and bio-waste value chain. Nevertheless, further research into this area is needed to provide better estimates.

Box 8.3. GHG abatement potential related to circular economy in other areas

Automotive industry – passenger cars

The automotive industry offers significant opportunities to reduce GHG emissions through the implementation of circular economy policies, in particular, with respect to passenger cars (Ellen MacArthur Foundation and Material Economics, 2019[208]; International Resource Panel, 2020[76]; Deloitte, 2016[217]; Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment, 2015[213]; Material Economics, 2018[78]). The largest potential appears to be in the design

and consumption phases of the car's life cycle, as the recycling of end-of-life vehicles is already happening to a significant degree. A combination of intensive car-sharing, electrification and automation, design supporting the extended life of vehicles and lighter materials, and smaller sized cars can substantially decrease GHG emissions. There are no circular economy-related GHG abatement potential estimates available for the Slovak Republic. However, since the country positions itself in the lower end of the global value chain of the car industry (the assembly part of the value chain), the largest GHG abatement potential in the country appears to be related to circular economy strategies in the consumption phase of a car (as product design decisions are typically made outside of the Slovak Republic, and the end-of-life reuse and recycling strategies are already in place). Consumption-based strategies aim at changing consumer behaviour and choices towards increased car-sharing, car occupancy and use of small cars as well as towards cars running on alternative fuels. Such strategies have an impact primarily on emissions associated with passenger transportation, which have been classified by the OECD (2012[205]) as emissions related to non-materials management.

Municipal waste

Increased recycling of municipal waste and restricting landfilling provide important GHG reduction benefits (OECD, 2012[205]; Eunomia et al., 2014[228]). These benefits are primarily linked to decreasing direct emissions from landfills. Increased energy recovery and incineration provide moderate GHG reduction potential, and composting and anaerobic digestion provide the least reductions per tonne of municipal waste diverted from landfill (OECD, 2012[205]). As the Slovak Republic has a relatively high landfill rate, these strategies could provide a substantial emissions reduction potential. Part of this potential is linked to food waste. The OECD (2012[205]) estimates that recycling and source reduction have the highest GHG abatement potential per tonne of municipal waste compared to other waste management strategies.

Manufacturing of steel

There is a large potential in the steel industry to reduce GHG emissions by implementing CE strategies. The key strategies include the replacement of primary steel production by secondary steel production and the reduction of steel demand in general (by substituting steel for other materials, where this is beneficial). Policy intervention would need to support measures aimed at increasing high-quality secondary production and the collection of post-consumer scrap, and at reducing copper contamination and fabrication scrap (Material Economics, 2018[78]). Most steel is consumed by the construction and automotive industries. The Slovak Republic could benefit from a wider implementation of some of the above-mentioned CE strategies to reduce further emissions from the steel industry.

Plastics

Increased recycling of plastics and increased use of recycled plastics could decrease GHG emissions. If more than half of plastics demand could be met by recycled plastics by 2050, the GHG abatement potential could be significant (Material Economics, 2018[78]). The key actions in this area include product design measures to facilitate recycling, specialised recycling operations, technology development for sorting, automation and chemical recycling. Such measures assume that separate collection systems are available. GHG abatement potential related to the use of plastics in the construction sector was addressed in the Construction/buildings section. The Slovak Republic has implemented national legislation to increase plastics recycling and the use of recycled plastics, in line with EU obligations. The country has also implemented a deposit-refund system for single use plastic bottles and cans from 1 January 2022.

Concluding remarks

This chapter explored and analysed the links between a circular economy and GHG emissions. The chapter reviewed relevant literature that estimates the share of GHG emissions associated with materials management activities as well as literature that assesses the potential benefits of applying circular economy practices to reduce GHG emissions.

The OECD estimated that around 70% of national GHG emissions in the Slovak Republic were related to materials management activities in 2019 compared to approximately 30% associated with other activities. Projections showed a similar trend, estimating that around 65% of the country's emissions could be attributed to materials management by 2050. Such findings provide initial insights into the order of magnitude of Slovak GHG emissions related to production, consumption and waste management of materials and goods produced in the Slovak Republic and create the basis for a discussion on the potential of a circular economy to reduce some of these emissions.

The highest GHG abatement potential from applying circular economy practices in the Slovak Republic appears to be in the construction sector, as the sector heavily relies on steel and cement production. Steel and cement production accounted for the highest share of production-related emissions in 2019 according to the UNFCCC GHG inventory. Further research into the potential of applying more circular product design choices to new constructions and renovating existing buildings in the Slovak Republic would help inform the country's evidence-based policy making. Increasing material substitution for steel, supporting space-sharing practices in non-residential buildings, and improving recycling, recovery, reuse and upcycling of construction and demolition waste are other key activities the country could explore that could contribute to the achievement of climate targets.

Less evidence was found on the GHG abatement potential from applying circular economy strategies in the food and bio-waste value chain. The Slovak Republic could explore the potential of regenerative farming practices as well as the role of behavioural interventions in the food sector to reduce GHG emissions. This may require additional investments in farming technologies. The country may also wish to strengthen its focus on food waste prevention strategies as these have been found to result in higher amounts of avoided emissions than recycling strategies. The implementation of circular economy strategies will also need to consider their wider economic as well as environmental impacts, including impacts that may occur across regions or countries.

9 Proposed Implementation Strategy for the Roadmap

The implementation strategy proposed in this chapter develops a list of actions for each prioritised recommendation across the three priority areas of the roadmap that could be taken forward in future national action plans to implement the roadmap. The strategy also allocates responsibilities for the implementation of the spelled out actions and suggests an implementation timeframe. It further outlines an approach for a circular economy monitoring framework that could be used to monitor the progress in implementing the roadmap and transitioning to a circular economy in the Slovak Republic through a set of indicators.

Proposed implementation plan

The proposed implementation plan was developed in consultation with the Slovak authorities, taking into account recommendations that were prioritised by stakeholders during organised consultation meetings within the context of this project. It is structured along the three priority areas and includes recommendations that could be implemented in the short term (by 2025, assuming that the roadmap would be approved by the Slovak Government in 2023) and the medium to long term (towards 2040).

In total, the proposed implementation plan suggests implementation actions for around 30 key policy recommendations across the three priority areas to achieve the vision and objectives of the roadmap by 2040.

Action plan to improve sustainable consumption and production, and increase the use of economic instruments

Table 9.1. Ten key actions to increase the use of five economic instruments in the short term

Recommendation	No.	Action	Funding	Responsibility
Gradually increase the landfill taxes for municipal waste beyond the period 2021 and reform the redistribution of subsidies from the landfill tax proceeds	1	Amend the relevant legislation to gradually reduce or remove compensation payments to municipalities because of their location and increase the landfill taxes also for municipal waste	Revenue generating instrument for the Slovak Environmental Fund and certain municipalities	Ministry of Environment
	2	Strengthen monitoring and enforcement to deter illegal landfilling, including a set of fines	Municipalities partly supported from the Environmental Fund (from increased landfill taxes). Partly covered by the municipalities' budget	Ministry of Environment; municipalities
Reduce VAT for repair services and the sale of refurbished, upcycled or second-hand products	3	Amend the relevant legislation, in particular its list with goods and services that benefit from reduced VAT to include repair services or the sale of refurbished, upcycled or second-hand products	Budget implications are unknown (there might be some losses to the state from reduced VAT but more companies might take up these services and pay the reduced VAT)	Ministry of Finance; Ministry of Environment
Implement eco-modulated	4	Research the type of eco-modulated fees	National or EU funding needed to	Ministry of

fees in existing EPR schemes (possibly integrating recycled content requirements)		that would be most suitable in the Slovak context of competitive EPR markets, considering the forthcoming EU guidance on EPR fee modulation	develop the study (or to be done in-house)	Environment
	5	Amend the relevant legislation to define and provide conditions for eco-modulation (eco-modulation is already included as a goal in the Waste Act No. 79/2015)	No specific budget implications for the government. Budget implications for existing PROs and their clients	Ministry of Environment
Strengthen GPP by gradually increasing the (mandatory) use of GPP criteria in awarding contracts	6	Showcase the benefits of GPP by developing a catalogue of national best practices	National or EU funding needed to develop the catalogue (or to be done in-house)	Ministry of Environment; Public Procurement Office
	7	Gradually make the use of green award criteria mandatory for all public entities	No specific budget implications for the government (to be done in-house)	
Expand the coverage of well-designed PAYT schemes across the country by making PAYT mandatory or by creating additional incentives for municipalities to adopt PAYT schemes	8	Targeted education and information campaigns to promote waste sorting by households and PAYT, ideally incorporating behavioural insights and incentives (in line with existing policies)	Environmental Fund, OP Slovakia, municipalities budget	Ministry of Environment; SEA; municipalities
	9	Provide incentive subsidies for municipalities to adopt PAYT schemes	Environmental Fund (from the increased landfill taxes)	Ministry of Environment
	10	Strengthen monitoring and enforcement to deter illegal waste disposal, including a set of fines	Municipalities partly supported from the Environmental Fund (from increased landfill taxes). Partly covered by the municipalities' budget	Ministry of Environment; municipalities

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies. SEA - Slovak Environment Agency, OP – Operational Programme.

Table 9.2. Thirteen key actions to support and explore the use of economic instruments in the medium to long term

Recommendation	No.	Action	Funding	Responsibility
Reconsider introducing a form of plastics taxes (possibly with recycled content requirements	1	Reopen the discussions with relevant stakeholders on the introduction of a plastics tax to finance the EU levy of EUR 0.80/kg of non-recyclable plastic packaging	Revenue generating instrument (for the state budget or the Environmental Fund)	Ministry of Finance; Ministry of Environment
Explore the option of introducing aggregates taxes	2	Develop an impact assessment study of a possible introduction of aggregates taxes	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Transport and Construction; Ministry of Environment
Expand EPR system to additional products (textiles are already covered by the Waste Management Plan 2021-2025)	3	Develop a preparatory study together with relevant stakeholders to design a potential EPR for additional products and assess its potential impacts.	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment
	4	If EPR is a way forward, amend the relevant legislation	No specific budget implications for the government. Budget implications for newly formed PROs	Ministry of Environment
Consider the option of introducing minimum recycled content requirements within the GPP system for certain materials, e.g. paper, plastics, construction materials	5	Research the best policy instrument to implement recycled content requirements (e.g. by direct regulation, within an EPR or GPP scheme or by means of a voluntary agreement)	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; SEA; Ministry of Transport and Construction; Public Procurement Office
	6	Consider the development of a tailored tendering and monitoring methodology	National or EU funding needed to develop the study	Ministry of Environment; Public

		to help evaluate proposed products and services in GPP	and tool (or to be done in-house)	Procurement Office
Provide financial support for eco-innovation to stimulate market uptake of innovative products (in line with existing policies)	7	Consider setting up different fiscal instruments (dedicated tax incentives and incentive subsidies), consider using Operational Programme (through calls for proposals) as well as promote different EU research funding programmes (e.g. LIFE and Horizon).	National or EU funding needed to support the action by grants. Unknown budget implications if the action is supported by a tax incentive.	Ministry of Environment; Ministry of Education, Science, Research and Sport; Ministry of Economy; MIRRI
Move beyond volume and frequency subscription based schemes, in particular in densely populated areas towards sack- or weight-based schemes	8	Targeted education and information campaigns to promote waste sorting by households and PAYT, ideally incorporating behavioural insights and incentives (in line with existing policies)	Environmental Fund, OP Slovakia, municipalities budget	Ministry of Environment; SEA; municipalities
	9	Financial support to municipalities to develop the needed infrastructure (in line with existing policies)	Environmental Fund (from the increased landfill taxes)	Ministry of Environment
Explore the option of introducing incineration taxes to limit excessive diversion of waste from landfill to incineration plants	10	Develop a study assessing the potential impacts from the introduction of incineration taxes	National or EU funding needed to develop the study and tool (or to be done in-house)	Ministry of Environment; Ministry of Finance; Ministry of Economy
	11	If incineration taxes are to be adopted, amend the relevant legislation	Revenue generating instrument (for the state budget or the Environmental Fund)	Ministry of Finance; Ministry of Environment
Consider the need to introduce 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	12	In the medium-to-long term, reopen the discussions on the potential need for additional product taxes	Revenue generating instrument (for the state budget or the Environmental Fund)	Ministry of Finance; Ministry of Environment
Explore the need to implement DRS for additional products if it is difficult to reach high recycling targets by separate collection schemes alone, or if the goal is to reduce littering	13	In the medium-to-long term, reopen the discussions on the potential need for additional DRS schemes	Considerable budget implications for the government. Budget implications also for existing PROs	Ministry of Environment

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies. MIRRI - Ministry of Investments and Regional Development, SEA - Slovak Environment Agency, OP – Operational Programme.

Action plan to support a circular economy in the Slovak construction sector

Table 9.3. Eighteen actions for a more circular construction sector in the short term, including the planned CDW reform

Recommendation	No.	Action	Funding	Responsibility
CDW reform (RRP)				
Improve the measurement and monitoring of CDW flows	1	Setting up a data management system: Make ISOH fully operational; Collect regular data on the availability and utilisation of current CDW recycling capacities, waste generation from renovation activities and final destination of CDW flows; follow Eurostat reporting when providing recovery rates of CDW	No additional budget implications	Ministry of Environment; MTC; Statistical Office; SEA
Introduce a quality standard for recycled construction materials	2	Conduct a feasibility and market study on the introduction of a quality standard for recycled CDW in the Slovak Republic (to determine the potential uptake, needs and specific technical standards within the local context)	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; Ministry of Transport and Construction; Authorisation bodies
	3	Develop legislation specifying quality standards for recycled construction materials	No specific budget implications	

Strengthen GPP for state level entities, including minimum recycled content requirements	4	Carry out a pre-market study to understand the feasibility and associated costs of introducing mandatory GPP criteria	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; MTC; Public Procurement Office
	5	Develop legislation introducing mandatory GPP criteria to be applied in the procurement of public construction works by state level entities (focus on mandatory award criteria only and possibly extend to all public entities)	No specific budget implications	
Introduce mandatory selective demolition, including a system of inspection/audit before and after demolitions take place	6	Develop legislation introducing mandatory selective demolition (in place from July 2022, after the report was drafted)	No specific budget implications	Ministry of Environment; MTC
Introduce end-of-waste criteria for additional construction and building materials	7	Develop additional End-of-waste criteria legislation (in place from June 2022, after the report was drafted)	No specific budget implications	Ministry of Environment; MTC
Increase the landfill tax rates for CDW and reduce or remove compensation payments to municipalities because of their location	8	Amend the relevant legislation to gradually reduce or remove compensation payments to municipalities because of their location (landfill taxes for industrial and construction waste were increased and in effect from July 2022, after the report was drafted)	Revenue generating instrument for the Slovak Environmental Fund and certain municipalities	Ministry of Environment; Ministry of Finance
	9	Strengthen monitoring and enforcement to deter illegal landfilling, including a set of fines	Municipalities partly supported from the Environmental Fund. Partly covered by the municipalities' budget	Ministry of Environment;
Other recommendations				
Support GPP for all public entities, catalogue of good practices in GPP (different infrastructure delivery models)	10	Develop a catalogue of national and international good practices in applying GPP in the construction sector (showcasing different infrastructure delivery models)	National or EU funding needed to develop the catalogue (or to be done in-house)	Ministry of Environment; Procurement Office; MTC
Consider introducing minimum recycled content requirements (other than through GPP)	11	Conduct an impact assessment study to define minimum recycled content requirements and to determine the optimal instrument to introduce minimum recycled content requirements for construction products	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; MTC
Support business model innovation for accessing secondary materials and developing new recovery processes and technologies	12	Support projects (through calls for proposals) for the establishment of decision-making tools for business managers, business support services, and innovation hubs	Operational Programme Slovakia (priority areas 1 More competitive and smarter Europe, and 2 Greener Europe)	Ministry of Environment; SEA
Future construction projects as pilots to test and apply circular economy principles and innovations	13	Financially support projects testing building information modelling (BIM), exploring the uses of material passports, and integrating these with reversible and modular building designs	Through EU/ national/ regional/local grant programmes or public procurement	Ministry of Environment; MTC
Stimulate the use of secondary and renewable materials in renovation	14	Set up a "renovation lab" programme providing incentive subsidies and sharing best practices for renovation projects using secondary and renewable materials.	National/regional grant programmes	Ministry of Environment; MTC
Strengthen the collaboration and partnerships between stakeholders	15	Set up a dedicated inter-ministerial working group to aid with the implementation of the roadmap recommendations for the construction sector	No specific budget implications	Ministry of Environment; MTC; Ministry of Economy
	16	Set up a working group with other stakeholders from the private sector and NGOs (a subgroup of the	No specific budget implications	Ministry of Environment; MTC

		existing circular economy stakeholder working group)		
Develop a comprehensive overview of the national building stock and its renovation needs	17	Update relevant legislation and strategy documents with Census 2021 results	No specific budget implications	MTC; Ministry of Economy
	18	Collect data on the total building stock for renovation (divided by type of buildings, such as single-family house, flat, apartment buildings, public and historical buildings), on renovation activities associated with circular economy (e.g. reuse of materials or components), as well as their respective unit costs (EUR per renovation activity) (e.g. via Census surveys and energy certificates)	National funding needed to operationalise data collection (or to be done in-house)	MTC; Ministry of Economy; Statistical Office

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies. SEA - Slovak Environment Agency, MTC - Ministry of Transport and Construction. At the time of writing this report, the proposed recommendations were not in place, however, some of them have been implemented as part of the RRP reform after the report was drafted.

Table 9.4. Nine key actions for a stronger circular construction sector in the medium to long term

Recommendation	No.	Action	Funding	Responsibility
Stimulate the use of secondary and renewable materials in renovation	1	Consider the introduction of tax incentives (e.g. tax credits/deductions or VAT reductions for renovations using high levels of secondary/renewable materials)	Budget implications are unknown, in general revenue losses from reduced taxes but cost savings on the side of industry and households	Ministry of Environment; Ministry of Finance; Ministry of Economy
Consider revising some of the zoning codes to include more flexibility in space distribution and utilisation	2	Awareness raising initiatives with municipalities being the target audience.	National or EU funding for such campaigns	Ministry of Environment; Municipalities
Strengthen GPP of construction works	3	Develop a tool to facilitate the preparation and evaluation of bids on green criteria (e.g. GRO sustainability tool for infrastructure projects in Flanders, a CO_2 performance ladder certification system in the Netherlands)	National or EU funding to finance a project to develop such a tool	Ministry of Environment; Ministry of Transport and Construction; Procurement Office
Explore the option of introducing aggregates taxes (Table 9.2)	4	Develop an impact assessment study of a possible introduction of aggregates taxes	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Transport and Construction; Ministry of Environment
Consider EPR for construction products	5	Develop a cost-benefit analysis study to assess the potential for EPR for construction products	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment
	6	If decision to introduce EPR for construction products, develop the relevant legislation	No specific budget implications.	
Develop a comprehensive overview of the national building stock and its renovation needs	7	Consider developing a digital strategy for the construction sector – introduce digital product passports (will become mandatory on EU level) and support BIM	National or EU funding for information and educational tools	Ministry of Transport and Construction; Ministry of Economy
Strengthen the collaboration and partnerships between stakeholders	8	Possibly set up an online platform to exchange good practices and build co-operation among actors from across the construction sector and the government	National or EU funding needed to run the platform	Ministry of Environment; Ministry of Transport and Construction
	9	Call for a research project (public-private collaboration) on the reuse potential of CDW in the Slovak Republic	National or EU funding needed to finance the project	

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies.

Investment needs to implement the proposed recommendations for the construction sector – estimates

This section develops an initial assessment of investment needs to implement the proposed recommendations and actions for the construction sector as a priority. This priority was chosen for assessment due to its high policy relevance and link to the legislative reform around construction and demolition waste, included in the Slovak RRP. This analysis offers an overview of the most directly incurred investment costs that arise due to the implementation of the proposed measures, but the assessment does not consider the full scale of possible costs. Not taken into account in the analysis, for example, are the costs of lost revenues due to the implementation of new tax exemptions or the costs related to the increased prices of some materials.

The assessment distinguishes between administrative and implementation costs. Administrative costs are associated with the design and implementation of policy measures, namely, the costs related to preparatory studies and change of legislation. Administrative costs would primarily be borne by the government and are related to almost all proposed policy recommendations. Implementation costs arise from the additional investments needed to finance the implementation of recommendations (e.g. the development of programmes, pilot projects, innovation hubs or collaborative platforms). Implementation costs may also include the additional funding needed to develop new waste management infrastructure to deal with increased recycling needs. Setting minimum recycled content targets, quality standards or raw materials taxes would lead to higher recycling rates of construction and demolition waste (CDW). This will increase the need for investments into new processing capacities. Unlike the administrative costs, implementation costs could be funded both from public and private sources, whereby a subsidy could support the funding of some of the implementation costs. The building of new waste infrastructure should be financed primarily by the private sector.

The analysis shows that the highest investment needs are associated with the implementation of innovation projects and programmes. For example, setting up an innovation hub is estimated to cost around EUR 28 million. A programme to support circular renovation could cost around EUR 3.5 million to EUR 8.4 million, based on examples of similar projects and programmes in other countries.

The second key investment cost relates to the building of new recycling and sorting infrastructure. We estimate that the investment costs for waste management infrastructure would range from no additional costs to EUR 3.6 million to achieve an 88% recycling rate of CDW (EU average in 2018) by implementing the proposed mix of recommendations. The range of these costs is relatively large as the costs depend on several factors:

- **Current recycling capacities for CDW and their availability**. The analysis assumes that the operational annual recycling capacity reaches approximately 200 000 tonnes based on the amount of CDW recycled in recent years. However, the current data on recycling capacities for CDW is highly uncertain. According to the official data on CDW recycling capacities in the Slovak Republic, currently, the recycling capacity is two to six times higher compared to the amount of waste recycled, which would imply that no additional investments are needed to increase the recycling capacity.
- **Current and future potential of CDW generation and treatment**. Based on available data from 2019, the lower and upper limits of CDW generation and treatment are 333 000–784 000 tonnes. The potential increase of CDW due to the renovation wave is estimated to lead to at least 100 000–280 000 tonnes annually.
- **Unit investment costs of building recycling facilities.** Based on available data, these costs range from EUR 1-5 per tonne of annual capacity, with the average value of EUR 2.3 per tonne of annual capacity.

The third group of key investment costs relate to the provision of training and the setup of collaborative platforms. Based on existing training costs, a unit cost of EUR 50 000 per training is expected. The costs of creating a collaboration platform are expected to range from EUR 100 000 to EUR 200 000. In the case of awareness-raising activities at the municipal level, the investment costs of EUR 38 000 to EUR 76 000 can be expected.

The last category of investment costs relates to administrative costs associated with measures requiring preparatory studies and a change of legislation (relevant to several policy recommendations). The cost of preparatory studies will depend on the depth and breadth of the study. The cost can be low (e.g. EUR 50 000-100 000) if the study evaluates a single policy solution, including available best practices. If the study requests a mix of tasks (e.g. alternative policy options and best practices; detailed data collection; stakeholder engagement; modelling to estimate impacts; development of overarching strategy/plan), the cost is expected to be higher (e.g. EUR 100 000-150 000). The costs associated with the change of legislation are estimated to be EUR 60 000.

There are no expected additional data collection investment costs associated with waste data management and the national building stock take (through Census surveys) as these initiatives are already ongoing. Additional data collection investment needs would be associated with applying digitalisation strategies in the construction sector. However, as this is a nascent topic, relevant estimates for implementing digitalisation strategies to collect additional data are limited. The scarce evidence points to investment costs of around EUR 7 000 to EUR 75 000, depending on the size of the project for the adoption of digital strategies for building renovation and construction pilot projects (e.g. BIM).

Including all the above cost elements, the total investment costs are estimated to be in the range of EUR 32-41 million. The table below shows the breakdown of possible investment costs per key policy recommendations.

Table 9.5. Overview of identified investment costs across prioritised policy recommendations

Recommendation	Life cycle phase	Administrative costs (public funding) (EUR)	Implementation costs (EUR)*	Explanation of the costing approach
Examine the potential of revising some of the zoning codes to include more flexibility in space distribution and utilisation	Use and renovation	No specific administrative costs	38 000 – 76 000 (cost of training at the municipal level)	Estimated range of cost of training is based on review of costs for training in various fields in the Slovak Republic (around EUR 100-200 per person). Assumption is that at least two people per office for department of building regulations would attend.
Investigate the potential of using fiscal instruments (tax benefits or subsidies) to stimulate the use of secondary and renewable materials in renovation	Use and renovation	60 000 (legislation) + 50 000 – 100 000 (preparatory study)	3.5 – 8.4 million (Setting up a "renovation lab" programme with a subsidy support) Additional investments in waste infrastructure (see the overall estimate below)	Estimated range of costs for conducting studies/training is based on own data and costs of similar projects for Member States with the EU funding. The costs of implementing the required legislation are based on a literature review.
Encourage business model innovation for accessing secondary materials and developing new recovery processes and technologies	Extraction, design and construction	No specific administrative costs	Up to 28 million (e.g. for setting up an innovation hub – it is the most advanced option for this recommendation)	The investment costs are based on a literature review of similar projects in the UK. The costs are adjusted by purchasing power parity and GDP per capita.

Use future construction projects as pilots to test and apply circular economy principles and innovations	Extraction, design and construction	No specific administrative costs	7 000 - 75 000 (adoption of BIM in pilot projects)	The investment costs are based on literature review of case studies adopting BIM during construction.
Consider introducing an aggregate tax to discourage the extraction of construction minerals	Extraction, design and construction	60 000 (legislation) + 50 000 – 100 000 (preparatory study)	No additional costs – 3.6 million** (cumulative costs for building additional waste management infrastructure related to the implementation of a package of policy recommendations)	Estimated range of costs for conducting studies/training is based on own data and costs of similar projects for Member States with the EU funding. The costs of implementing the required legislation are based on a literature review. Total investment costs of building waste management infrastructure are based on several factors, including current available recycling capacities, estimated future CDW generation, effectiveness of a policy, and unit investment costs of building recycling facilities. The data are based on a literature review and national statistics.
Introduce a quality standard for recycled construction materials	Extraction, design and construction	60 000 (legislation) + 50 000 – 100 000 (preparatory study)		
Introduce minimum recycled content requirements for specific construction products	Extraction, design and construction	60 000 (legislation) + 50 000 – 800 000 (preparatory study)		
Increase the use of GPP criteria in the construction sector to stimulate the market for sustainable buildings construction and renovation, possibly including minimum recycled content requirements as a GPP criterion	Extraction, design and construction	60 000 (legislation)		
Gradually increase the landfill taxes and reform the redistribution of proceeds from the landfill tax in combination with strengthened waste management enforcement	End-of-life and re-use and recycling	60 000 (legislation)		
Remove legal obstacles to the use of recycled materials by implementing end-of-waste criteria for some additional construction and building materials	End-of-life and re-use and recycling	60 000 (legislation)		
Introduce a mandatory selective demolition, including a system of inspection/audit before and after demolitions take place	End-of-life and re-use and recycling	50 000 (training materials and organization of training sessions for auditors)		
Consider expanding EPR to construction products or specific renovation waste	End-of-life and re-use and recycling	60 000 (legislation) + 100 000 – 150 000 (preparatory study)		
Strengthen the collaboration and partnerships between stakeholders from across the value chain	Cross-cutting	No specific administrative costs	200 000 max., depending on final set-up (platform creation and support)	Setting up a collaboration platform would require costs for 5 experts to develop its structure, engage the stakeholders and promote the platform. In addition, an office space rental and ICT equipment would be needed. The cost estimate is based on estimates from similar projects. Other activities, such as inter-ministerial collaboration or setting up the working group would not be associated with any specific investment costs.
Improve the measurement and monitoring of CDW flows from producers to final waste processors	Cross-cutting	No specific administrative costs	No specific implementation costs	The ISOH system should be available soon
Develop a comprehensive overview of the national building stock and its renovation needs	Cross-cutting	No specific administrative costs	No specific implementation costs (as data is collected through existing census surveys)	There might be additional implementation costs from the implementation of digitalisation strategies to improve data collection, such as digital renovation passports. Application of such digital strategies across the building stock in the Slovak Republic would be associated with significant costs. To date, however, there is no relevant literature on investment cost estimates.

Note: * Some implementation costs can be supported by public subsidies (a mix of public and private funding).
** Additional investments into waste infrastructure (including recycling capacity) are relatively low as, according to the official data on CDW recycling capacities in the Slovak Republic, no additional investments would be required.
*** The cost of preparatory studies will depend on the depth and breadth of the study.

Actions in the food and bio-waste value chain

Table 9.6. Ten key short-term actions for a circular food and bio-waste value chain in the Slovak Republic

Recommendation	No.	Action	Funding	Responsibility
Stimulate multi-stakeholder collaboration, with a specific focus on inter-ministerial collaboration	1	Set up a working group, a sub-group of the existing circular economy stakeholder working group, focusing on food and bio-waste issues. The core team (the Ministry of Environment, and the Ministry of Agriculture and Rural Development) will set the agenda of and the desired outcomes of this group	No specific budget implications (done in-house)	Ministry of Environment; Ministry of Agriculture and Rural Development
Support the development of a methodology to measure food waste and food losses and stimulate data collection	2	Improve data collection (set up a competent authority for data management, create a detailed waste catalogue and improve reporting methodology)	No specific budget implications (done in-house)	Ministry of Environment; Ministry of Agriculture and Rural Development; Statistical Office
	3	Develop an integrated quantification approach and methodology, covering the full value chain from primary production to households, including bio-waste destinations, in line with EU methodology (already planned)	National funding needed to develop the methodology (or to be done in-house).	
Strengthen economic instruments to provide food producers with incentives to reduce side flows at source and to make a stronger use of recycled materials	4	Strengthen incentive subsidies for entrepreneurs, start-ups, and research and innovation projects	Through EU/ national/ regional/local grant programmes	Ministry of Environment; Ministry of Education, Science, Research and Sport; Ministry of Economy; MIRRI
	5	Introduce GPP of food and catering services (e.g. in state-owned canteens and facilities) (already planned in the Slovak Republic)	No specific budget implications for the government (to be done in-house)	Ministry of Environment; Ministry of Agriculture and Rural Development; Public Procurement Office
Strengthen information and education tools on food waste prevention for the food industry	6	Develop information materials/guidance for the food industry on food waste prevention marketing techniques directed at consumers; guidance on food donations	Environmental Fund, OP Slovakia, municipalities budget or in-house	Ministry of Environment; Ministry of Agriculture; municipalities
Strengthen information and education tools on household food prevention strategies, sorting of household bio-waste and home composting	7	Develop effective campaigns and events on food waste prevention, date marking and social norms directed at consumers (also on out-of-home consumption); awards for positive behaviour (separation, no illegal dumping of waste)	Environmental Fund, OP Slovakia, municipalities budget or done in-house	Ministry of Environment; Ministry of Agriculture; municipalities
Consider extending financial support for bio-waste processing and composting facilities to additional actors in the value chain	8	Consider adjusting the existing financial support for bio-waste facilities (through EU funds) by extending the eligibility for such funds to additional actors.	Existing EU funds	Ministry of Environment; Ministry of Agriculture
Adopt legislation setting requirements for compost and digestate, including for relevant facilities	9	Develop legislation setting requirements for AD and composting facilities, and their outputs (already planned within the WMP 2021-2027)	No specific budget implications for the government (to be done in-house)	Ministry of Environment; Ministry of Agriculture
Expand the coverage of well-designed PAYT schemes across the country (Table 9.1)	10	Targeted education and information campaigns to promote waste sorting by households and PAYT, ideally incorporating behavioural insights and incentives	Environmental Fund, OP Slovakia, municipalities budget	Ministry of Environment; Slovak Environment Agency; municipalities

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies. MIRRI - Ministry of Investments and Regional Development, OP – Operational Programme.

Table 9.7. Seven medium to long-term actions for a circular food and bio-waste value chain

Recommendation	No.	Action	Funding	Responsibility
Stimulate multi-stakeholder collaboration, with a specific focus on inter-ministerial collaboration	1	Provide the sub-group with a formal status and legal mandate with supporting funding	Additional funds needed to support the sub-group.	Ministry of Environment; Ministry of Agriculture and Rural Development
Consider additional tax advantages for food donations and simplify relevant regulatory framework	2	Develop a study assessing the impact and feasibility of additional tax advantages to stimulate food donations and how to simplify the existing regulatory framework (or consider the existing study for Free Food)	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; Ministry of Agriculture and Rural Development
Consider introducing tax benefits supporting food waste prevention and valorisation rather than AD and recycling	3	Develop a study assessing the impact and feasibility of additional tax advantages, e.g. tax credits, VAT reductions)	National or EU funding needed to develop the study (or to be done in-house)	Ministry of Environment; Ministry of Agriculture and Rural Development
Engage and support stakeholders from animal (feed) production to map the availability of suitable surplus resources as animal feed that are allowed under the current EU legislation	4	Set up a research project or a public-private partnership to discuss potential valorisation options with stakeholders (e.g. for animal feed)	National or EU funding needed to support the research	Ministry of Environment; Ministry of Agriculture and Rural Development
Reconsider the planned removal of the "best before" date from food labelling	5	Do not remove the "best before" date.	No budget implications	Ministry of Environment; Ministry of Agriculture and Rural Development
Strengthen information and education tools on household food waste prevention strategies, sorting of household bio-waste and home composting	6	Integrate food waste prevention into curricula; Conduct research into behavioural insights	Environmental Fund, OP Slovakia, or done in-house	Ministry of Environment; Ministry of Agriculture
Move beyond volume and frequency subscription based schemes, towards sack- or weight-based schemes (Table 9.2)	7	Targeted education and information campaigns to promote waste sorting by households and PAYT, ideally incorporating behavioural insights and incentives	Environmental Fund, OP Slovakia, municipalities budget	Ministry of Environment; Slovak Environment Agency; municipalities

Note: All recommendations will require in-kind contributions from the staff to prepare (legislative) proposals and studies. OP – Operational Programme.

A monitoring framework to support the implementation of the roadmap

A circular economy monitoring framework is needed to help measure the progress towards specific targets and goals of the roadmap over time through a set of indicators. It will help Slovak policy makers understand how the country is performing on selected circular economy indicators and identify areas for further intervention. The monitoring should also form the basis for setting new circular economy long-term priorities (European Commission, 2018[175]) and deliver feedback to strategy and planning development for the different actors in the economy (Alaerts et al., 2019[229]). This is consistent with the two general aims of indicators: forward-looking to provide guidance, and backward-looking to provide feedback and review of performance (Ekins et al., 2019[230]).

A circular economy monitoring framework can take a variety of forms, draw on an extensive set of existing indicators and those under development, as well as aim to develop its own set of indicators. Existing circular economy monitoring frameworks include a larger set of relevant indicators, as capturing circular economy by a single indicator is challenging owing to the circular economy's cross-cutting and wide-ranging definition. The monitoring frameworks can take the form of a set of individual indicators, which are not necessarily linked, or they can be structured using a multi-tiered approach with a limited number of headline indicators (for communication purposes) complemented by a dashboard of concrete thematic indicators. A multi-layered approach allows for the introduction of more detailed information on additional

levels (e.g. regional, city, sectoral or product groups levels) or on specific strategic objectives and recommendations.

Existing indicator sets largely contain macro-level indicators related to resource flows, waste generation, recycling and recovery rates of specific waste streams, secondary materials use, but also jobs related to circular activities. For example, the EU's circular economy monitoring framework offers a default set of 10 macro-level indicators (in total 23 individual indicators) grouped into four categories of indicators: (1) production and consumption; (2) waste management; (3) secondary raw materials; and (4) competitiveness and innovation for the circular economy (Table 9.8). Some policy related circular economy monitoring frameworks also include additional indicators capturing other aspects of a transition to a circular economy on the national level, for example:

- Consumer behaviour measured as household spending on maintenance and repair, the extent of car-sharing (both in the French monitoring framework), or the percentage of citizens choosing alternatives to buying a new product (in the EU eco-innovation scoreboard).
- Business behaviour measured by the amount of financing sources spent on a circular economy or practices related to extending the lifetime of products (in the EU eco-innovation scoreboard and in the Dutch monitoring framework).
- Mass media coverage measured by the number of articles published on circular economy (in the EU eco-innovation scoreboard).

Several ongoing initiatives exist on an international level, which aim to further conceptualise and develop circular economy monitoring frameworks for policy makers (e.g. initiatives led by the European Commission, United Nations Economic Commission for Europe [UNECE], Platform for Accelerating the Circular Economy [PACE], European Environment Agency and the OECD). The academic literature and experts strongly suggest going beyond the commonly used macro-level indicators to include indicators that provide direct feedback to policy on specific products and services, addressing consumer and business behaviour as well as societal needs related to a circular economy (the so-called "meso" level indicators) (Alaerts et al., 2019[229]; Giljum et al., 2011[231]; Ekins et al., 2019[230]; Potting et al., 2018[232]). A need for additional indicators to properly measure the effects and the transition process itself, connecting circular economy to environmental impacts, and capturing possible rebound effects has also been called for (e.g. the Dutch monitoring framework should include such indicators) (Potting et al., 2018[232]; Alaerts et al., 2019[229]). The current key challenges centre around data gaps and the lack of robust methodologies to develop timely and regularly reported-on indicators, as well as the challenge to select a limited number of indicators that are easily understood and communicated to the public by policy makers (some suggest using a maximum of ten key indicators).

Proposal for a Roadmap monitoring framework composed of headline indicators supported by a dashboard of thematic indicators

The proposed monitoring framework to support the implementation of the future roadmap has a two-tier structure:

1. **A set of headline indicators restating the EU circular economy monitoring framework** consisting of a set of 10 macro-level indicators (in total 23 individual indicators) grouped into four categories (Table 9.8). The Slovak Republic needs to report on this set of indicators (and is already reporting on those that are available - e.g. on Enviroportal). The European Commission is currently updating the EU CE monitoring framework, and the Slovak Republic could play a role in these discussions and adopt any changes within the roadmap's monitoring framework once it is made available. Some of these indicators cut across the three priorities but others are priority specific (e.g. food waste or the recovery rate of construction and demolition waste).

2. **Additional, experimental and operational indicators per priority area** (Table 9.9). These indicators would monitor the progress made on specific recommendations and actions. Some of these indicators could be qualitative, for instance, some of the operational indicators monitoring the progress made on specific implementation actions (e.g. the action has started, is ongoing or completed). Others are currently at an experimental stage requiring further development of the indicator or additional data collection (e.g. monitoring the revenues generated from specific environmental taxes). The Slovak Republic may reconsider this list of indicators during the preparation of the future roadmap and select those indicators for which data might become available (e.g. once the Waste Management Information System (ISOH) becomes fully operational or through ad hoc surveys).

Table 9.8. Proposed headline indicators based on the EU circular economy monitoring framework

No	Indicator group	Name indicator
Production and consumption		
1	Waste generation	Generation of municipal waste per capita (Kg per capita)
2		Generation of waste excluding major mineral wastes per GDP unit (Kg per thousand euro, chain linked volumes (2010))
3		Generation of waste excluding major mineral wastes per domestic material consumption (%)
4	Food waste	Amount of food waste generated (million tonnes)
Waste management		
5	Recycling rates	Recycling rate of municipal waste (%)
6		Recycling rate of all waste excluding major mineral waste (%)
7	Recycling/recovery for specific waste streams	Recycling rate of overall packaging (%)
8		Recycling rate of plastic packaging (%)
9		Recycling rate of wood packaging (%)
10		Recycling rate of e-waste (%)
11		Recycling of bio-waste (kg per capita)
12		Recovery rate of construction and demolition waste (%)
Secondary raw materials		
13	Contribution of recycled materials to raw materials demand	Circular material use rate (%)
14	Trade in recyclable raw materials	Imports from non-EU countries
15		Exports to non-EU countries
16		Intra EU trade
Competitiveness and innovation		
17	Private investments, jobs and gross value added related to circular economy sectors	Gross investment in tangible goods (% of GDP at current prices)
18		Persons employed (% of total employment)
19		Value added at factor cost (% of GDP at current prices)
20	Number of patents related to waste management and recycling	Number of patents related to waste management and recycling

Source: European Commission (2018[175]).

Potential criteria to select priority-specific indicators for the future roadmap include (adapted from OECD (2011[233])):

- **Policy relevance**. Provide a balanced coverage of the key aspects covered by the roadmap.
- **Analytical soundness**. The indicators should be analytically sound and benefit from a consensus about their validity.
- **Measurability**. The indicators should be based on data that are available or that can be made available at a reasonable cost, and that are of known quality and regularly updated.

The Slovak Republic will need to decide on the frequency of reporting on the indicators selected for the monitoring of the future roadmap.

Table 9.9. Proposed dashboard of specific indicators

Name indicator	Description	Justification	Source
Sustainable consumption and production with a focus on economic instruments			
Resource productivity	Measures the total amount of materials directly used by an economy	Headline indicator for the EU Resource efficiency roadmap	Eurostat
Green Public Procurement (%)	Measures the GPP share in public contracts (in volume and value) across all procured products and services	Link to a national target by 2030 (in Envirostrategy 2030), data already being collected and additional data collection foreseen by 2023, a key policy instrument of the roadmap, focused on the supply of sustainable products and services, GPP is included in the EU circular economy monitoring framework	Public Procurement Office (Government Office of the Slovak Republic) (through eForms)
The amount of tax revenues or tax savings generated from CE related tax instruments	Measures the use of economic instruments for the CE	To monitor if the use of environmental taxes for CE is increasing	Indicator(s) not existing, data not systematically collected and aggregated
Eco-innovation index	Composite indicator measuring the progress made on eco-innovation	EU Eco-innovation scoreboard	EU Eco-innovation scoreboard
Revenues on repair activities	Measures the amount of EUR spent on repair activities	The French monitoring framework includes this indicator, but the data was collected by a survey	As reported to Eurostat or would require specific surveys
Number of eco-label holders/product categories	Measures the uptake of eco-labelling.	Data is already collected. Included in the French monitoring framework	Ministry of Environment
Consumption footprint	Measures the environmental footprint of consumption rather than production	Estimates already exist for the EU level and its Member States	European Platform on Life Cycle Assessment; Enviroportal
Consumer surveys on circular economy related behaviour	Measures environmental attitudes of consumers and circular consumption patterns	To understand the attitudes and consumption patterns of consumers	Indicator not existing, data not systematically collected and aggregated, partly done by Eurobarometers and consumer surveys on EU level.
Mixed municipal waste (kg/cap)	Measures the amount of mixed municipal waste generated per capita	It seems important to monitor the evolution of mixed municipal waste, but the indicator is linked to some of the other municipal waste indicators	Ministry of Environment
Landfill rate of municipal waste (%)	Measures the rate of landfilling of municipal waste	EU target	Reported to Eurostat
Landfill rate of recyclable/recoverable waste (%)	Measures the rate of landfilling of individual waste fractions	To monitor if the landfilling of recyclable/recoverable waste is on the decline	ISOH (Ministry of Environment)
Hazardous waste production and methods of its treatment	Measures the amount of hazardous waste produced and how it is treated.	To monitor the evolution of hazardous waste generated and treated over time	Eurostat
Separate collection rate of selected components of municipal waste (metals, paper and cardboard, glass, plastics packaging, biodegradable waste, used batteries and accumulators)	The amount of separately collected individual waste fractions or their percentage share out of the total products/materials placed on the market	To monitor if separate collection of individual waste fractions is increasing	Ministry of Environment
Separate collection rate of municipal waste (%)	Measures the percentage share of total municipal waste that is separately collected	To monitor if total separate collection of municipal waste is increasing	Ministry of Environment
Action specific indicators	Monitors the implementation status of	To measure the progress made on the	Indicators and data to be

	concrete actions.	implementation of the recommendations of the future roadmap	provided by the Ministry of Environment
Construction sector			
Extraction of construction materials (million tonnes)	Measures the amount of extracted construction materials	To monitor if the extraction volume is decreasing over time	State Geological Institute of Dionýz Štúr
Domestic Material Consumption of construction minerals	Measures the total amount of construction materials directly used by an economy	To monitor if the domestic material consumption of construction materials is decreasing	Eurostat
Share of recycled CDW used in new construction/renovation	Measures the extent of the use of recycled CDW in the construction sector	To monitor if the use of recycled CDW is increasing	Experimental indicator for which data is not yet available
GPP of construction and renovation activities (%)	GPP share in public infrastructure contracts (in volume and value)	Link to a national target by 2030 (in Envirostrategy 2030), data collected, a key policy instrument of the roadmap, focused on the supply of sustainable products and services, GPP in the EU circular economy monitoring framework	Public Procurement Office (Government Office of the Slovak Republic) (through eForms)
Uptake of circular renovations	Measures the extent to which renovations of buildings consider circular economy principles	To monitor if the use of secondary and alternative materials in renovations is increasing	Experimental indicator for which data is not yet available
Generation of CDW (total and per capita)	Measures the amount of CDW generated	Important to monitor the impact of measures on the generation of CDW.	Ministry of Environment
Landfill rate of inert and construction waste	Measures the rate of landfilling of inert and CDW	To monitor if the landfill rate of inert and CDW is decreasing	Ministry of Environment
Backfilling rate of CDW	Measures the rate of CDW that is used for backfilling not recycling	To monitor if the backfilling rate is decreasing.	Ministry of Environment
Action specific indicators	Monitors the implementation status of concrete actions.	To measure the progress made on the implementation of the recommendations of the future roadmap	Indicators and data to be provided by the Ministry of Environment
Food and bio-waste value chain			
Investment into food waste prevention	Measures the extent of public and private funds raised to support food waste prevention measures	To monitor the total investment made into supporting food waste prevention strategies.	Experimental indicator for which data is not yet available
GPP of food and catering services	Measures the uptake of GPP of food and catering services in public contracts (in volume and value)	Link to a national target by 2030 (in Envirostrategy 2030), data collected, a key policy instrument of the roadmap, focused on the supply of sustainable products and services, GPP in the EU circular economy monitoring framework	Public Procurement Office (Government Office of the Slovak Republic) (through eForms)
Uptake of food donations	Measures the quantity of donated food	To monitor if the amount of donated food is increasing	Data is not currently available
Recycling rate of municipal waste - composting	Measures the rate of composting of municipal waste	To measure if composting of bio-waste is increasing	Reported to Eurostat
Uptake of home composting	Measures the extent of home composting	To measure if home composting is increasing	Data is not currently available
Action specific indicators	Monitors the implementation status of concrete actions	To measure the progress made on the implementation of the recommendations of the future roadmap	Indicators and data to be provided by the Ministry of Environment

Annexes

The Annexes to this report are contained within a separate document uploaded on https://www.oecd.org/environment/waste/circular-economy-country-studies.htm. The list of annexes is the following:

- Annex A. European Circular Economy-Related Regulatory Framework
- Annex B. Analysis of National Circular Economy Roadmaps and Strategies across Selected EU Member States
- Annex C. Stocktake of the Slovak Circular Economy Policy Landscape
- Annex D. Measures Promoting Sustainable Consumption and Production with a Focus on Economic Instruments
- Annex E. Circular Economy in the Construction Sector
- Annex F. Circular Economy in the Food and Bio-waste Value Chain
- Annex G. Links between Circular Economy and Greenhouse Gas Emissions

References

(n.a.) (2020), *Twee houdbaarheidsdatums [Two expiration dates]*, https://www.youtube.com/watch?v=F4cAZqy5abc. [196]

Alaerts, L. et al. (2019), "Towards a more direct policy feedback in circular economy monitoring via a societal needs perspective", *Resources, Conservation and Recycling*, Vol. 149, pp. 363-371, https://doi.org/10.1016/j.resconrec.2019.06.004. [229]

Arup (2016), *Circular Economy in the Built Environment*, https://www.arup.com/perspectives/publications/research/section/circular-economy-in-the-built-environment. [81]

ASB (2022), *Ako „upratať" územný plán Bratislavy? [How to "tidy" the zoning plan of Bratislava?]*, https://www.asb.sk/aktualne/ako-upratat-uzemny-plan-bratislavy (accessed on 16 May 2022). [142]

Austrian Ministry for Agriculture and Forestry, E. (2009), *The State of the Art of Composting*, https://www.bmk.gv.at/dam/jcr:69c43c71-1844-4c52-8d0c-20e0d9ced59f/Richtlinie_Kompost_en.pdf (accessed on 5 April 2022). [201]

BAMB (n.d.), *BUILD REVERSIBLE IN CONCEPTION (B.R.I.C.)*, https://www.bamb2020.eu/topics/pilot-cases-in-bamb/bric/ (accessed on 4 February 2022). [139]

BAMB (n.d.), *New office building*, https://www.bamb2020.eu/topics/pilot-cases-in-bamb/new-office-building/ (accessed on 4 February 2022). [135]

Benachio, G., M. Freitas and S. Tavares (2020), *Circular economy in the construction industry: A systematic literature review*, https://doi.org/10.1016/j.jclepro.2020.121046. [163]

BIM Asociácia Slovensko (2021), *Národná BIM Konferencia*, https://www.bimas.sk/bim-konferencia-2021 (accessed on 25 February 2022). [133]

BIO Intelligence Service, Cambridge Econometrics and European Commission (2014), *Study on modelling of the economic and environmental impacts of raw material consumption*, European Commission, https://op.europa.eu/en/publication-detail/-/publication/15b47bd3-ce94-46a4-99a9-2206f4fdc658 (accessed on 4 June 2021). [215]

Blok, M. (n.d.), *Prospecting the Urban Mines of Amsterdam*, https://www.metabolic.nl/projects/prospecting-the-urban-mines-of-amsterdam-puma/. [136]

Bos-Brouwers, H. et al. (2020), *Changing the rules of the game: Impact and feasibility of policy and regulatory measures on the prevention and reduction of food waste*. [186]

BRE, Deloitte, FCT, ICEDD, RPS, VTT (2017), *Resource efficient use of mixed wastes improving* [86]

management of construction and demolition waste, https://op.europa.eu/en/publication-detail/-/publication/78e42e6c-d8a6-11e7-a506-01aa75ed71a1/language-en.

Bruxelles Capitale (2019), *Stratégie de réduction de l'impact environnemental du bati existant en Région de Bruxelles-Capitale aux horizons 2030-2050*, https://energy.ec.europa.eu/system/files/2020-03/bruxelles_capitale_2020_ltrs_0.pdf. [100]

Cár, M. (2015), *Vybrané aspekty bývania v európskych krajinách [Selected aspects of housing in European countries]*, https://www.nbs.sk/_img/Documents/_PUBLIK_NBS_FSR/Biatec/Rok2015/09-2015/biatec_09_2015_03Car.pdf. [219]

CBRE (2015), *Asia Pacific Major Report - Space Utilisation: The Next Frontier September 2015*, https://www.cbre.com/research-and-reports/apac-space-utilisation-the-next-frontier. [222]

CEWEP (2021), *Landfill taxes and bans*, CEWEP, https://www.cewep.eu/wp-content/uploads/2021/10/Landfill-taxes-and-bans-overview.pdf. [70]

Circle Economy (2020), *Will you be my partner? Nine steps to identify and establish successful collaborations for a circular economy*, https://www.circle-economy.com/resources/will-you-be-my-partner-collaborations-in-the-circular-economy. [102]

Circle Economy (2019), *Building blocks for the new strategy Amsterdam Circular 2020-2025*, https://assets.website-files.com/5d26d80e8836af2d12ed1269/5de954d913854755653be926_Building-blocks-Amsterdam-Circular-2019.pdf (accessed on 21 April 2022). [146]

Circle Economy, DGBC, Metabolic (2021), *Framework voor circulaire bestaande gebouwen*, https://www.dgbc.nl/publicaties/framework-voor-circulaire-gebouwen-27. [80]

Circle-Economy (2021), *The Circularity Gap Report 2021*, Circle-Economy, PACE, https://www.circularity-gap.world/2021 (accessed on 4 June 2021). [212]

Circular Cities Declaration (n.d.), *Wiltz, Luxembourg*, https://circularcitiesdeclaration.eu/cities/wiltz#:~:text=Wiltz%20has%20been%20nominated%20%E2%80%9CNational,in%20this%20field%20since%20then. (accessed on 4 March 2022). [124]

City of Seattle (n.d.), *Housing Affordability and Livability*, http://www.seattle.gov/hala. [144]

Commission of the European Communities (2008), "Green Paper on the management of bio-waste in the European Union", https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52008DC0811&from=EN (accessed on 10 May 2022). [238]

Condotta, M. and E. Zatta (2021), "Reuse of building elements in the architectural practice and the European regulatory context: Inconsistencies and possible improvements", *Journal of Cleaner Production*, Vol. 318, p. 128413, https://doi.org/10.1016/j.jclepro.2021.128413. [113]

Constructing Excellence (2020), *Totally Modular Pilot Scheme for Citizen Housing*, https://constructingexcellence.org.uk/totally-modular-pilot-scheme-for-citizen-housing/ (accessed on 4 February 2022). [138]

CSCP (2021), *Advancing Change Towards the Circular Behaviours That Really Matter*, https://www.scp-centre.org/ciap-launch/ (accessed on 1 October 2021). [59]

de Sadeleer, I., H. Brattebø and P. Callewaert (2020), "Waste prevention, energy recovery or recycling - Directions for household food waste management in light of circular economy policy", *Resources, Conservation and Recycling*, Vol. 160, p. 104908, https://doi.org/10.1016/j.resconrec.2020.104908. [225]

Delgado, L. et al. (2009), *End-of-Waste Criteria*, https://doi.org/10.2791/28650. [156]

Deloitte (2016), *Circular economy potential for climate change mitigation*, Deloitte Sustainability, https://www2.deloitte.com/content/dam/Deloitte/fi/Documents/risk/Deloitte%20-%20Circular%20economy%20and%20Global%20Warming.pdf (accessed on 4 June 2021). [217]

Dodd, N., E. Garbarino and M. Gama Caldas (2016), *Green Public Procurement Criteria for Office Building Design, Construction and Management Technical background report and final criteria*, https://doi.org/10.2791/28566. [116]

Dráb, J. and S. Slučiaková (2018), *Skutočná cena zálohy (Real price of deposit)*, Institute for Environmental Policy of the Slovak Ministry of Environment, Bratislava, https://www.minzp.sk/iep/publikacie/ekonomicke-analyzy/skutocna-cena-zalohy.html. [67]

Duren, R. et al. (2019), "California's methane super-emitters", *Nature*, Vol. 575/7781, pp. 180-184, https://doi.org/10.1038/s41586-019-1720-3. [206]

Eco-innovation Observatory (2020), *Eco-innovation in Slovakia 2018-2019*, European Commission, https://ec.europa.eu/environment/ecoap/sites/default/files/field/field-country-files/eio_country_profile_2018-2019_slovakia.pdf (accessed on 8 November 2021). [53]

Eco-innovation Observatory (2019), *Eco-Innovation Scoreboard*, https://ec.europa.eu/environment/ecoap/indicators/index_en (accessed on 24 September 2020). [48]

Ekins, P. et al. (2019), *The Circular Economy: What, Why, How and Where*, http://www.oecd.org/cfe/regional-policy/Ekins-2019-Circular-Economy-What-Why-How-Where.pdf (accessed on 22 May 2020). [230]

Ellen MacArthur Foundation (2015), *Delivering the Circular Economy: A Toolkit for Policymakers*, Ellen MacArthur Foundation, https://www.ellenmacarthurfoundation.org/publications/delivering-the-circular-economy-a-toolkit-for-policymakers (accessed on 10 December 2020). [31]

Ellen MacArthur Foundation (2013), *Towards the circular economy - Opportunities for the consumer goods sector*, https://emf.thirdlight.com/link/coj8yt1jogq8-hkhkq2/@/preview/1?o. [58]

Ellen MacArthur Foundation and Material Economics (2019), *Completing the picture: How the circular economy tackles climate change*, https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf. [208]

Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment (2015), *Growth within: A circular economy vision for a competitive Europe*, Ellen MacArthur Foundation, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf (accessed on 4 June 2021). [213]

EPR Canada (2017), *Overview of the State of EPR in Canada: What Have We Learned?*, http://eprcanada.ca/reports/2017/Overview-of-the-State-of-EPR-in-Canada-long-version- [165]

EN.pdf.

EU Platform on Food Losses and Food Waste (2019), *Redistribution of surplus food: Examples of practices in the Member States*, EU Platform on Food Losses and Food Waste, https://ec.europa.eu/food/system/files/2019-06/fw_eu-actions_food-donation_ms-practices-food-redis.pdf (accessed on 14 January 2022). [192]

EUBIM (2019), *5th National BIM Conference in Slovakia*, http://www.eubim.eu/5th-national-bim-conference-slovakia/. [132]

Eunomia et al. (2014), *Impact Assessment on Options Reviewing Targets in the Waste Framework Directive, Landfill Directive and Packaging and Packaging Waste Directive*, European Commission, https://www.eunomia.co.uk/reports-tools/impact-assessment-on-options-reviewing-targets-in-the-waste-framework-directive-landfill-directive-and-packaging-and-packaging-waste-directive/ (accessed on 4 June 2021). [228]

Euractiv (2021), *Ivana Maleš: Žiadne mesto nebude bez odpadov, Bratislava sa k tomu chce priblížiť [Ivana Maleš: No city will be waste-free, Bratislava wants to get closer to this aim]*, https://euractiv.sk/section/ekonomika-a-euro/interview/males-o-bratislavskom-odpade-ziadne-mesto-nebude-bez-odpadov-bratislava-sa-k-tomu-chce-priblizit/. [177]

Euractiv (2014), *The sustainable sourcing of materials is crucial to the circular economy*, https://www.euractiv.com/section/sustainable-dev/opinion/the-sustainable-sourcing-of-materials-is-crucial-to-the-circular-economy/ (accessed on 30 September 2021). [41]

European Commission (2022), “COM (2022) 140 - Communication on making sustainable products the norm”, https://ec.europa.eu/environment/publications/communication-making-sustainable-products-norm_en (accessed on 21 April 2022). [125]

European Commission (2022), “COM (2022) 144 - Proposal for a Regulation laying down harmonised conditions for the marketing of construction products, amending Regulation (EU) 2019/1020 and repealing Regulation (EU) 305/2011”, https://ec.europa.eu/docsroom/documents/49315 (accessed on 21 April 2022). [99]

European Commission (2021), *Authorisation to feed non-ruminants with ruminant collagen / gelatine and with proteins from insects, pigs and poultry*, https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/11640-Authorisation-to-feed-non-ruminants-with-ruminant-collagen-gelatine-and-with-proteins-from-insects-pigs-and-poultry_en (accessed on 14 January 2022). [193]

European Commission (2021), *Disrupting the linear model: LIFE and the circular economy*, https://cinea.ec.europa.eu/publications/disrupting-linear-model-life-and-circular-economy_en. [105]

European Commission (2021), *Guidance on reporting of data on food waste and food waste prevention according to Commission Implementing Decision (EU) 2019/2000*, Eurostat, https://ec.europa.eu/eurostat/documents/342366/351811/Guidance+on+food+waste+reporting/5581b0a2-b09e-adc0-4e0a-b20062dfe564 (accessed on 4 January 2022). [169]

European Commission (2021), *Key consumer data*, https://ec.europa.eu/info/policies/consumers/consumer-protection-policy/key-consumer-data_en (accessed on 17 January 2022). [62]

European Commission (2021), *Programme for the Environment and Climate Action (LIFE) - Call for proposals*, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/life/wp- [106]

call/2021-2024/call-fiche_life-2021-sap-env_en.pdf (accessed on 2 March 2022).

European Commission (2021), “SWD (2021) 365 - Analysis of the national long-term renovation strategies”, https://energy.ec.europa.eu/system/files/2021-12/swd-on-national-long-term-renovation-strategies.pdf (accessed on 21 April 2022). [141]

European Commission (2020), *A new Circular Economy Action Plan: For a cleaner and more competitive Europe*, https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6388-11ea-b735-01aa75ed71a1.0017.02/DOC_1&format=PDF. [3]

European Commission (2020), *Circular Economy - Principles for Building Design*, https://ec.europa.eu/docsroom/documents/39984 (accessed on 3 February 2022). [126]

European Commission (2020), *European Semester 2020 Slovakia*, European Commission, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0524&from=EN (accessed on 18 November 2020). [6]

European Commission (2020), *Food redistribution in the EU - Mapping and analysis of existing regulatory and policy measures impacting food redistribution from EU Member States*, Publications Office, https://data.europa.eu/doi/10.2875/406299. [185]

European Commission (2020), *Recovery plan for Europe*, https://ec.europa.eu/info/strategy/recovery-plan-europe_en (accessed on 2 December 2020). [20]

European Commission (2020), *Special Eurobarometer 501 - Attitudes of European Citizens towards the Environment*, https://europa.eu/eurobarometer/surveys/detail/2257 (accessed on 1 October 2021). [55]

European Commission (2020), *Study to assess member states (MS) practices on by-product (BP) and end-of waste (EoW)*, https://op.europa.eu/en/publication-detail/-/publication/beb56eaa-9fc0-11ea-9d2d-01aa75ed71a1/language-en/format-PDF/source-130896232. [154]

European Commission (2019), *Commission delegated decision on common methodology and minimum quality requirements for the uniform measurement of levels of food waste*. [170]

European Commission (2019), *The Environmental Implementation Review 2019 - Country Report Slovakia*, https://ec.europa.eu/environment/eir/pdf/report_sk_en.pdf (accessed on 1 October 2021). [4]

European Commission (2019), *The European Green Deal*, European Commission, Brussels, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN (accessed on 20 November 2020). [2]

European Commission (2018), *Communication on a monitoring framework for the circular economy*, https://ec.europa.eu/environment/circular-economy/pdf/monitoring-framework.pdf. [175]

European Commission (2018), *Market study on date marking and other information provided on food labels and food waste prevention*, Publications Office, https://data.europa.eu/doi/10.2875/808514. [190]

European Commission (2017), *Commission notice — EU guidelines on food donation*, Official Journal of the European Union, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017XC1025(01) (accessed on 14 January 2022). [191]

European Commission (2016), *EU Construction and Demolition Waste Management Protocol*, https://ec.europa.eu/docsroom/documents/20509/ (accessed on 2 February 2022). [160]

European Commission (2016), *EU Platform on Food Losses and Food Waste*, https://ec.europa.eu/food/safety/food-waste/eu-actions-against-food-waste/eu-platform-food-losses-and-food-waste_en (accessed on 4 January 2022). [176]

European Commission (2015), *Closing the loop - An EU action plan for the Circular Economy*, http://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF (accessed on 16 November 2019). [19]

European Commission (2014), *European Resource Efficiency Platform*, https://ec.europa.eu/environment/resource_efficiency/re_platform/index_en.htm (accessed on 17 March 2022). [18]

European Commission (2012), *Use of economic instruments and waste management performances*, https://op.europa.eu/en/publication-detail/-/publication/566f28fd-3a94-4fe0-b52d-6e40f8961c7e (accessed on 5 February 2022). [148]

European Commission (2011), *Service contract on management of construction and demolition waste – SR1*, https://op.europa.eu/en/publication-detail/-/publication/0c9ecefc-d07a-492e-a7e1-6d355b16dde4 (accessed on 5 February 2022). [153]

European Commission (2011), *Taxes on natural resources reduce use of raw materials*, DG Environment News Alert Service, https://ec.europa.eu/environment/integration/research/newsalert/pdf/262na1_en.pdf. [108]

European Commission (n.d.), *EMAS Cost and resource savings through efficiency*, https://ec.europa.eu/environment/emas/emas_for_you/premium_benefits_through_emas/cost_and_resource_savings_through_efficiency_en.htm (accessed on 16 November 2021). [49]

European Commission (n.d.), *EU Buildings Factsheets*, European Commission, https://ec.europa.eu/energy/eu-buildings-factsheets_en (accessed on 4 June 2021). [218]

European Commission Construction Sector Observatory (2019), *Country profile Denmark*, European Commission, https://www.buildup.eu/sites/default/files/content/ecso_cfs_denmark_2020.pdf. [96]

European Compost Network (2022), *Guidance on Separate Collection*, https://www.compostnetwork.info (accessed on 5 April 2022). [202]

European Construction Sector Observatory (2021), “Digitalisation in the construction sector”, https://ec.europa.eu/docsroom/documents/45547/attachments/1/translations/en/renditions/pdf (accessed on 27 January 2022). [98]

European Construction Sector Observatory (2019), *Building Information Modelling in the EU construction sector*, https://ec.europa.eu/docsroom/documents/34518 (accessed on 4 February 2022). [130]

European Environment Agency (2020), *Bio-waste in Europe - turning challenges into opportunities*, EEA, https://www.eea.europa.eu/publications/bio-waste-in-europe. [172]

European Environment Agency (2020), *Construction and Demolition Waste: challenges and opportunities in a circular economy*, https://www.snpambiente.it/wp- [112]

content/uploads/2020/08/Clean-Version_CDW-and-CE-Report-version-January-10-2020_final.pdf (accessed on 1 February 2022).

European Environment Agency (2020), “Cutting greenhouse gas emissions through circular economy actions in the buildings sector”, *Briefing*, No. 6, European Environment Agency, https://www.eea.europa.eu/publications/cutting-greenhouse-gas-emissions-through [79] (accessed on 4 June 2021).

European Environment Agency (2017), *Circular by design - Products in the circular economy*, https://www.eea.europa.eu/publications/circular-by-design [39] (accessed on 30 September 2021).

European Environment Agency (2013), *Managing municipal solid waste - a review of achievements in 32 European countries - managing_municipal_solid_waste_2013.pdf*, http://www.cri.dk/sites/cri.dk/files/dokumenter/artikler/managing_municipal_solid_waste_2013.pdf [179].

Eurostat (2022), *Circular economy indicators - Recovery rate of construction and demolition waste*, https://ec.europa.eu/eurostat/databrowser/view/cei_wm040/default/table?lang=en [147] (accessed on 25 February 2022).

Eurostat (2022), *Living conditions data*, https://ec.europa.eu/eurostat/databrowser/explore/all/popul?lang=en&subtheme=livcon.ilc.ilc_lv&display=list&sort=category&extractionId=ILC_LVHO03__custom_1513490 [221] (accessed on 21 April 2022).

Eurostat (2022), *Municipal waste statistics*, European Commission, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Municipal_waste_statistics [68] (accessed on 14 June 2021).

Eurostat (2021), *Circular economy indicators*, European Commission, https://ec.europa.eu/eurostat/web/circular-economy/indicators/main-tables [47] (accessed on 8 November 2021).

Eurostat (2021), *Eurostat Statistics Explained: Greenhouse gas emission statistics - carbon footprints*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Greenhouse_gas_emission_statistics_-_carbon_footprints [211] (accessed on 4 June 2021).

Eurostat (2021), *Recovery rate of construction and demolition waste*, European Commission, https://ec.europa.eu/eurostat/databrowser/view/cei_wm040/default/table?lang=en [223] (accessed on 14 June 2021).

Eurostat (2021), *Recycling of biowaste*, https://ec.europa.eu/eurostat/databrowser/view/cei_wm030/default/table?lang=en [180] (accessed on 20 December 2021).

Eurostat (2021), *Resource productivity indicator*, European Commission, https://ec.europa.eu/eurostat/databrowser/view/env_ac_rp/default/table?lang=en [23] (accessed on 8 November 2021).

Eurostat (2021), *Treatment of waste by waste category, hazardousness and waste management operations*, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics#Hazardous_waste_generation [87].

Eurostat (2020), “Generation of waste by economic activity”, https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=ten00106&plugin=1 (accessed on 8 October 2020). [24]

Everett, H. (2021), *Circular economy 3D printing: Opportunities to improve sustainability in AM*, https://3dprintingindustry.com/news/circular-economy-3d-printing-opportunities-to-improve-sustainability-in-am-190425/ (accessed on 30 September 2021). [43]

Fischer, C., M. Lehner and D. McKinnon (2012), “Overview of the use of landfill taxes in Europe”, http://www.embopar.pt/folder/documento/99_Landfill%20taxes%20in%20Europe.pdf (accessed on 5 February 2022). [152]

Flanagan, K., K. Robertson and C. Hanson (2019), “Reducing Food Loss and Waste: Setting a Global Action Agenda”, *World Resources Institute*, https://doi.org/10.46830/wrirpt.18.00130. [187]

G20 (2017), *G20 Resource Efficiency Dialogue*, http://www.g20.utoronto.ca/2017/2017-g20-resource-efficiency-dialogue-en.pdf (accessed on 9 July 2018). [15]

G7 (2017), *G7 Bologna Environment Ministers’ Meeting - Communiqué*, http://www.g7italy.it/sites/default/files/documents/Communiqu%C3%A9%20G7%20Environment%20-%20Bologna/index.pdf. [14]

G8 Environment Ministers Meeting (2008), *2008 Kobe 3R Action Plan*, http://www.g7.utoronto.ca/environment/env080526-3R.html. [13]

Garbarino, E. et al. (2016), *Revision of Green Public Procurement Criteria for Road Design, Construction and Maintenance*, https://doi.org/10.2791/683567. [117]

Gilbert, J., M. Ricci-Jürgensen and A. Ramola (2020), *Benefits of Compost and Anaerobic Digestate When Applied to Soil*, International Solid Waste Association, https://www.altereko.it/wp-content/uploads/2020/03/Report-2-Benefits-of-Compost-and-Anaerobic-Digestate.pdf. [200]

Giljum, S. et al. (2011), “A comprehensive set of resource use indicators from the micro to the macro level”, *Resources, Conservation and Recycling*, Vol. 55/3, pp. 300-308, https://doi.org/10.1016/j.resconrec.2010.09.009. [231]

Giorgi, S., M. Lavagna and A. Campioli (2019), “Circular Economy and Regeneration of Building Stock: Policy Improvements, Stakeholder Networking and Life Cycle Tools”, in *Research for Development, Regeneration of the Built Environment from a Circular Economy Perspective*, Springer International Publishing, Cham, https://doi.org/10.1007/978-3-030-33256-3_27. [140]

Giorgi, S., M. Lavagna and A. Campioli (2018), “Guidelines for Effective and Sustainable Recycling of Construction and Demolition Waste”, in *Designing Sustainable Technologies, Products and Policies*, Springer International Publishing, Cham, https://doi.org/10.1007/978-3-319-66981-6_24. [92]

Government of the Slovak Republic (2021), *Uznesenie vlády k návrhu metodiky pre produktovú skupinu „Čistiace prostriedky a upratovacie služby“ s uplatnením environmentálnych charakteristík v rámci zeleného verejného obstarávania [Government Resolution No. 80/2021 on GPP]*, https://rokovania.gov.sk/RVL/Resolution/19047/1 (accessed on 17 January 2022). [51]

Government of the Slovak Republic (2020), *Uznesenie Vlády k Návrhu metodík pre produktové skupiny cestná doprava, kopírovací a grafický papier a počítače a monitory s uplatnením* [50]

environmentálnych charakteristík v rámci zeleného verejného obstarávania [Government Resolution No. 92/2020 on GPP], https://rokovania.gov.sk/RVL/Resolution/18228/1 (accessed on 8 November 2021).

Government of the Slovak Republic (2017), *Update of the Residential and Non-residential Building Stock Renovation Strategy, Slovak Republic*, https://ec.europa.eu/energy/sites/default/files/documents/update_of_the_residential_and_non-residential_building_stock_renovation_strategy_slovak_republic.pdf. [127]

Greenhouse Gas Protocol (n.d.), *Greenhouse Gas Protocol - Calculation Tools*, https://ghgprotocol.org/calculationg-tools-faq (accessed on 4 June 2021). [240]

Grgulová, A. (2014), *Extended Producer Responsibility – Packaging and Packaging Waste in Slovakia*, https://www.oecd.org/environment/waste/Slovakia%20final.pdf. [52]

Heinrich, M. and W. Lang (2019), *Materials Passports - Best Practice*, https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf (accessed on 4 February 2022). [137]

Hertwich, E. (2019), *Increased carbon footprint of materials production driven by rise in investments*, Center for Open Science, https://doi.org/10.31235/osf.io/n9ecw. [209]

Hirt, S. (2012), "Mixed Use by Default", *Journal of Planning Literature*, Vol. 27/4, pp. 375-393, https://doi.org/10.1177/0885412212451029. [143]

Holland Circular Hotspot (2022), *Construction*, https://hollandcircularhotspot.nl/themes/construction/ (accessed on 31 January 2022). [104]

Hradil, P. et al. (2019), "PARADE. Best practices for Pre-demolition Audits ensuring high quality RAw materials.", https://www.snpambiente.it/wp-content/uploads/2020/08/Clean-Version_CDW-and-CE-Report-version-January-10-2020_final.pdf (accessed on 2 February 2022). [161]

IEA and UNEP (2018), *Global Status Report: towards a zero-emission, efficient and resilient buildings and construction sector.*. [74]

INCIEN (2021), *INCIEN od nového roku startuje Český cirkulární hotspot – budete součástí?*. [103]

ING (2020), *Learning from consumers: How shifting demands are shaping companies' circular economy transition*, https://mondovisione.com/_assets/files/Learning-from-Consumers---ING-Report-04.02.2020.pdf (accessed on 1 October 2021). [56]

International Resource Panel (2020), *Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future*, International Resource Panel. United Nations Environment Programme, Nairobi, Kenya, https://www.resourcepanel.org/reports/resource-efficiency-and-climate-change (accessed on 11 May 2021). [76]

International Solid Waste Association (n.d.), "FACT SHEET: Requirements for the Treatment and Application of Digestate and Sewage Sludge (Biosolids)", https://www.iswa.org/biological-treatment-of-waste/?v=11aedd0e4327 (accessed on 10 May 2022). [237]

IRP (2019), *Global Resources Outlook 2019: Natural Resources for the Future We Want*, International Resource Panel. United Nations Environment Programme, Nairobi, Kenya, [207]

https://www.resourcepanel.org/reports/global-resources-outlook (accessed on 3 June 2021).

Italian Consumer Associations (2021), *Circular Consumption Charter*, https://circulareconomy.europa.eu/platform/sites/default/files/carta_consumo_circolare_eng.pdf (accessed on 1 October 2021). [61]

Journal Officiel de la République Française (2021), *Décret n° 2021-1941 du 31 décembre 2021 relatif à la responsabilité élargie des producteurs pour les produits et les matériaux de construction du secteur du bâtiment*, https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044806344 (accessed on 22 February 2022). [149]

Kolaric (2019), *The Influence of BIM Education Improvement on Raising BIM Awareness in Croatia and Slovakia*, https://www.researchgate.net/publication/332156982_The_Influence_of_BIM_Education_Improvement_on_Raising_BIM_Awareness_in_Croatia_and_Slovakia. [131]

Kúšik, Mižák and Šoltés (2017), *Nerastné suroviny Slovenskej republiky 2016*, https://www.geology.sk/wp-content/uploads/2020/07/SMY-2016_w.pdf. [84]

Laura Järvinen and Riku Sinervo (2020), *How to create a national circular economy road map: A guide to making the change happen*, SITRA, https://www.sitra.fi/en/publications/how-to-create-a-national-circular-economy-road-map/ (accessed on 14 January 2021). [30]

LE Europe et al. (2018), *Behavioural Study on Consumers' Engagement in the Circular Economy*, European Commission, https://doi.org/10.2818/956512. [60]

Leising, E., J. Quist and N. Bocken (2018), "Circular Economy in the building sector: Three cases and a collaboration tool", *Journal of Cleaner Production*, Vol. 176, pp. 976-989, https://doi.org/10.1016/j.jclepro.2017.12.010. [101]

Lembachar, Y. and A. Sutherland (2021), *A Third of the World's Emissions Come From Food - The Circular Economy Can Change This*, Circle-Economy, https://www.circle-economy.com/blogs/a-third-of-the-worlds-emissions-come-from-food-the-circular-economy-can-change-this (accessed on 19 April 2022). [224]

Local Housing Solutions (n.d.), *Zoning changes to allow for higher residential density*, https://www.localhousingsolutions.org/housing-policy-library/zoning-changes-to-allow-for-higher-residential-density/. [145]

Madaster (n.d.), *Amsterdam Metropolitan Area material passports to boost the circular economy in the region*, https://madaster.com/amsterdam-metropolitan-area-uses-material-passports-to-boost-the-circular-economy-in-the-region/ (accessed on 4 February 2022). [134]

Maitre-Ekern, E. and C. Dalhammar (2019), "Towards a hierarchy of consumption behaviour in the circular economy", *Maastricht Journal of European and Comparative Law*, Vol. 26/3, pp. 394-420, https://doi.org/10.1177/1023263x19840943. [57]

Material Economics (2018), *The Circular Economy - a Powerful Force for Climate Mitigation*, https://materialeconomics.com/publications/the-circular-economy-a-powerful-force-for-climate-mitigation-1. [78]

McCarthy, A., R. Dellink and R. Bibas (2018), "The Macroeconomics of the Circular Economy Transition: A Critical Review of Modelling Approaches", *OECD Environment Working Papers*, [16]

No. 130, OECD Publishing, Paris, https://dx.doi.org/10.1787/af983f9a-en.

Ministère de la Transition Écologique (2020), *The Anti Waste Law in the Daily Lives of the French People: What does that mean in practice?*, https://www.ecologie.gouv.fr/sites/default/files/en_DP%20PJL.pdf (accessed on 5 May 2021). [150]

Ministry of Agriculture and Rural Development of the Slovak Republic (2016), *Plán predchádzania plytvaniu potravinami [Food waste prevention plan]*, Ministry of Agriculture and Rural Development of the Slovak Republic, Bratislava, https://rokovania.gov.sk/RVL/Material/21487/2 (accessed on 9 March 2021). [28]

Ministry of Agriculture and Rural Development of the Slovak Republic (2014), *Akčný plán rozvoja pôdohospodárstva SR na roky 2014 – 2020 [Action Plan for the Development of Agriculture 2014-2020]*, https://rokovania.gov.sk/RVL/Material/10519/1 (accessed on 14 January 2022). [181]

Ministry of Economy of the Slovak Republic (2018), *Stratégia hospodárskej politiky Slovenskej republiky do roku 2030 [Economic policy strategy of the Slovak Republic up to 2030]*, Ministry of Economy of the Slovak Republic, Bratislava, https://rokovania.gov.sk/RVL/Material/23019/1 (accessed on 23 November 2020). [8]

Ministry of Economy of the Slovak Republic (2004), *Aktualizácia surovinovej politiky Slovenskej republiky pre oblasť nerastných surovín [Updated raw materials policy of the Slovak Republic]*, Ministry of Economy of the Slovak Republic, Bratislava, https://www.mhsr.sk/uploads/files/ShzZssN3.pdf (accessed on 8 December 2020). [25]

Ministry of Environment of the Slovak Republic (2021), *Informácia o implementácii Národného akčného plánu pre zelené verejné obstarávanie v Slovenskej republike na roky 2016 – 2020 za rok 2020 [Implementation of the National Action Plan on GPP in 2020]*, https://rokovania.gov.sk/RVL/Material/26247/1 (accessed on 8 November 2021). [45]

Ministry of Environment of the Slovak Republic (2021), *Program odpadového hospodárstva SR na roky 2021– 2025 [Waste Management Plan of the Slovak Republic 2021-2025]*, Ministry of Environment of the Slovak Republic, https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2021-118 (accessed on 20 December 2021). [26]

Ministry of Environment of the Slovak Republic (2019), *Greener Slovakia: Strategy of the Environmental Policy of the Slovak Republic until 2030 (Envirostrategy 2030)*, Ministry of Environment of the Slovak Republic, Institute of Environmental Policy, https://www.minzp.sk/iep/strategicke-materialy/envirostrategia-2030/ (accessed on 23 November 2020). [7]

Ministry of Environment of the Slovak Republic (2018), *Program predchádzania vzniku odpadu Slovenskej republiky na roky 2019 – 2025 [Waste Prevention Programme of the Slovak Republic for the period 2019-2025]*, Ministry of Environment of the Slovak Republic, Bratislava, https://www.minzp.sk/files/sekcia-enviromentalneho-hodnotenia-riadenia/odpady-a-obaly/registre-a-zoznamy/ppvo-sr-19-25.pdf (accessed on 30 November 2020). [27]

Ministry of Environment of the Slovak Republic and Slovak Environment Agency (2020), *Správa o stave životného prostredia Slovenskej republiky v roku 2019 [State of the Environment report in the Slovak Republic for 2019]*, https://www.enviroportal.sk/spravy/detail/10661 (accessed on 8 November 2021). [64]

Ministry of Environmental of the Slovak Republic (2020), *Low-Carbon Development Strategy of the* [90]

Slovak Republic until 2030 with a view to 2050, Ministry of Environment of the Slovak Republic, Bratislava, https://www.minzp.sk/klima/nizkouhlikova-strategia/ (accessed on 23 November 2020).

Ministry of Finance of the Slovak Republic (2021), *Recovery and Resilience Plan of the Slovak Republic*, Ministry of Finance of the Slovak Republic, Bratislava, https://www.planobnovy.sk/ (accessed on 12 March 2021). [89]

Ministry of Investments Regional Development and Informatization of the Slovak Republic (2022), *LP/2022/73 Návrh Partnerskej dohody Slovenskej republiky na roky 2021 - 2027*, https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2022-73 (accessed on 4 March 2022). [95]

Ministry of Investments, Regional Development and Informatization (2020), *Vízia a stratégia rozvoja Slovenska do roku 2030 - dlhodobá stratégia udržateľného rozvoja [Vision and sustainable development strategy of Slovakia up to 2030] (Slovakia 2030)*, Ministry of Investments, Regional Development and Informatization, https://www.mirri.gov.sk/sekcie/vizia-a-strategia-rozvoja-slovenska-do-roku-2030/index.html (accessed on 24 January 2021). [9]

Ministry of the Environment Government of Japan (n.d.), "Construction Material Recycling Law", https://www.env.go.jp/en/laws/recycle/09.pdf (accessed on 21 April 2022). [167]

Ministry of the Environment of the Slovak Republic (2022), *LP/2022/42 Zákon, ktorým sa mení a dopĺňa zákon č. 79/2015 Z. z. o odpadoch a o zmene a doplnení niektorých zákonov v znení neskorších predpisov [LP / 2022/42 Act amending Act no. 79/2015 Coll. on waste and on the amendment of certain laws as amended]*, https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2022-42, https://www.slov-lex.sk/legislativne-procesy/-/SK/dokumenty/LP-2022-42 (accessed on 25 February 2022). [155]

Ministry of the Environment of the Slovak Republic (n.d.), *Waste Management Information System - About the Portal*, https://www.isoh.gov.sk/en/about.html (accessed on 4 March 2022). [94]

Ministry of the Interior of the Czech Republic (2019), *Strategy to Prevent and Combat Waste-Related Crime for the Years 2021 – 2023*, https://www.mvcr.cz/soubor/strategy-to-prevent-and-combat-waste-related-crime-for-the-years-2021-2023.aspx (accessed on 22 February 2022). [151]

Ministry of Transport and Construction of the Slovak Republic (2020), *Dlhodobá stratégia obnovy fondu budov (Long-term renovation strategy)*, https://ec.europa.eu/energy/sites/default/files/documents/sk_2020_ltrs.pdf. [88]

Ministry of Transport, Information Technology and Communications of the Republic of Bulgaria (2020), *DIGITAL TRANSFORMATION OF BULGARIA FOR THE PERIOD 2020-2030*, https://www.mtitc.government.bg/sites/default/files/digital_transformation_of_bulgaria_for_the_period_2020-2030_f.pdf. [97]

Monier, V. et al. (2010), *Prepatory study on food waste across EU 27*, https://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf. [174]

Nadazdi, A., Z. Naunovic and N. Ivanisevic (2022), "Circular Economy in Construction and Demolition Waste Management in the Western Balkans: A Sustainability Assessment Framework", *Sustainability*, Vol. 14/2, p. 871, https://doi.org/10.3390/su14020871. [110]

NPPC (2017), *Situačná správa o plnení úlohy odbornej pomoci (priebežná) „Príprava postupov pre zabezpečenie kvantifikácie potravinového odpadu a metodiky jeho merania" [Progress* [189]

report - Preparation of inputs for the quantification of food waste and the methodology].

Odpady-Portal (2022), *Igor Matovič ohlásil nový termín, kedy bude naplno spustený ISOH [Igor Matovic announced the new date when ISOH would be fully launched]*, https://www.odpady-portal.sk/Dokument/106565/igor-matovic-ohlasil-novy-termin-kedy-bude-naplno-spusteny-isoh-video.aspx. [93]

Odpady-Portal (2022), *Na kompostárne idú ďalšie dotácie, ministerstvo vyčlenilo dodatočné eurofondy [More subsidies for composting plants, the Ministry has allocated additional EU funds]*, https://www.odpady-portal.sk/Dokument/106650/kompostarne-eurofondy-2022.aspx. [199]

OECD (2022), "Material resources: Material resources", *OECD Environment Statistics* (database), https://dx.doi.org/10.1787/data-00695-en (accessed on 22 February 2022). [11]

OECD (2022), *OECD Affordable Housing Database - Housing stock and construction*, https://www.oecd.org/els/family/HM1-1-Housing-stock-and-construction.pdf. [220]

OECD (2021), "Promoting research and innovation in the Slovak Republic through an effective use of European funds"*, OECD Public Governance Policy Papers*, No. 04, OECD Publishing, Paris, https://dx.doi.org/10.1787/f0e9d786-en. [72]

OECD (2021), "Towards a national strategic framework for the circular economy in the Czech Republic"*, OECD Environment Policy Papers*, No. 27, Organisation for Economic Co-Operation and Development (OECD), https://doi.org/10.1787/5d33734d-en. [34]

OECD (2020), *Best Available Techniques (BAT) for Preventing and Controlling Industrial Pollution, Activity 4: Guidance Document on Determining BAT, BATAssociated Environmental Performance Levels and BAT-Based Permit Conditions*, https://www.oecd.org/chemicalsafety/risk-management/guidance-document-on-determining-best-available-techniques.pdf (accessed on 30 September 2021). [42]

OECD (2020), *Country statistical profiles: Slovak Republic*, https://stats.oecd.org/# (accessed on 8 September 2020). [22]

OECD (2020), "Improving resource efficiency and the circularity of economies for a greener world"*, OECD Environment Policy Papers*, No. 20, OECD Publishing, Paris, https://dx.doi.org/10.1787/1b38a38f-en. [10]

OECD (2020), *Material resources*, https://stats.oecd.org/ (accessed on 8 October 2020). [85]

OECD (2020), *The Circular Economy in Cities and Regions: Synthesis Report*, OECD Urban Studies, OECD Publishing, Paris, https://dx.doi.org/10.1787/10ac6ae4-en. [128]

OECD (2020), "Towards a green fiscal reform in the Slovak Republic: Proposals for strengthening the role of market-based environmental policy instruments"*, OECD Environment Policy Papers*, No. 19, OECD Publishing, Paris, https://dx.doi.org/10.1787/1aa92a49-en. [235]

OECD (2019), *Business Models for the Circular Economy: Opportunities and Challenges for Policy*, OECD Publishing, Paris, https://dx.doi.org/10.1787/g2g9dd62-en. [17]

OECD (2019), *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264307452-en. [1]

OECD (2019), *OECD Economic Surveys: Slovak Republic 2019*, OECD Publishing, Paris, [21]

https://dx.doi.org/10.1787/eco_surveys-svk-2019-en.

OECD (2019), *Waste Management and the Circular Economy in Selected OECD Countries*, OECD, https://doi.org/10.1787/9789264309395-en. [38]

OECD (2017), "Making the Slovak Republic a more resource efficient economy: Country Study", *OECD Environment Policy Papers*, No. 7, https://dx.doi.org/10.1787/2d5c00e7-en. [5]

OECD (2017), *Policy Instruments for the Environment Database*, https://www.oecd.org/environment/tools-evaluation/PINE_database_brochure.pdf. [33]

OECD (2017), *Tackling Environmental Problems with the Help of Behavioural Insights*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264273887-en. [227]

OECD (2016), *Extended Producer Responsibility*, OECD, https://doi.org/10.1787/9789264256385-en. [37]

OECD (2016), *Policy Guidance on Resource Efficiency*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264257344-en. [36]

OECD (2015), *Effective Delivery of Large Infrastructure Projects: The Case of the New International Airport of Mexico City*, OECD Public Governance Reviews, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264248335-en. [120]

OECD (2014), "Innovative economic instruments for sustainable materials management", *Working paper for the Working Party on Resource Productivity and Waste*, OECD, Paris, https://one.oecd.org/document/ENV/EPOC/WPRPW(2014)8/en/pdf (accessed on 7 November 2021). [35]

OECD (2012), *Greenhouse gas emissions and the potential for mitigation from materials management within OECD countries*, OECD, Paris, https://www.oecd.org/env/waste/50035102.pdf (accessed on 13 April 2021). [205]

OECD (2011), *OECD Environmental Performance Reviews: Norway 2011*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264098473-en. [168]

OECD (2011), *Towards Green Growth: Monitoring Progress: OECD Indicators*, OECD Green Growth Studies, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264111356-en. [233]

OECD (2008), *Recommendation of the Council on Resource Productivity [C(2008)40]*, https://www.oecd.org/env/40564462.pdf. [12]

OECD (2006), "Impacts of Unit-based Waste Collection Charges", *OECD Papers*, https://dx.doi.org/10.1787/oecd_papers-v6-art30-en. [63]

OECD (n.d.), *Policy Instruments for the Environment (PINE) Database*, http://oe.cd/pine (accessed on 4 January 2020). [69]

Office of the Provincial Government of Styria (2020), *The Styrian Guide to Construction & Demolition Waste 2020*, https://www.abfallwirtschaft.steiermark.at/cms/dokumente/11629595_71142128/f46de97c/BRM_Leitfaden2020_EN.pdf (accessed on 2 February 2022). [162]

Ogushi, Y. and M. Kandlikar (2007), "Assessing Extended Producer Responsibility Laws in Japan", *Environmental Science & Technology*, Vol. 41/13, pp. 4502-4508, [166]

https://doi.org/10.1021/es072561x.

Pantini, S. and L. Rigamonti (2020), "Is selective demolition always a sustainable choice?", *Waste Management*, Vol. 103, pp. 169-176, https://doi.org/10.1016/j.wasman.2019.12.033. [158]

Pomponi, F. and A. Moncaster (2017), "Circular economy for the built environment: A research framework", *Journal of Cleaner Production*, Vol. 143, https://doi.org/10.1016/j.jclepro.2016.12.055. [164]

Potting, J. et al. (2018), *Circular economy: what we want to know and can measure. Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands*, PBL Netherlands Environmental Assessment Agency, The Hague, https://www.pbl.nl/sites/default/files/downloads/pbl-2018-circular-economy-what-we-want-to-know-and-can-measure-3217.pdf (accessed on 10 May 2020). [232]

Ramboll, Fraunhofer ISI and Ecologic Institute (2020), *The decarbonisation benefits of sectoral circular economy actions*, European Environment Agency, https://ramboll.com/media/environ/decarbonisation-benefits-of-sectoral-circular-economy-actions (accessed on 11 May 2021). [77]

Recycling Today (2013), *Suez Environnement Partners with ZenRobotics to Deliver Robotic Sorting System*, https://www.recyclingtoday.com/article/suez-zenrobotics-recycler/. [159]

REFRESH (2019), *Voluntary Agreements as a collaborative solution for food waste reduction*. [188]

Reloop (2021), *Factsheet: Deposit Return Systems Reduce Litter Fact Sheet: Deposit Return Systems Reduce Litter*, https://www.reloopplatform.org/wp-content/uploads/2021/01/DRS-Factsheet-Litter-long-29Jan2021.pdf (accessed on 23 April 2021). [234]

Rietveld, E. et al. (2018), *Effecten van het Rijksbrede Programma Circulaire Economie en de Transitieagenda's op de emissie van broeikasgassen [Effects of the nation-wide programme on Circular Economy and the transition agendas on greenhouse gas emissions]*, TNO, Den Haag, https://www.parlementairemonitor.nl/9353000/1/j4nvgs5kjg27kof_j9vvij5epmj1ey0/vkotkj6nthyr/f=/blg843683.pdf (accessed on 4 June 2021). [214]

Roland Berger (2021), "It's time for construction to embrace the circular economy", *It's time for construction to embrace the circular economy*, https://www.rolandberger.com/en/Insights/Publications/It%E2%80%99s-time-for-construction-to-embrace-the-circular-economy.html (accessed on 4 November 2021). [75]

Rusko, M. (ed.) (2016), *Survey on consumer awareness on construction product ecolabels in Slovakia*, Management of Environment, http://www.sszp.eu/wp-content/uploads/2016_conference_MaZP__p-63__Rusko_Sliva_Mikulov%C3%A1_Ilko___f4.pdf. [65]

Sahlin, J. et al. (2007), "Introduction of a waste incineration tax: Effects on the Swedish waste flows", *Resources, Conservation and Recycling*, Vol. 51/4, pp. 827-846, https://doi.org/10.1016/j.resconrec.2007.01.002. [71]

Salvatori, G., F. Holstein and K. Böhme (2019), *Circular economy strategies and roadmaps in Europe: Identifying synergies and the potential for cooperation and alliance building – Study*, The European Economic and Social Committee, https://doi.org/doi:10.2864/554946. [32]

Schneeman, B. and M. Oria (eds.) (2020), *A National Strategy to Reduce Food Waste at the* [19

Consumer Level, National Academies Press, Washington, D.C., https://doi.org/10.17226/25876. [115]

SCI-Network (2012), *Procuring Innovative and Sustainable Construction. A Guide for European Public Authorities*, http://www.rebekkadold.de. [118]

Škantárová (2020), *Využívanie nerastných surovín*, https://www.enviroportal.sk/indicator/detail?id=181&print=yes. [83]

Slovak Environment Agency (2021), *Register EMAS v SR*, https://www.emas.sk/register-emas-v-sr/ (accessed on 6 October 2021). [46]

Slovak Hydrometeorological Institute and Ministry of Environment of the Slovak Republic (2020), "Slovak Republic - National Inventory Report 2020", https://unfccc.int/documents/227921 (accessed on 23 May 2022). [239]

Slovak Ministry of Economy (2019), *Integrated National Energy and Climate Plan for 2021 to 2030*, https://ec.europa.eu/energy/sites/ener/files/sk_final_necp_main_en.pdf. [91]

Slovak Republic (2013), *Stratégia bezpečnosti potravinového reťazca*. [182]

Slučiaková, S. (2021), "Effects of the unit-based pricing of waste in Slovakia: Spatial panel data models and matching approach", *Environmental Challenges*, Vol. 2, p. 100022, https://doi.org/10.1016/j.envc.2021.100022. [66]

Söderholm, P. (2011), "Taxing virgin natural resources: Lessons from aggregates taxation in Europe", *Resources, Conservation and Recycling*, Vol. 55/11, pp. 911-922, https://doi.org/10.1016/j.resconrec.2011.05.011. [109]

Springmann, M. et al. (2018), "Options for keeping the food system within environmental limits", *Nature*, Vol. 562/7728, pp. 519-525, https://doi.org/10.1038/s41586-018-0594-0. [226]

Statistical Office of the Slovak Republic (2020), *Yearbook of construction in SR 2020*, https://slovak.statistics.sk/wps/portal/!ut/p/z1/rVRdc6IwFP0t-9BHzA0JJDwiKlAoyqc1LzuiuGWtaLeubf_9RtfpVKlgZzcwGSDncE9yz71IoHskqumu_DHdlutq-ijfJ0L_HjKXd7vYBGBaD9zbtBfasYGBAhofAJZtOpT5ANy3NXBNJ42MkBAwCRJyOfNHf_k2SzC4QRCnGQ8JD7UjHy4ME67jvwvk3UwFlwUR9sLQHjF64F. [82]

Stenmarck, Å. et al. (2016), *Estimates of European food waste levels*, https://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf. [173]

Stolker, M. and A. Van Stijn (2021), *Handboek Circulair Renoveren Woningcorporaties*, Amsterdam Institute for Advanced Metropolitan Solutions, https://www.ams-institute.org/documents/49/Handboek_Circulair_Renoveren_voor_Woningcorporaties.pdf (accessed on 21 April 2022). [236]

Tam, V., M. Soomro and A. Evangelista (2018), "A review of recycled aggregate in concrete applications (2000–2017)", *Construction and Building Materials*, Vol. 172, pp. 272-292, https://doi.org/10.1016/j.conbuildmat.2018.03.240. [111]

Technology Agency of the Czech Republic (n.d.), *Programy a soutěže*, https://www.tacr.cz/programy-a-souteze/programy/ (accessed on 2 March 2022). [107]

The Government of the Grand Duchy of Luxembourg Luxinnovation (2020), *Performance programmes Fit 4 Circularity*, https://www.luxinnovation.lu/innovate-in-luxembourg/performance-programmes/fit-4-circularity/. [122]

U.S. EPA (2009), *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices*, United States Environmental Protection Agency, https://www.epa.gov/sites/production/files/documents/ghg-land-materials-management.pdf (accessed on 3 June 2021). [204]

UK Government (2012), *Industrial strategy: government and industry in partnership*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/34710/12-1327-building-information-modelling.pdf (accessed on 4 February 2022). [129]

UNDP (2017), *Circular economy strategies for Lao PDR A metabolic approach to redefine resource efficient and low-carbon development*, UNDP, https://www.undp.org/sites/g/files/zskgke326/files/publications/undp-lecb-circular-economy-strategies-for-laos-pdr-20170911_0.pdf (accessed on 3 June 2021). [210]

UNEP (2019), *Understanding circularity*, https://buildingcircularity.org/ (accessed on 30 September 2021). [40]

United Nations Climate Change (2022), *Greenhouse Gas Inventory Data - Detailed data by Party*, United Nations Climate Change, https://di.unfccc.int/detailed_data_by_party (accessed on 4 June 2021). [216]

United Nations Development Programme (2020), *A 1.5°C World Requires a Circular and Low Carbon Economy*, UNDP, New York, https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/library/a-1-5-c-world-requires-a-circular-and-low-carbon-economy.html (accessed on 3 June 2021). [203]

van Geffen, L., E. van Herpen and H. van Trijp (2019), "Household Food Waste—How to Avoid It? An Integrative Review", in *Food Waste Management*, Springer International Publishing, Cham, https://doi.org/10.1007/978-3-030-20561-4_2. [194]

Van Zanten, H., M. Van Ittersum and I. De Boer (2019), "The role of farm animals in a circular food system", *Global Food Security*, Vol. 21, pp. 18-22, https://doi.org/10.1016/j.gfs.2019.06.003. [171]

Vandák, R. and P. Krasnec (2019), *Ako efektívne plniť environmentálne ciele v podmienkach Slovenskej republiky: Analýza možností riešenia nakladania s komunálnymi odpadmi*. [178]

Vittuari, M. et al. (2015), *Review of EU legislation and policies with implications on food waste*. [183]

Vlaanderen Circulair (n.d.), *Circulair bouwen*, https://bouwen.vlaanderen-circulair.be/nl (accessed on 4 March 2022). [123]

Vrijders, J., B. Dooms and P. Van Itterbeeck (2017), *Putting recycled concrete into practice in Belgium: From case studies over chain management to standards and quality assurance*, https://repository.tudelft.nl/islandora/object/uuid%3A94a004aa-d118-46a0-950c-02e4688971b1. [114]

Wahlström, M. et al. (2019), *Improving quality of construction & demolition waste: Requirements for pre-demolition audit*, TemaNord, Nordic Council of Ministers, Copenhagen K, https://dx.doi.org/10.6027/TN2019-508. [157]

WBCSD (2018), *Industrial symbiosis*, https://www.ceguide.org/Strategies-and-examples/Dispose/Industrial-symbiosis (accessed on 1 October 2021). [44]

Weber, T. and M. Stuchtey (2019), *Pathways towards a German Circular Economy - Lessons from European Strategies Preliminary Study*, Circular Economy Initiative Deutschland, Munich, https://en.acatech.de/wp-content/uploads/sites/6/2019/09/Circular_Economy_EN.pdf. [29]

Wiedmann, T. et al. (2020), "Scientists' warning on affluence", *Nature Communications*, Vol. 11/1, https://doi.org/10.1038/s41467-020-16941-y. [54]

Wood, R. et al. (2018), "Growth in Environmental Footprints and Environmental Impacts Embodied in Trade: Resource Efficiency Indicators from EXIOBASE3", *Journal of Industrial Ecology*, Vol. 22/3, pp. 553-564, https://doi.org/10.1111/jiec.12735. [241]

World Bank (2021), *Green Public Procurement: An Overview of Green Reforms in Country Procurement Systems*, World Bank, Washington, DC, http://www.worldbank.org. [119]

WRAP (2021), *Grants and investments*, https://wrap.org.uk/what-we-do/our-services/grants-and-investments (accessed on 22 November 2021). [73]

WRAP (2015), *Food Promotions-Guidance for Manufacturers*, https://wrap.org.uk/resources/guide/food-promotions-guidance-manufacturers#download-file (accessed on 12 January 2022). [198]

WRAP (2009), *Construction procurement guidance - Delivering higher recycled content in construction projects*, https://www.cewales.org.uk/files/3314/4369/9241/Delivering_higher_recycled_content_in_construction_projects.pdf (accessed on 3 February 2022). [115]

Wunder, S. et al. (2018), *Food waste prevention and valorisation: Relevant EU policy areas*. [184]

WWF (2017), *Hotel Kitchen: Fighting Food Waste in Hotels*, https://www.worldwildlife.org/publications/hotel-kitchen-fighting-food-waste-in-hotels. [197]

Zero Waste Scotland (2020), *Circular Economy Business Support Service*, https://www.zerowastescotland.org.uk/circular-economy/business-support-service (accessed on 3 June 2021). [121]

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.

OECD
BETTER POLICIES FOR BETTER LIVES

MINISTRY
OF ENVIRONMENT
OF THE SLOVAK REPUBLIC

Co-funded by the
European Union