Towards a National Circular Economy Strategy for Hungary

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Towards a National Circular Economy Strategy for Hungary

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Foreword

The past decades have witnessed unprecedented growth in the global consumption of raw materials. In light of a growing world population, improving living standards, changing consumer behaviour and changing production modes due to new technologies, this trend is expected to further increase and almost double by 2060, if decisive policy action is not taken. The continued increase in materials demand is expected to exert significant pressure on the environment, including intensification of land use, human toxicity and increases in greenhouse gas emissions, putting countries at risk of missing important environmental goals.

Over the years, the OECD has accumulated extensive experience in developing policy recommendations in support of the transition to a resource-efficient circular economy, with analytical work focusing on topics as diverse as plastics, metal and other minerals, macroeconomic and labour market consequences, the role of digitalisation and trade.

I am delighted that the OECD was able to support the Hungarian government, jointly with the Directorate-General for Structural Reform Support (REFORM) of the European Commission, in its endeavour to develop a national circular economy strategy and an action plan. To make the consumption of materials more sustainable and generate additional economic value for the country, Hungary is aiming to extend its current plans and create new policies and programmes by 2040.

Our analysis shows that, although Hungary has achieved some decoupling of economic growth from resource and energy uses as well as from waste generation, several challenges remain. Despite structural and technological changes, materials consumption in Hungary is projected to increase by one-third by 2050 compared to 2017 levels, generating significant additional pressures on the environment. This report therefore identifies a set of priority areas and puts forward concrete policy recommendations that are deemed critical to the Hungarian circular economy transition. These include better managing biomass, food, and plastics, as well as decreasing the very large materials footprint of the construction sector.

When implemented, the recommended policy measures will contribute to lower materials consumption and related environmental externalities, help enhance Hungary's competitive advantages, accelerate eco-innovation and investment in green products and services, generate green jobs, and make the economy less dependent on imported raw materials.

Jo Tyndall

Director

OECD – Environment Directorate

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Abbreviations and acronyms

4NEP	Fourth National Environmental Programme
AD	Anaerobic digestion
AP	Action Plan
BIM	Building information model
BIOEAST	Central Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy
CDW	Construction and demolition waste
CE	Circular economy
CEAP	Circular Economy Action Plan
CMU	Circular material use
CO_2	Carbon dioxide
CO_2-eq	CO2-equivalents
CPR	Construction Products Regulation
DMC	Domestic material consumption
DPP	Digital product passport
EC	European Commission
EDIOP Plus	Environmental and Energy Efficiency Operational Programme
EE	Energy efficiency
EEE	Electrical and electronic equipment
EEA	European Environment Agency
EEEOP Plus	Environmental and Energy Efficiency Operational Programme Plus
EHIR	Unified Waste Management Information System
EIB	European Investment Bank
EoW	End-of-waste
EPR	Extended producer responsibility
ERDF	European Regional Development Fund
EU	European Union
EWC	European Waste Catalogue
GDP	Gross domestic product
GHG	Greenhouse gas
GPP	Green public procurement
Gt	Gigatonnes
GVA	Gross value added
HCSO	Hungarian Central Statistical Office
HDPE	High density polyethylene
HUF	Hungarian Forint
ICT	Information and communication technology
ISIC	International Standard Industrial Classification of All Economic Activities
KM^2	Square kilometres
LDPE	Low density polyethylene
LTRS	Long-term Renovation Strategy
MBT	Mechanical biological treatment
MSME	Micro, small and medium-sized enterprise
Mt	Million tonnes
NACE	Statistical Classification of Economic Activities in the European Community
NCES	National Circular Economy Strategy

NEB	New European Bauhaus
NETIS	National Environmental Technology Innovation Strategy
NWMP	National Waste Management Plan 2021-2027
OECD	Organisation for Economic Co-operation and Development
OKIR	National Environmental Information System (Hungary)
OP	Operational Programme
PAYT	Pay-as-you-throw
PE	Polyethylene
PET	Polyethylene terephthalate
PLA	Polylactic acid
PP	Polypropylene
PPP	Purchasing Power Parities
PS	Polystyrene
PVC	Polyvinyl chloride
R&I	Research and innovation
R&D	Research and development
R&D&I	Research, development and innovation
RRF	Recovery and Resilience Facility
RRP	Recovery and Resilience Plan
SDG	Sustainable Development Goal
SME	Small and medium-sized enterprise
SPI	Sustainable Products Initiative
SRSP	Structural Reform Support Programme
SUP	Single-use plastic
SUPD	Single-use Plastics Directive
VAT	Value added tax
WEEE	Waste from Electrical and Electronic Equipment
WFD	Waste Framework Directive
WMPSP	Waste Management Public Services Plan
WWTP	Wastewater treatment plant

Executive summary

This report outlines a set of key elements for the development of the Hungarian National Circular Economy Strategy and Action Plan within the framework of the European Commission's Technical Support Instrument, which provides support to the circular economy transition in Hungary.

There is a strong rationale for transitioning towards a circular economy in Hungary

The continuously growing demand for raw materials in the Hungarian economy is expected to exert significant pressure on the environment, putting the country at risk of missing important environmental goals and opportunities to strengthen the competitiveness and resilience of its economy. Despite the notable progress in achieving relative decoupling of economic growth from materials use, several challenges remain related to the country's relatively low performance in resource productivity, circular materials use and waste recycling. On current trends, the overall demand for materials is projected to increase by one-third in 2050 compared to 2017 levels (an increase from 119 million tonnes [Mt] to 160 Mt). Economic growth and increased consumption will drive this demand for raw materials and generate significant negative environmental impacts. A circular economy offers a significant potential to address these challenges, making the consumption of materials more sustainable and generating additional economic value for the country.

A national strategy is required to help steer the transition in the right direction

To fully realise the circular potential of the economy, Hungary will need to adopt a comprehensive circular economy policy framework. Although Hungary has a long-established policy and legal framework for waste management, it has struggled to finance high-quality municipal waste management, and has not yet succeeded in integrating circular economy principles into its sectoral policies nor has it adopted a whole-of-government approach to the circular economy transition. Additional policies are needed to achieve absolute decoupling of materials consumption and environmental pressures from economic growth. Further improvements in resource efficiency and waste management can lower environmental externalities related to the use of materials and enhance Hungary's competitive advantages. Fostering and investing in recycling and promoting eco-design can increase the availability of green jobs, products and services. The development of product reuse and repair can generate local product loops that create local jobs and make the economy less dependent on imports. A national circular economy strategy can focus policy efforts where they are needed most to complement the existing policy framework.

To achieve its ambitions by 2040, Hungary will need to focus its efforts on high-impact actions critical to the circular economy transition

The OECD analysis, combined with a stakeholder dialogue and a multi-criteria assessment, identified a set of priority areas and high-impact actions that are deemed critical to the Hungarian circular economy transition. These selected priority areas include biomass and food, construction, and plastics, as well as cross-cutting horizontal tools that can be put in place across product and material life cycles. This report outlines 45 policy recommendations and suggests specific implementation actions across the priority areas for the short, medium and long term. These are summarised below.

The **biomass and food** sector's transition to circularity has significant potential to contribute to Hungary's economic development, climate change mitigation and environmental protection. It is also critical for achieving the EU municipal waste targets and obligations. The value added in Hungary's agricultural sector already outperforms that of the rest of the EU, while the industrial processing and distribution of food products, beverages and tobacco represents the third largest sector of Hungary's economy. However, the current policy framework does not sufficiently encourage circular approaches. To accelerate the sustainable consumption and production of biomass and food, Hungary's long-term policy efforts will need to shift focus from waste management (composting and anaerobic digestion) towards strategies aimed at supporting the use of bio-based resources in agricultural practices and the development of the circular bioeconomy. Key policy recommendations include:

- Developing a regulatory framework to support the use of quality compost and digestate in agriculture.
- Providing additional economic incentives for the separate collection of municipal bio-waste by supporting "pay-as-you-throw"-based household waste charges and by increasing landfill taxes.
- Strengthening education, information and training tools to raise awareness and skills in the area of circular bioeconomy.

The **construction** sector offers a large untapped opportunity for Hungary's transition to a circular economy. More than half of all raw materials consumed by the Hungarian economy were used within the built environment. Construction is also responsible for about one-third of Hungary's waste generation. The current Hungarian construction policy framework has a strong focus on the end-of-life phase, while measures are missing upstream in the value chain. To fully unleash the potential of a circular building construction sector, Hungary will need to strengthen existing measures targeting construction, renovation and waste management in the short term, and introduce new policies to tackle the production of materials and the design of buildings and cities in the long term. Key policy recommendations include:

- Developing a new quality standard and a quality label for secondary construction materials to increase demand for them.
- Establishing a mandatory selective demolition scheme to enhance materials recovery.
- Promoting digitalisation of the industry to enhance reuse and recycling.

Plastics are strategically important for Hungary for its high circularity potential. They are a key input to several sectors in Hungary's economy, most importantly in packaging, construction and transportation. Plastic packaging currently makes up one-quarter of total packaging used in Hungary. Only about one-third of plastic packaging waste is recycled. Hungary faces a potential challenge in meeting relevant EU targets on plastics because its few plastics-specific laws were only recently introduced. To encourage a shift away from primary plastics, promote sustainable alternatives and bolster recycling, Hungary would benefit from a mix of policy instruments, targeting the most frequently used polymers in the most problematic applications. Key policy recommendations for a more circular plastics life cycle include:

- Promoting design for recyclability among businesses.
- Eco-modulating extended producer responsibility (EPR) fees on plastic packaging to create economic incentives for recyclability.
- Expanding Green Public Procurement (GPP) and introducing mandatory GPP to disincentivise the use of primary plastics and promote the use of secondary plastics and sustainable alternatives.

1 Introduction

This chapter introduces the context and provides an overview of the objectives and the structure of the report.

1.1. Context

Hungary has managed to decouple the increase of many environmental pressures from its economic growth and has a long-established policy and legal framework for waste management, supported with quantitative targets and economic instruments. The national waste framework is aligned with the relevant European Union (EU) legislation and the Organisation for Economic Co-operation and Development (OECD) Council decisions. However, Hungary has not yet succeeded in integrating circular economy principles into its sectoral policies nor has it adopted a whole-of-government approach to the circular economy transition. For instance, although waste quantities have decreased, waste management practices have not improved significantly, leading to linear life cycles with landfilling remaining the most frequent treatment option. The share of secondary materials used from recycled products is low, well below the EU average. In addition, Hungary's material resource productivity is below the OECD average, pointing to the inefficient use of resources in generating economic value.

Further improvements in resource efficiency and waste management can lower environmental externalities in the use of materials and enhance Hungary's competitive advantages. Fostering and investing in recycling and promoting eco-design can increase the availability of green jobs, products and services. The development of product reuse and repair can generate local product loops that create local jobs and make the economy less dependent on imports. This transition, however, requires the adoption of a comprehensive circular economy policy framework.

1.2. Objectives

Hungary aspires to unleash the potential of the Hungarian economy, aligning it with the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs), and the ambitions of the European Green Deal. Hungary aims to live up to the EU Circular Economy Action Plan (CEAP) and the EU Strategy for Plastics in the Circular Economy, and achieve its 2030/35 EU waste management targets. Hungary is therefore determined to extend existing plans and create new policies and programmes, and it has requested technical support from the Directorate-General for Structural Reform Support (DG REFORM) of the European Commission to develop its national circular economy strategy. With the financial assistance from the DG REFORM, the technical assistance was provided by the OECD.[1]

The overall outcome of this technical support is the development of a National Circular Economy Strategy (NCES) and Action Plan (AP), which will complement and expand existing policies. This report is the concrete output of the technical support[2] and outlines a set of key elements for the Hungarian NCES and AP. It is expected that Hungary, having been closely involved in the development of this report, will integrate these elements into its NCES and AP through its internal mechanisms. The expected result will be the creation of a coherent policy framework and a set of actions by the Hungarian government that will enable the circular economy transition and improve resource efficiency, material security, innovation potential, competitiveness, productivity, as well as job creation. The action was funded by the European Union via the Structural Reform Support Programme, and implemented by the OECD, in cooperation with the Directorate-General for Structural Reform Support of the European Commission.

1.3. Report structure

This report is structured as follows:

- Chapter 2 provides insights into global trends in resource use and its environmental implications, and discusses the rationale for transitioning to a circular economy in Hungary.
- Chapter 3 reviews the existing circular economy-related policy landscape in Hungary, and highlights the prevailing policy gaps.
- Chapter 4 presents the Hungarian vision for a circular economy transition by 2040, and outlines the selected priority areas to implement this vision.
- Chapters 5, 6 and 7 analyse three priority areas in great detail: biomass and food, construction, and plastics. Their circular potential is identified and recommendations for policy measures for each priority area, as well as horizontally across different areas, are put forward.
- Chapter 8 outlines the recommendations for an action plan and a monitoring framework.
- Chapter 9 provides an overview of the public funding mechanisms for a circular economy transition.
- A summary of the Strategic Environmental Assessment (SEA), assessing the potential impacts of the policy recommendations and implementation actions put forward in this report, is included in the Annex A.

Supplementary information, in the form of tables, figures and text boxes, is included within the respective annexes following each chapter.

Notes

[1] The mission of the Directorate General for Structural Reform Support (DG REFORM) of the European Commission is to provide support for the preparation and implementation of growth-enhancing administrative and structural reforms by mobilising EU funds and technical expertise. Hungary has requested support from the European Commission under Regulation EU 2017/825 on the establishment of the Structural Reform Support Programme ("SRSP Regulation"). The request has been analysed by the Commission in accordance with the criteria and principles referred to in Article 7(2) of the SRSP Regulation, following which the European Commission has agreed to provide support to Hungary, together with the OECD, in the area of circular economy and resource efficiency. The purpose of this support is to develop a report comprising elements of a draft National Circular Economy Strategy and Action Plan under the conditions set out in the Framework Delegation Agreement (REFORM/IM2020/018).

[2] Communication and awareness materials are prepared as separate documents.

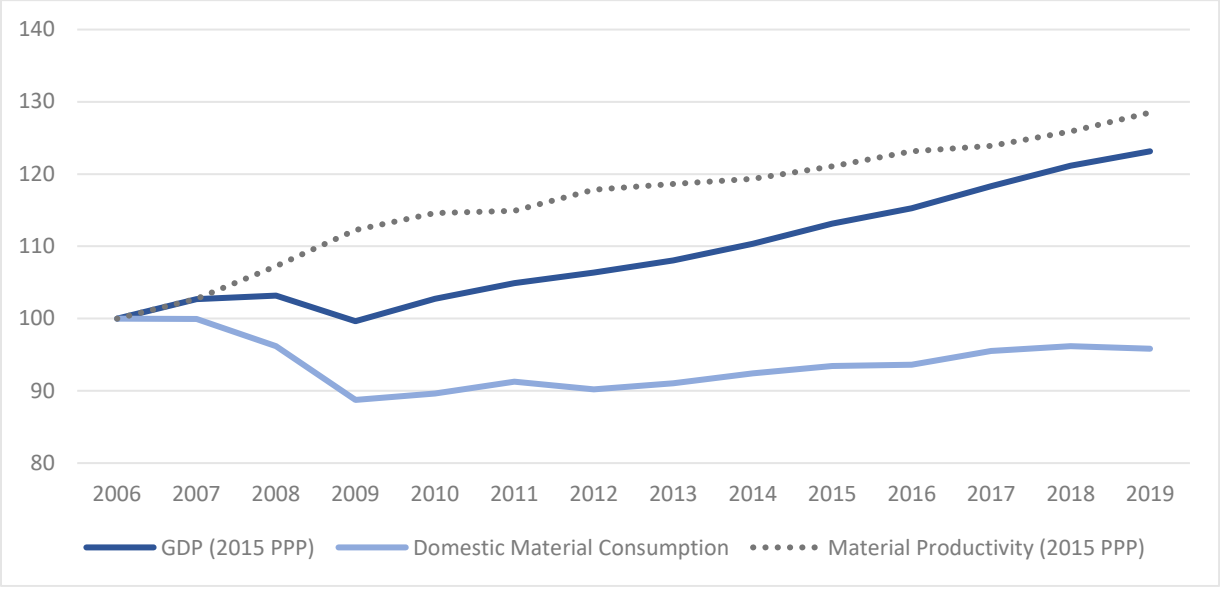
2 Rationale for a circular economy transition in Hungary

This chapter provides insights into global trends in resource use and its environmental implications, and outlines the role of circular economy in addressing them. It also discusses the rationale for transitioning to a circular economy in Hungary. Although Hungary has achieved relative decoupling of economic growth from resource and energy uses as well from waste generation, several challenges remain in the country's resource productivity, circular materials use and waste recycling. Despite structural and technological changes, materials consumption in Hungary is projected to increase significantly to 2050.

2.1. Global resource use and its environmental implications are on the rise

The past decades have witnessed unprecedented growth in the global consumption of raw materials. The effect of lower materials intensity – due to the global shift towards more services and more efficient technologies – has been dampened by the rise in global economic output (see Figure 2.1). Overall, past policies and societal trends have contributed to a relative decoupling, but they have not achieved an absolute reduction in materials use (OECD, 2019[1]).[1] Recent OECD modelling suggests that, in light of a growing world population, improving living standards, structural changes (driven by ageing, globalisation and consumer behaviour), as well as changes in production modes due to new technologies (including servitisation and digitalisation), materials consumption will almost double between 2017 and 2060 in OECD countries (from 89 Gigatonnes [Gt] to 167 Gt) (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).
Source: OECD (2023[2]).

The constant rise in the use of materials has severe environmental impacts, including acidification, eutrophication, intensification of land use, human toxicity and terrestrial ecotoxicity (OECD, 2019[1]). Moreover, every stage of the materials life cycle contributes to the emission of greenhouse gases (GHG) into the atmosphere and is indirectly responsible for two-thirds of global GHG emissions, therefore playing a crucial role in climate change (OECD, 2019[1]; OECD, 2020[3]). In the absence of new policies targeting the life cycle of materials, countries will be at risk of missing the targets of the Paris Climate Agreement, including Nationally Determined Contributions (NDCs) and the “well below” two degrees Celsius objective.

The recent COVID-19 pandemic and its associated restrictions have had severe economic consequences, leading to a significant drop in economic activity. The GHG emissions, as well as emissions of some of the most important air pollutants, fell by around 7% below the pre-COVID baseline level in a single year. The reduction in materials use ranges from 2% for biotic resources to 11% for the use of non-metallic minerals (including construction materials) (Dellink et al., 2021[4]). However, economic growth is expected to recover in the coming years, and the pandemic has not changed the long-term trend towards increasing

environmental pressures structurally (OECD, 2020[5]; Dellink et al., 2021[4]) (see Annex Box 2.A.1). More ambitious policy action therefore remains urgent.

2.2. A circular economy can act as a response to these trends

Concerns about the environmental consequences of climate change, acidification, eutrophication, intensified land use, among others, have increased global attention on the continuous rise of materials use. The traditional linear model of resource extraction, product ownership and end-of-life disposal is unlikely to deliver the desired sustainable future. Promoting sustainable materials management has become a major focus of a number of high-profile multilateral and national initiatives and frameworks, including the G7 Alliance on Resource Efficiency (G7, 2015[6]), the G20 Resource Efficiency Dialogue (G20, 2017[7]), and the various partnerships and initiatives launched by the World Economic Forum (World Economic Forum, n.d.[8]).

One of the channels through which decoupling of economic activity from materials use and their environmental impacts can be achieved is in the transition to a more circular economy (Ellen MacArthur Foundation, 2015[9]; OECD, 2019[10]). In contrast to the linear model, a circular economy is regenerative by design and helps to keep resources flowing within rather than through the economy. A circular economy is a model of production and consumption, which eliminates waste and pollution, circulates products and materials (at their highest value), and regenerates nature (by building natural capital) throughout the economy's technical and biological cycles. Products are kept in circulation through reuse, repair, remanufacture and recycling, and nutrients from biodegradable materials are returned to the earth through composting or anaerobic digestion (Ellen MacArthur Foundation, n.d.[11]). More specifically, a circular economy modifies product and material flows through three main mechanisms (McCarthy, Dellink and Bibas, 2018[12]):

- **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 dissemination 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. There are five business models that support the transition to a more resource efficient and circular economy (OECD, 2019[10]):

- **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 demand for extraction and processing of virgin natural resources.
- **Product life extension models** extend the use period 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 demand for new products.
- **Product service system models** where services rather than products are marketed, improve incentives for green product design and more efficient product use.

2.3. Europe wants to lead the global transition to a circular economy

As a response to global trends, the EU has made the transition to a circular economy one of its policy priorities. The EU established a Resource Efficiency Platform as early as 2012 (European Commission, 2012[13]), and adopted the first Circular Economy Package in 2015 (European Commission, 2015[14]). More recently, the new Circular Economy Action Plan (CEAP) (European Commission, 2020[15]) was adopted in 2020, encompassing bold initiatives along the entire life cycle of products. 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[16]). The EU has also revised its waste legislation and developed legislative proposals in several new policy areas, such as plastics, textiles and product policy. For an overview of the key developments in the EU circular economy policy landscape, see Box 2.1.

The circular economy has a key role to play in Europe's recovery from the global pandemic and is one of the ways of "building back better". The EU has established a recovery plan for Europe to help repair the immediate economic and social damage brought about by the pandemic. As much as one-fifth of the funds from the EU's long-term budget and the temporary NextGenerationEU fund will be dedicated to natural resources and environment. To benefit from the EU recovery funds, the EU Member States have developed national Recovery and Resilience Plans (RRPs) to include, among others, measures related to green initiatives and digital recovery (also foreseeing investments and reforms in support of the circular economy) (European Commission, 2020[17]).

Box 2.1. Key circular economy-related policies in the EU

Over the past decade, the European Commission (EC) has launched several flagship policy initiatives.

- The first Circular Economy Package, adopted as early as 2015, contained proposals to amend the EU waste legislation and an EU Circular Economy Action Plan (European Commission, 2015[14]).
- In 2018, the second Circular Economy Package included the EU Strategy for Plastics (European Commission, 2018[18]), a proposal for a Directive on the reduction of the impact of certain plastic products on the environment (European Commission, 2018[19]), a Communication on a monitoring framework for the circular economy (European Commission, 2018[20]) and the *Report on Critical Raw Materials and the Circular Economy* (European Commission, 2018[21]).
- In 2019, the EC presented a non-legislative proposal for Sustainable Products in a Circular Economy (European Commission, 2019[22]) and launched the European Green Deal (European Commission, 2019[16]). One of the main building blocks of the European Green Deal and the European agenda for sustainable growth is the new Circular Economy Action Plan (European Commission, 2020[15]). Adopted in 2020, this document outlines several planned legislative proposals, including widening the Ecodesign Directive, a framework for non-energy-related products and additional sustainability principles, establishing a "right to repair" and revising the Construction Products Regulation. It also foresees revision of the legislation for specific waste streams, such as end-of-life vehicles, packaging and plastic waste, and waste from electrical and electronic equipment (WEEE).

In addition to these policy initiatives, several sector-specific legislations were adopted and revised to implement the policy vision set out in the Circular Economy Action Plan of 2015 and 2020. These elements are discussed in more detail in Annex Box 2.A.2.

2.4. There is a large diversity of national and subnational circular economy strategies

During the past decade, a growing number of EU Member States have embarked on individual paths towards a circular economy. Countries have scaled up local actions, put forward national policy targets, implemented circular economy strategies, and enacted circular economy related laws and regulations. More than 60 circular economy strategies and roadmaps have been developed at national, regional and local levels to stimulate the transition towards a more resource efficient and circular economy (Salvatori, Holstein and Böhme, 2019[23]). Countries with more advanced national circular economy policies include Denmark, Finland, France and the Netherlands, whereas those with more recent strategic frameworks include the Czech Republic, Poland, Slovenia and Sweden. Among the regional and municipal initiatives, most strategies come from countries that already have well-established frameworks at the national level (European Commission, 2019[24]; OECD, 2020[25]). Capitals and large cities throughout Europe (such as Brussels, Glasgow, Helsinki, London and Paris) have been developing circular economy strategies. A number of European cities have signed the European Circular Cities Declaration, including Budapest, which aims to accelerate the transition to a circular economy (ICLEI Europe, 2020[26]).

These strategies aim to further the paradigm shift from a linear to a circular economy as they work within the common framework of the EU's circular economy ambitions (European Commission, 2020[15]; European Commission, 2019[27]). However, there is a rich diversity in the applied approach, ambition and priorities. For instance, different priorities have led to various sectors being targeted to undergo a circular transition. Some countries have also opted for a broad horizontal approach that surpasses individual sectors. These structural choices have, in turn, had an impact on the targets, implementation measures and monitoring instruments for measuring the progress of the transition (see Annex Box 2.A.3). This disparity highlights the need to customize circular economy strategies to the national or local context and priorities.

2.5. Current trends and recent developments in Hungary point to a number of structural, economic and environmental challenges

Hungary has managed to decouple the growing number of environmental pressures from its economic growth. However, the country has so far shown limited efforts to promote the transition towards a circular economy. Several challenges remain related to the country's relatively low performance in waste recycling, circular materials use, resource productivity and eco-innovation. This section discusses Hungary's current socio-economic characteristics and circular economy-related performance.

2.5.1. Slow uptake of circular economy activities

Hungary is a small open economy that has enjoyed relatively fast economic growth. Between 2010 and 2019, Hungary's gross domestic product (GDP) has grown at an average annual rate of 2.8% (OECD, 2020[28]). Almost all sectors have contributed to this growth, including manufacturing, construction and services (Hungarian Central Statistical Office, 2020[29]). This growth has led to record low unemployment and rising wages. However, despite convergence towards the OECD's standard of living, Hungary's GDP per capita is still only three-quarters of the OECD average (OECD, 2020[30]). Moreover, the COVID-19 pandemic has led to disruptions in several sectors, causing considerable economic damage (see Annex Box 2.A.4).

The uptake of circular economy activities in the Hungarian economy has been below par, reflecting, among others, the important gaps in the country's circular economy-related policy landscape (see discussion in chapter 3). Moreover, the slow adoption of circular business models by small and medium-sized

enterprises (SME), the shortages in skills critical to the circular economy, and the low levels of eco-innovation have further hampered the transition to a circular economy in the country. These issues are outlined in more detail in the following paragraphs.

First, despite the great importance of **services** and **industry** in the Hungarian economy, circular activities represent only a negligible fraction of these sectors. The "Services" sector[2] currently represents around two-thirds of the economy's gross value added (GVA), with strong growth in the past few years (OECD, 2020[31]). Although circular economy services, such as repairs of computers and other household goods, have also experienced positive growth, they represent a tiny fraction of the economy, constituting less than 1% of its GVA. At the same time, Hungary has a strong industrial sector, with more than one-fifth of GVA attributable to "Manufacturing"[3] (OECD, 2020[31]). The "Repair and installation of machinery" sub-sector is the fastest growing sub-sector (doubling between 2015 and 2019), but with less than 1% of GVA it still represents a small segment of the economy. Nonetheless, this sub-sector illustrates how the servitisation and circularisation of Hungarian manufacturing can be accelerated, by which the manufacture of equipment is accompanied by services related to extending its lifetime.

Second, the Hungarian **construction** and **mining** sectors have been growing exponentially within the past years. "Construction" only represents 6% of GVA, but has strongly expanded – doubling from 2015 to 2019 (OECD, 2020[31]). "Mining and quarrying" represents less than 1% of GVA, but it has almost tripled over the same period. Both sectors are closely related to the extraction of construction materials, have high resource intensity per unit of added value, and generate substantial environmental impacts such that their growth raises challenges in the transition to a circular economy.

Third, although **agriculture** has relatively high importance in Hungary, the uptake of bioeconomy practices lags significantly behind other European countries. The share of "Agriculture"[4] is one of the highest among the OECD countries, accounting for almost 4% of the GVA (OECD, 2018[32]). Despite owning the largest share of agricultural land in the EU (almost 60% of the country's land area), Hungary's biomass only constitutes a small share of the EU's total annual production (less than 5%) (BIOEAST, 2021[33]). The bioeconomy contributes to the circular economy transition in various ways, for instance, by supporting the production of bio-based fertilisers, using organic waste as feed and fodder, and replacing fossil-based production.

Fourth, the overall circular economy **employment** in Hungary is above the EU average, yet shortages in skilled labour might hamper the pace of progress towards the circular transition. Hungary's employment has seen favourable labour market developments in the past decade, with the employment rate increasing to a remarkable high of 70% (OECD, 2020[34]). Of this, the circular economy employed 2%, or about 90 000 people, in 2018 in sectors related to the repair and reuse of a variety of equipment (from motor vehicles to consumer electronics and furniture), the sale of second-hand products, and waste management (Eurostat, 2021[35]). The bioeconomy also constituted an important sector in terms of employment (European Commission, 2020[36]). At the same time, the labour market has been characterised by shortages in skilled labour and a mismatch between skills and employer needs (OECD, 2018[32]). This is particularly critical to the circular economy, for which acquiring new skills (reskilling) and topping-up existing skills (upskilling), especially transferable skills and "green skills", is a prerequisite.

Fifth, **SMEs** remain essential economic actors in the Hungarian economy, with underlying trends of servitisation and digitalisation, offering an, as yet, untapped potential for the uptake of circular business models. SMEs contribute to more than half of the GVA (OECD, 2019[37]) and employ around 70% of the business sector (OECD, 2019[37]). Certain sectors, enabled by servitisation and digitalisation, such as information and communication technologies (ICTs), administration and support services, or transportation and storage, have an above average rate of high growth enterprises (see Annex Figure 2.A.7). At the same time, sectors that have a consistently below average presence of high-growth enterprises include construction, wholesale and retail trade, and accommodation and food (OECD, 2019[37]). For these sectors, finding new synergies for growth by employing circular economy business models, enabled by servitisation

and digitalisation, could be an important avenue for expansion, helping them to increase their value added, and making better use of under-utilised assets, reducing costs and entering new markets.

Lastly, Hungary is considered a modest innovator with relatively low levels of **eco-innovation** and generally low expenditure on research and development (R&D). According to the European Innovation Scoreboard (EIS), Hungary ranked 22nd in the EU in 2019 (European Commission, 2020[38]). Hungary has also significantly fallen back on its Eco-Innovation Index since 2015 (Eco-innovation Observatory, 2019[39]); it ranked last but one among the EU Member States in 2019. In addition, Hungary's innovation performance is lagging in terms of intellectual assets. When looking at patents filed under the Patent Cooperation Treaty, the number of patents in Hungary is significantly below the number of patents filed by inventors residing in frontrunner countries (OECD, 2021[40]). Of the total patent count, environmental technologies constitute less than 10%, with the majority representing climate change technologies (especially for buildings, energy generation and transmission, as well as environmental management). Only a small share of the patents is related to waste management, including wastewater management (see Annex Figure 2.A.8). Finally, Hungary's relatively low expenditure on R&D remains an impediment to improved innovative performance. In 2018, Hungary's gross expenditure on R&D stood at 1.5% of GDP, which is less than the EU average (at 2.1% of GDP). The transition to a circular economy inherently requires multidimensional innovation at the product, process, organisation and marketing levels.

Box 2.2. Hungary's Circular Economy Technology Platform

Hungary recently established the Circular Economy Technology Platform (EGOV.HU, 2022[41]) in response to its lag in research, development and innovation (R&D&I) related to the circular economy. The aim of the platform is to accelerate Hungary's transition to a circular economy and to place the country at the forefront of using innovative circular technologies, thereby strengthening its competitiveness, and establishing and strengthening collaborations between private and public stakeholders, professional organisations, academia and civil society (Circular Hungary, 2022[42]).

Established at the University of Pannonia, the platform is a consultation and cooperation forum, which is based on the voluntary professional work of its member organisations (with 135 founding members). The main responsibilities include: establishing an advisory forum; operating working groups; supporting changes in regulatory environment; promoting R&D&I and education and training; and reviewing technical materials (Circular Point, 2022[43]). The objectives of the platform are six-fold: i) accelerating the circular economy transition; ii) mainstreaming systems thinking; iii) creating and connecting local circular value chains; iv) shaping the attitude, and changing the behaviour of businesses and citizens; v) representing the interests of industrial players and research institutes, and providing inputs to policy making; and vi) developing a financing framework (private sector financing and public funding through tenders).

The platform will focus its work on 12 areas covering both horizontal and vertical topics. Altogether, five horizontal working groups will focus on:

- funding for new business models and the circular transition
- inputs for policy
- knowledge transfer and innovation
- awareness raising and behavioural change
- data and measurement.

The vertical working groups will cover the following focus areas:

- critical and secondary raw materials
- circular construction
- circular electronics
- circular agriculture, food industry, and trade
- circular water management
- circular textile industry
- circular settlements.

More information can be obtained from the platform's website: https://circularhungary.hu/.

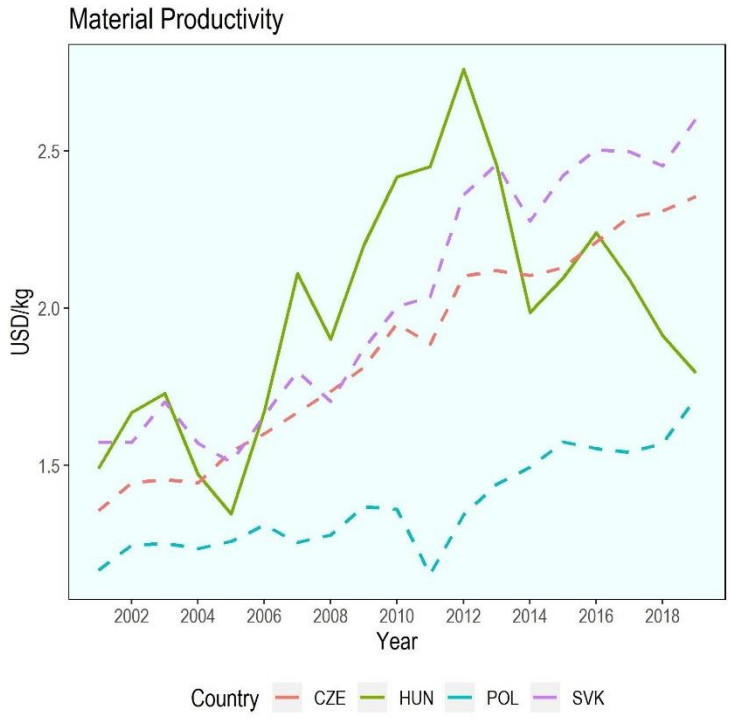
2.5.2. Continuous growth of raw materials use, waste generation and energy consumption

Hungary has achieved relative decoupling of economic growth from resource and energy use, as well as from waste generation (refer to Annex Figure 2.A.9). However, in many aspects, Hungary is an average performer. For instance, the efficiency and the circularity of materials use lag behind its European counterparts. Additionally, its material consumption levels are still increasing while its recycling rates remain low (European Commission, 2019[44]; OECD, 2018[32]). Moreover, Hungary's decrease in domestic energy production has led to a higher dependence on imported fossil fuels with an energy import dependence above the EU average, which continues to rise (Eurostat, 2021[45]).

Hungary's material productivity has been low and has not structurally improved (decreasing again since its peak in 2012, as seen in Figure 2.2), implying that Hungary does not use its materials efficiently to generate economic value.[5] The country's materials productivity stands at USD 1.8 per kg, well below EU levels (at USD 2.9 per kg in 2019). Moreover, Hungary's domestic material consumption (DMC)[6] per capita is above the EU average (at 17.8 tonnes for Hungary and 14.2 tonnes per capita for the EU in 2019) and shows a continuously increasing trend. The significant increases in DMC and decreases in material productivity can be attributed in large part to the consumption of construction minerals (which make up more than half of all materials consumed), followed by biomass for food and feed, and fossil energy carriers (refer to Annex Figure 2.A.10).

At the same time, Hungary's performance in terms of circular material use (CMU) rate[7] has been relatively low. The share of material resources used from recycled products attained only 6.8%, which is far below the EU average (at 11.9% in 2019) (see Annex Figure 2.A.11).

Figure 2.2. Material productivity



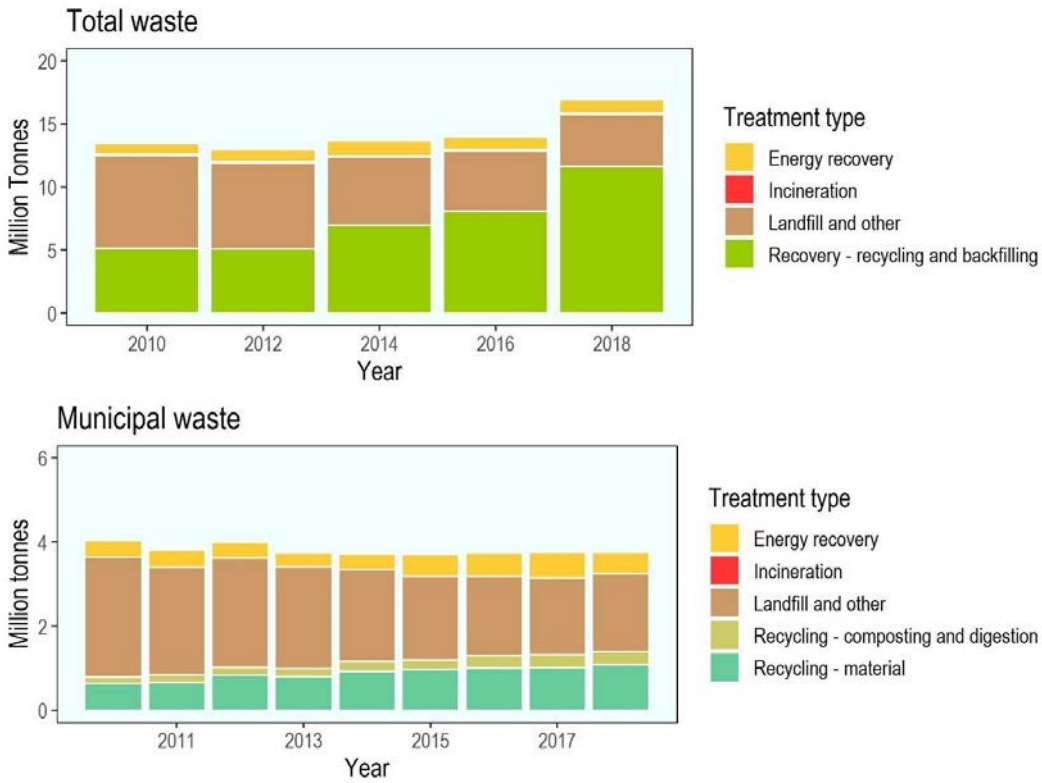
Source: OECD (2020[46]).

Hungary's total waste generation has recently increased with different trends prevailing across individual waste streams. With about one-third of total waste, the construction sector has been dominating waste generation in Hungary (see Annex Figure 2.A.12). Between 2016 and 2018 alone, waste generation in this sector almost doubled. Other significant contributors to waste generation include manufacturing, energy production and households. Agricultural waste, on the other hand, has decreased significantly over the last two decades, becoming a small fraction of total waste. Annex Box 2.A.5 provides more detail on the different waste categories generated by individual sectors.

Waste treatment in Hungary shows disparate trends. On the one hand, the quantity of total landfilled waste has been decreasing, almost halving between 2010 and 2018 (as shown in Figure 2.3). Waste that is recovered (including from recycling and backfilling) has more than doubled since 2010, while energy recovery rates and incineration have remained stable (OECD, 2018[32]). However, on the other hand, municipal waste management performance has been lagging behind despite the stable totals and the low per capita values (381 kg/capita in 2018) compared to the EU average (495 kg/capita) (Eurostat, 2020[47]). Although material recovery rates have been increasing, landfilling still represents about half of municipal waste treatment, which falls short of the ambitious European targets.[8]

Although recycling rates for packaging materials have been relatively high in the last decade, they have continued to decrease. Recycling rates for paper and cardboard packaging reached an historic peak of almost 95% in 2010 but have since decreased to 70% in 2018 (see Annex Figure 2.A.15). Moreover, plastic packaging, glass packaging and miscellaneous packaging rates have been stagnating and have further decreased, thus posing challenges for Hungary to reach EU recycling targets.[9]

Figure 2.3. Total waste and municipal waste, by waste management operations



Source: Eurostat (2021[48]; 2020[47]).

Hungary's total energy supply has been slowly decreasing from its historical peak in 1987, but so has domestic energy production, exposing the country to greater import dependence on fossil fuels. Natural gas and crude oil remain the two most important energy sources in Hungary. In 2019, they each represented about one-third of total energy supply (refer to Annex Figure 2.A.16). However, the majority of natural gas and crude oil consumption is imported from the Russian Federation, leading to an important energy dependency and threatening the security of supply in times of global energy crisis (Eurostat, 2021[45]; IEA, 2022[49]; IEA, 2017[50]). Additionally, while Hungary has one of the highest shares of nuclear energy (slightly less than one-fifth of total energy supply and around half of domestic electricity production in 2019), the share of renewables is among the lowest in the OECD (with only 2% of hydropower, wind and solar power, and 10% of biofuels in 2019). Coal still represents almost one-tenth of the total energy supply, though its role in the energy mix has steadily declined.

Hungary's total energy consumption has been increasing, reaching its highest rate in the past two decades. Although the residential sector accounted for almost one-third of total final consumption, its consumption has been decreasing due to improvements in the energy efficiency of buildings. Other important sectors are "Transport" (due to the country's relatively old car fleet) and "Industry" (which has been growing ever since its recovery from the 2008 financial crisis) (IEA, 2017[50]).

2.6. Macroeconomic projections to 2050 show that Hungary's economy will not become more circular without new policies

Despite the progress made in decoupling environmental pressures from economic activity, macroeconomic projections indicate that in the absence of more stringent policies, Hungary will continue to face a number of challenges in the decades to come. As wealth increases and living standards in Hungary converge towards the EU and OECD averages, demand for resources and materials is projected to increase further. This section presents the projections of macroeconomic indicators for Hungary to 2050, developed using the OECD ENV-Linkages model (Chateau, Dellink and Lanzi, 2014[51]).

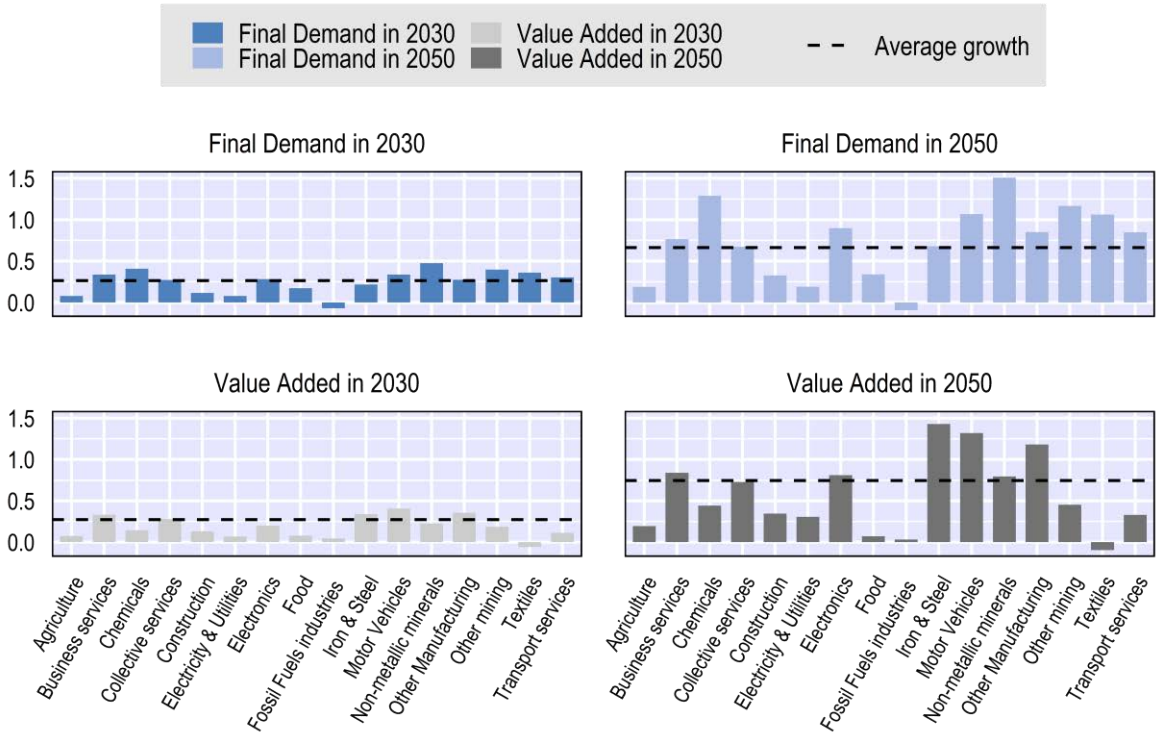
2.6.1. Projected changes in the economic structure

Living standards in Hungary are expected to continue increasing in the next decades. Hungary's economy is projected to grow at an annual rate of 1.9% towards 2050 – a faster growth rate than the EU and OECD averages.[10] Sectors where Hungary holds a comparative advantage (including electronics, motor vehicles, and other manufacturing) are projected to experience fast growth over the next three decades. Moreover, construction is expected to rise following the country's economic progress, while growth in services (including business, collective and transport services) reflects the servitisation of Hungary's economy (see Figure 2.4).

Structural and technological changes are expected to alter the structure of the Hungarian economy. In particular, structural changes towards sectors characterised by low materials intensity (such as services and higher-end manufacturing sectors) will increase resource efficiency, while materials intensive sectors are projected to grow but still remain below the average rate (see Annex Figure 2.A.17). At the same time, technological changes (such as the uptake of technological progress and digitalisation) are projected to further increase resource efficiency in production, shifting the production process away from primary materials towards secondary materials and recyclables (refer to Annex Figure 2.A.18).

Although changes in Hungary's economic structure partially mitigate the increase in materials use, they are not sufficient to offset them. In the absence of new policies, the rise in living standards, along with the underlying structural changes and changes in production modes, are projected to increase the demand for materials by one-third in 2050 compared to 2017 levels (an increase from 119 million tonnes (Mt) to 160 Mt, as shown in Figure 2.5). With an increase in GDP per capita by more than two-thirds, Hungary is projected to experience relative, but not absolute, decoupling of materials consumption from its economic output over the next three decades (see Annex Figure 2.A.19).

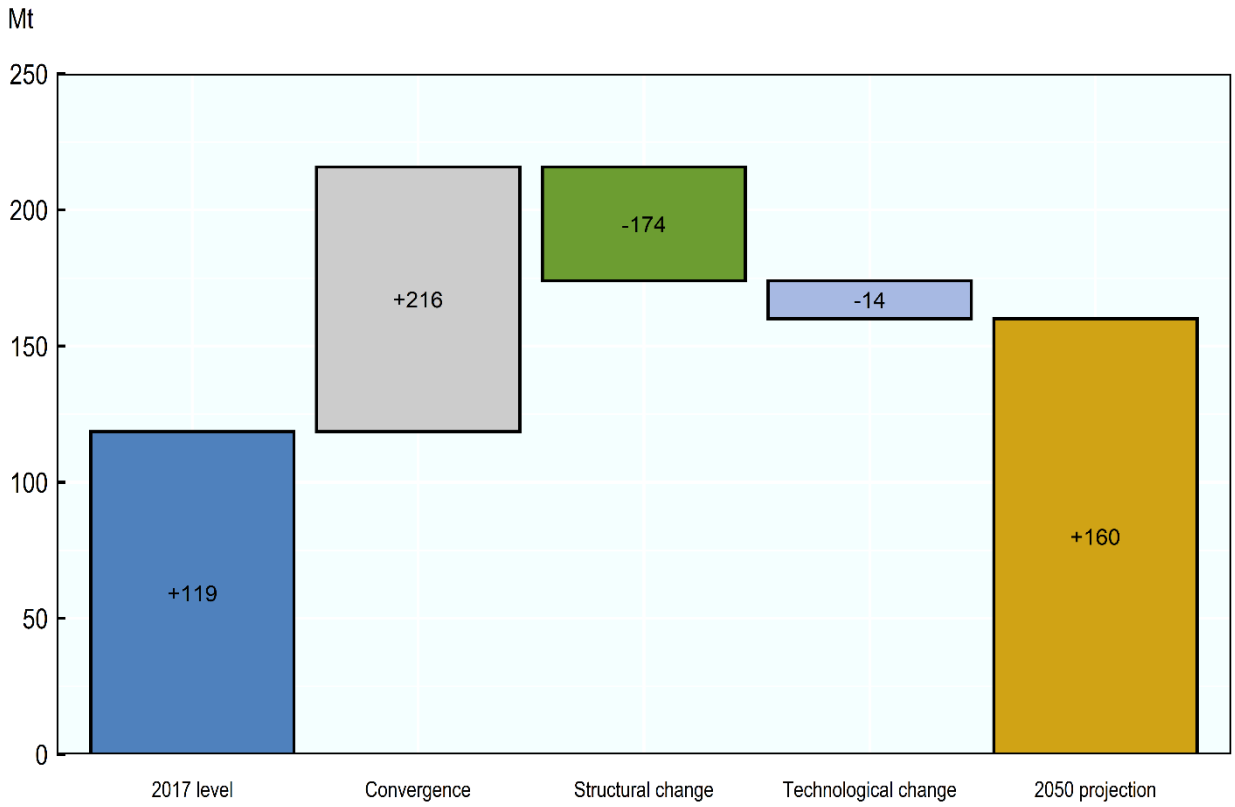
Figure 2.4. Projected changes in sectoral value added and final demand in 2030 and 2050 (relative to 2020)



Note: A change of 1 means a doubling of the quantity.
Source : OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/p1exgn

Figure 2.5. Decomposition of the increase of materials use between 2017 and 2050 in Mt



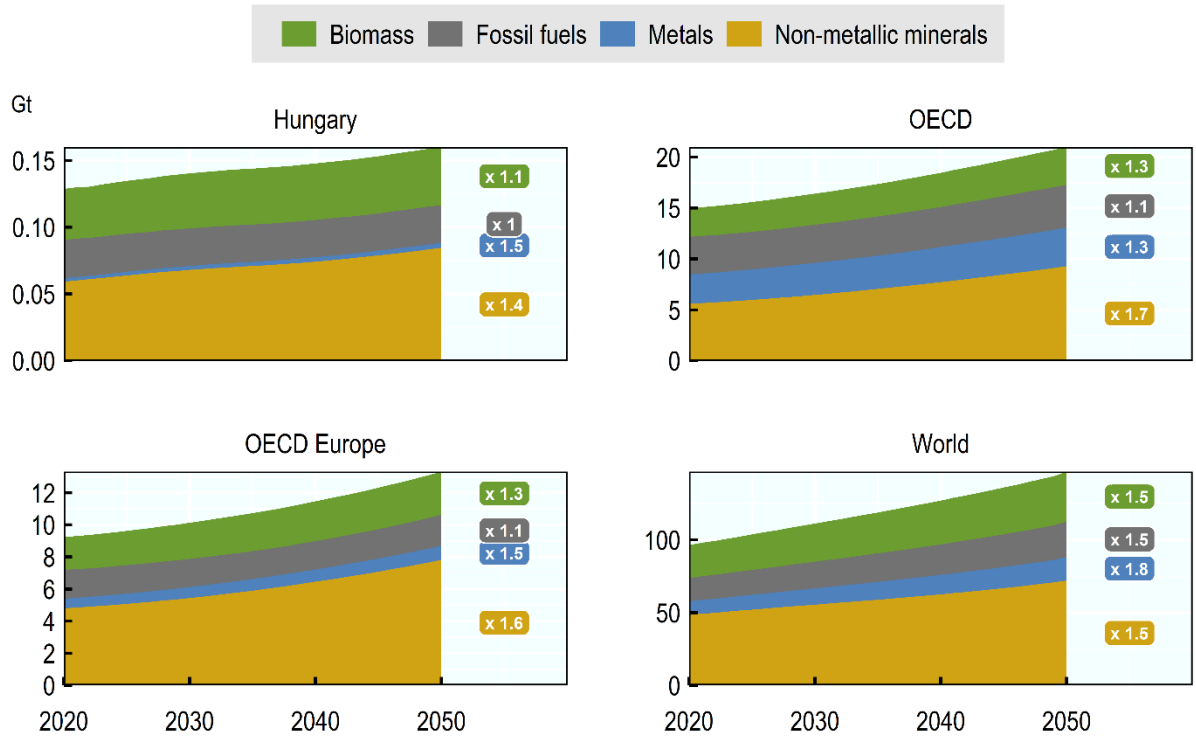
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/arzoh5

2.6.2. Projected increase in materials use and associated environmental impacts

Materials use in Hungary is expected to grow at a slower pace than in other OECD countries, however, growth rates differ across the different materials categories. The overall use of primary materials in the country is expected to increase by 25% (compared to 40% for OECD, as shown in Figure 2.6). Non-metallic minerals constitute the bulk of materials, with demand for construction minerals expected to double by 2050. Biomass is also an important materials category. However, its growth is slower than in the OECD Europe region. The moderate growth of fossil fuels in Hungary reflects a shift towards alternative energy sources. Although metals are the smallest category (when measured by weight), metal extraction and processing are associated with bigger environmental impacts.

Figure 2.6. Projected materials use growth for 2020-2050



Note: Regional averages, except for Hungary. Materials use varies widely across regions, therefore the scale is different across the four charts. The reported material uses include both domestic and imported materials.
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/x6m5wq

The continued increase in materials demand is expected to exert significant pressure on the environment, putting Hungary at risk of missing important environmental goals, and missing opportunities to strengthen the competitiveness and resilience of its economy. More specifically, the increased use of construction minerals (with the largest projected use by 2050), is likely to lead to high acidification and climate warming, placing an extra burden on cumulative energy demand (as total energy use increases along the production chain). Additionally, GHG emissions are expected to increase (mainly driven by emissions associated with construction and chemical sectors), whereas air pollutant emissions are declining across most categories (driven by improvements in energy efficiency in transportation and heating systems, among others) (refer to Annex Figure 2.A.20). Although Hungary is performing better than OECD Europe, and the country is projected to experience a relative decoupling of its GHG emissions from its economic output (as shown in Annex Figure 2.A.21), its progress is still far from Hungary's 2050 carbon neutrality goal.

Additional policies are needed to achieve stronger decoupling of materials use and GHG emissions from economic growth. The NCES could help focus policies on the most materials intensive sectors, in particular, construction,[11] food and agriculture. Given the present and future importance of metals, motor vehicles, electronics, other manufacturing sectors, and chemicals (including plastics), the NCES could also investigate the potential of circular economy opportunities in these sectors.[12] Moreover, horizontal policies directed towards greater technological (and structural) changes can speed up the circular economy transition. The NCES could focus on research and innovation policies, as well as policies directed towards greater use of circular business models (servitisation and digitalisation), shifting the economy away from materials intensive industries towards higher-end manufacturing and services.

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Annex 2.A. Supplementary information

Annex Box 2.A.1. The long-term implications of the COVID-19 pandemic and recovery measures on environmental pressure

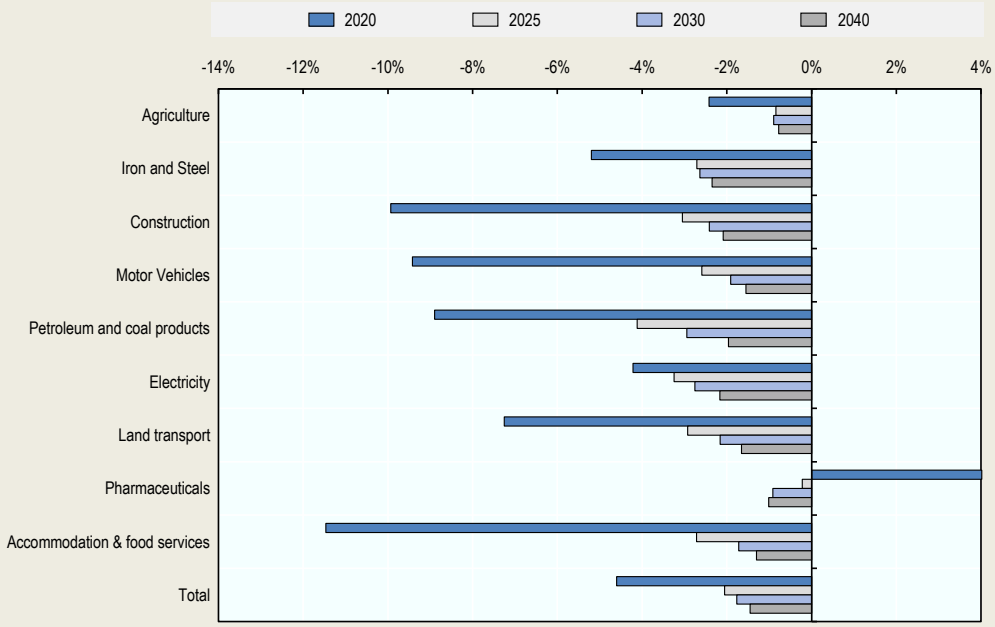
The COVID-19 pandemic and its associated restrictions, not least the lockdowns, have had severe economic consequences, leading to a significant decline in economic activity. Recovery will be a long-term process, and economic activity will likely be affected even after the health crisis is over. The effects of COVID-19 on economic growth will affect the pressure of economic activity on the environment.

The first numerical assessment of the effects of the pandemic on medium and long-term environmental pressure uses the large-scale modelling tool ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]) to investigate the impact of sectoral and regional shocks to the economy up to 2040.

The modelling analysis shows that there are significant differences in terms of economic impacts across regions, influenced to some extent by the severity of the pandemic in those regions and the strictness and duration of the lockdowns. Differences in the structure of these economies, as well as shifts in international trade patterns, were also observed. Sectoral differences are pronounced. For example, while transport activities and certain services were substantially affected in 2020, pharmaceutical companies are projected to boost production in the short term. After 2020, the low short-term economic growth and fall in investments began to negatively affect all sectors. In the longer term, the burden will shift towards the more capital-intensive industries due to a slower build-up of the capital stock, while services, especially agriculture, will rebound more quickly to pre-COVID baseline levels.

Annex Figure 2.A.1. Effects of the COVID-19 scenario on global output of selected sectors

Deviations from the pre-COVID baseline projection

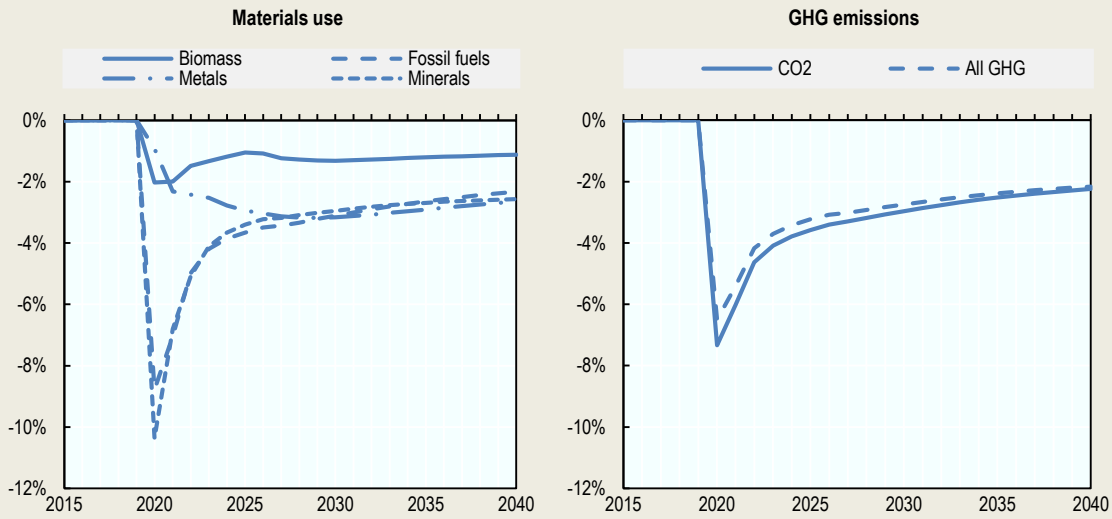


Source: ENV-Linkages model (Chateau, Dellink and Lanzi, 2014[51]).

The short-term easing of the environmental pressures caused by COVID-19 emergency response measures, like lockdowns and social distancing, are significant. Greenhouse gas (GHG) emissions, as well as emissions of some of the most important air pollutants, fell by around 7% below the pre-COVID baseline level in a single year. Other air pollutants, including those more strongly related to agriculture, followed a smaller decline in 2020. The fall in materials use varies with the type of material, for example, biotic resources declined by just 2%, whereas the reduction in the use of non-metallic minerals, including construction materials, is projected to reach 11%.

Annex Figure 2.A.2. Effects of the COVID-19 scenario on global environmental pressures

Deviations from the pre-COVID baseline projection



Source: ENV-Linkages model (Chateau, Dellink and Lanzi, 2014[51]).

GHG emissions were projected to increase again after 2020 as economic activity resumed and vaccines began to be deployed, gradually getting closer to pre-COVID baseline levels. However, there is a long-term (potentially permanent) downward impact on the levels of environmental pressure of 1-3%, depending on the indicator, and roughly 2% for emissions and materials use related to energy use and industry, and less than half of that for land use change, emissions and materials use that are more closely linked to agriculture. Growth rates do recover fully.

Source: Dellink et al. (2021[4]).

Annex Box 2.A.2. European circular economy legislation and related targets

The policy packages introduced by the EC have put forward a range of ambitious targets, as highlighted in Annex Table 2.A.1, as well as binding obligations for the Member States.

Annex Table 2.A.1. Key EU circular economy related targets

Target	Timeframe	Legislation
The preparation of municipal waste for reuse and recycling shall be increased by weight to a minimum of 55% (by 2025), 60% (by 2030) and 65% (by 2035)	By 2025, 2030, 2035	Waste Framework Directive
Separate collection of textiles and hazardous waste generated by households	By 01/01/2025	Waste Framework Directive
Separate collection or recycling at source of bio-waste	By 31/12/2023	Waste Framework Directive
A binding landfill target to reduce landfill to a maximum of 10% of municipal waste.	By 2035	Landfill Directive
Restrictions on landfilling of all waste (or other materials) that is suitable for recycling or energy recovery	From 2030	Landfill Directive
A common EU target for recycling a minimum of 65% by weight of all packaging waste (70% by 2030)	By 31/12/2025 (31/12/2030)	Packaging and Packaging Waste Directive
Minimum recycling targets for specific packaging materials: paper and cardboard to 75% (85% by 2030); ferrous metals to 70% (80% by 2030); aluminium to 50% (60% by 2030); Glass to70% (75% by 2030); plastic to 50% (55% by 2030); wood to 25% (30% by 2030)	By 2025 (By 2030)	Packaging and Packaging Waste Directive
A 77% separate collection target for plastic bottles (90% by 2029)	By 2029	Single-Use Plastics Directive
Incorporate 25% of recycled plastic in the manufacture of PET bottles from 2025 and 30% in all plastic bottles as from 2030	By 2025 By 2030	Single-Use Plastics Directive
At least 55% reduction in GHG emissions (from 1990 levels)	By 2030	Proposal for a European Climate Law
At least 32.5% improvement in energy efficiency (compared to projections of the expected energy use in 2030)	By 2030	Energy Efficiency Directive
At least 32% of total energy needs covered by renewable energy	By 2030	Renewable Energy Directive

Note: Only targets beyond 2020 were included. The table does not include a comprehensive list of sectoral climate and energy targets.

Revised EU waste legislative framework

- Six EU waste directives were amended within the context of the 2015 Circular Economy Package: i) Directive (EU) 2018/851 amending Directive 2008/98/EC on waste; ii) Directive (EU) 2018/850 amending Directive 1999/31/EC on the landfill of waste; iii) Directive (EU) 2018/852 amending Directive 94/62/EC on packaging and packaging waste; iv) Directive (EU) 2018/849 amending Directives 2000/53/EC on end-of-life vehicles (ELV); v) Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators; and vi) Directive 2012/19/EU on waste electrical and electronic equipment (WEEE).

Revised EU eco-design requirements, sustainable products and product labelling

- The Ecodesign Framework Directive (Directive 2009/125/EC) is implemented through product-specific regulations. In 2019, 10 eco-design implementing regulations were adopted by the European Commission (8 revisions and 2 new product group introductions). These regulations

set energy efficiency (EE) and other product design requirements, including aspects on reparability, recyclability and durability.

- The Sustainable Products Initiative (SPI) will revise and widen the scope of the Ecodesign Framework Directive beyond energy-related products so as to make them fit for climate neutral, resource efficient and circular economy objectives. The initiative will also tackle the presence of harmful chemicals in electronics and ICT equipment, textiles, furniture, steel, cement and chemicals. It may also establish product sustainability principles and other ways to regulate sustainability-related aspects in a wide range of products.
- The revised Energy Labelling Regulation (EU) 2017/1369 updates the energy efficiency labelling requirements for products to allow consumers to distinguish between energy efficient products.
- The EU Ecolabel Regulation (EC No 66/2010) sets a voluntary environmental labelling scheme.

EU plastics legislation

- The Single-use Plastics Directive (EU) 2019/904 aims to reduce certain plastic waste streams, such as marine plastic litter. It covers single-use plastic (SUP) items, products made from oxo-degradable plastic and fishing gear-containing plastic.

EU climate and energy legislation

- The EU energy and climate legislation was also revised in 2018. The European Climate Law Regulation (EU) 2021/1119 establishes the framework for achieving climate neutrality. All relevant legislation is expected to be updated with a view to implementing the newly proposed 2030 GHG emissions reduction target and help the EU reach the proposed legally binding target of net zero GHG emissions by 2050.

EU chemicals policies

- One of the most important pieces of legislation in this area is the REACH Regulation (EC) 1907/2006, which aims to protect human health and environment by obliging companies to identify and manage risks related to the chemical substances they produce and sell.

Revised European Fertilising Product Regulation

- The EU Fertilising Products Regulation (EU) 2019/1009 introduces harmonised rules for organic fertilisers manufactured from secondary raw materials, such as agricultural by-products and recovered bio-waste.

Annex Box 2.A.3. Key insights for developing the circular economy strategy in Hungary

From the review of international literature and the analysis of circular economy strategies in Europe, the following lessons can be drawn from the different experiences of countries developing circular economy strategies and roadmaps.

- **A circular economy strategy is a flagship document** that contains the following elements: an inspiring vision and strategic goals, links to critical stakeholders and related policy areas, selected priority areas, quantitative targets and monitoring, as well as a high level implementation plan.
- **A clear vision inspires and makes the ambitions more concrete.** Most countries have presented highly ambitious visions for systemic change that aim to concretise what is meant by a circular transition. Some have opted for an explicit vision statement, while others have been more implicit about the future. Furthermore, the level of ambition of the visions varies, ranging from the most ambitious countries, aiming to become regional or even global leaders in the circular economy, to the less ambitious ones targeting the creation of future-proof sustainable economies and stimulating innovation.
- **The strategy should be tailored to the local context and be embedded in the domestic policy landscape.** Countries reference the links to specific policies and strategies, notably: overarching country development strategies, sectoral strategies, environmental policies and programmes, waste management and raw materials policies and plans, as well as broader enabling policies. Concerning the EU-level regulation, Member States refer to both the circular economy related guidelines (e.g. the EU Circular Economy Action Plan and the EU Circular Economy Package) and the broader environmental regulations (e.g. European waste directives, Industrial Emissions Directive, Ecodesign Directive).
- **Shared ownership across stakeholder groups and government actors is crucial in the process of developing and implementing the roadmap.** The most inclusive strategies incorporate stakeholder consultation, balanced partnerships, inter-ministerial coordination and cross-sectoral cooperation during both development and implementation phases. Stakeholders are involved through public consultations, individual meetings and topical workshops. The strategy development is governed by one or more ministries, and steered by a diverse working group. The implementation is then carried out by stakeholders from priority areas, with a central coordination body typically monitoring the overall implementation.
- **To narrow down the scope and elaborate flagship actions, a selection of priority areas is needed.** Member States tend to select a wide variety of priority areas depending on the local priorities. The priority areas can relate to manufacturing sectors/industries, service sectors, material streams or horizontal tools (see Annex Table 2.A.2). Waste management has a specific role because it can be considered as a service sector but also as a horizontal tool that is essential for every closed materials loop. All strategies include the waste management sector in one way or the other. The approach to select the priorities varies but, typically, economic data, material-related data, stakeholder concerns and political priorities are all taken into account. Typically three to six priority areas are selected.
- **Quantitative targets make the vision more actionable and induce stronger commitments for implementation**. Countries use one or more high level targets as a beacon to focus efforts. In addition to the national level of implementation, countries can also formulate targets for priority sectors or areas. Most quantitative targets build on existing targets from related national and European strategy documents or monitoring frameworks. Their level of ambition varies, ranging from those in compliance with existing targets and obligations to those going beyond

them. In practice, most quantitative targets are related to the environment, more specifically, to resource productivity, reduction in the use of primary raw materials, waste reduction, and recycling. Social and economic quantitative targets are rare and limited to the number of additional jobs to be created or, exceptionally, to circular business models.

- **The strategy needs to be underpinned by an implementation plan that transforms the high-level principles of the strategy into actions.** The implementation plan can be a stand-alone document or it can be integrated in the strategy as a chapter or annex. It should list high-impact actions, allocate responsibilities, develop a timeline, describe the governance structure to coordinate the actions, and foresee a monitoring system for the key indicators. Countries typically put forward a mix of policy instruments including: economic instruments, regulatory instruments and other instruments, for instance, voluntary environmental labelling, voluntary product stewardship or green deal initiatives, education and research, to name a few. The flagship actions, the responsibilities and the timeline around communication can be fully integrated into the implementation plan or can be grouped together in a stand-alone communication plan. Overall, most implementation plans include both cross-sector actions and sector-specific actions, but the sector-specific actions are often more concrete.
- **Local strategies at the municipal, provincial or regional level can support national objectives.** Local authorities have a range of policy instruments that can be used to enhance the transition. These relate to spatial planning, permit requirements for activities and obligations for new construction projects, facilities for material-related start-ups, and waste management. The city-level strategies focus on implementing the national goals by leveraging local authorities. Moreover, they aim to create a dynamic vibe that makes the city a driver for circular economy innovation and an attractive place to live.

Annex Table 2.A.2. Priority areas

Materials	Manufacturing sector	Service sector	Horizontal tools
Biomass and food	Automotive	Circular business models	Digital tools
Building materials	Chemicals	Financial sector	Economic instruments
Glass	Construction	Logistics	Education
Metals	Electronics	Retail	Local authorities
Paper	Packaging	Tourism & hospitality	Public procurement
Plastics	Textiles	Waste management	Research
Other materials, sectors and tools			

Annex Box 2.A.4. Recent trends and economic implications: COVID-19

The COVID-19 pandemic has led to closures in manufacturing and services, and has disrupted international trade, causing considerable economic damage. Hungary swiftly acted on the first wave of the pandemic, but a resurgence of cases was experienced in September 2020. Overall, the economy contracted by 4.8% in 2020, and unemployment increased to 4.1% from its record low of 3.4% in 2019.

The automotive sector, which accounts for nearly one-third of manufacturing output, was hard hit by the double whammy of disrupted international supply chains and a collapse in demand. International supply chains could be particularly difficult to fully restore, leaving the economy with underutilised resources (OECD, 2020[52]). Export volumes decreased by 13.7% and import volumes decreased by 9.7%. In the services sector, tourism and its supporting sectors were particularly affected. The cushioning effect of a fiscal stimulus package (Economy Protection Fund) of 7.9% of GDP provided relief to workers and businesses with wage support and cuts to social security contributions.

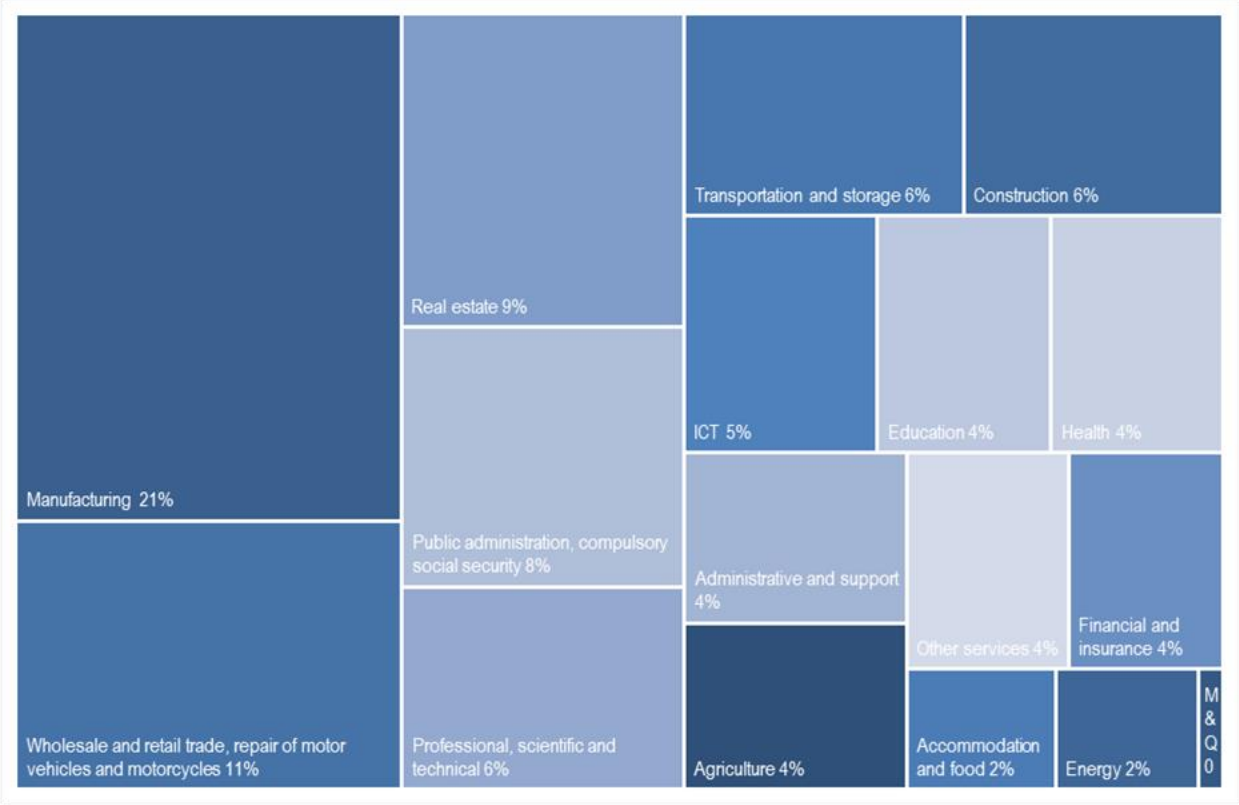
Global economic growth was estimated at 5.6% in 2021. In Hungary, real GDP growth was estimated at 6.9% in 2021 and was projected at 5% for 2022. Downside risks to a robust recovery included prolonged restrictions, subsequent waves and variants of the virus, as well as a slow rollout of vaccines.

The sudden changes in public finances and thus public debt are a global phenomenon in the COVID-19 crisis, and Hungary faces similar pressures. The economic shock has also led to dramatic increases in funding needs across the OECD area. Some of the fiscal interventions were of a short-term nature, while others may need to be medium to longer term. The gross borrowing needs of the OECD member countries increased by 30% compared to pre-COVID estimates in 2020, increasing the OECD countries' debt stock from USD 49.1 trillion to USD 52.7 trillion (OECD, 2020[53]). Due to contraction in economies and an increase in outstanding debt, central government debt-to-GDP ratio may increase to 86.2% (OECD, 2020[53]). Thus, there is a global trend of increasing government debt, with implications for fiscal policy in the short and long term.

Government attention to the more immediate needs to alleviate the economic damage of the COVID-19 pandemic might crowd out some of the initiatives and funds that could otherwise be directed towards the transition to a circular economy. However, there are opportunities to "greening" the recovery by devising appropriate instruments, and by doing no harm, i.e. avoiding environmentally damaging policies, shovel-ready projects or roll-back of existing environmental regulations (Agrawala, Dussaux and Monti, 2020[54]). EU funding, specifically earmarked to tackle environmental issues, could therefore be an important avenue. The NextGenerationEU is one of the largest recovery instruments of the European Union. One of the key constituent parts of this instrument is the Recovery and Resilience Facility (RRF), which makes available loans and grants totalling EUR 673 billion. The RRF aims to green the recovery and allow for a digital transition by requiring that each recovery plan dedicate at least 40% on climate and 20% on digital actions. Hungary has also submitted a Recovery and Resilience Plan (RRP) in 2021, which lays emphasis on green recovery measures, including on the circular economy (Government of Hungary, 2021[55]). The broad circular economy-related measures included in the plan concern regulatory change for a transition to a circular economy, the development of waste management infrastructure (EUR 335 million), and the development of intelligent, innovative and sustainable industry and secondary materials markets (EUR 240 million).[1]

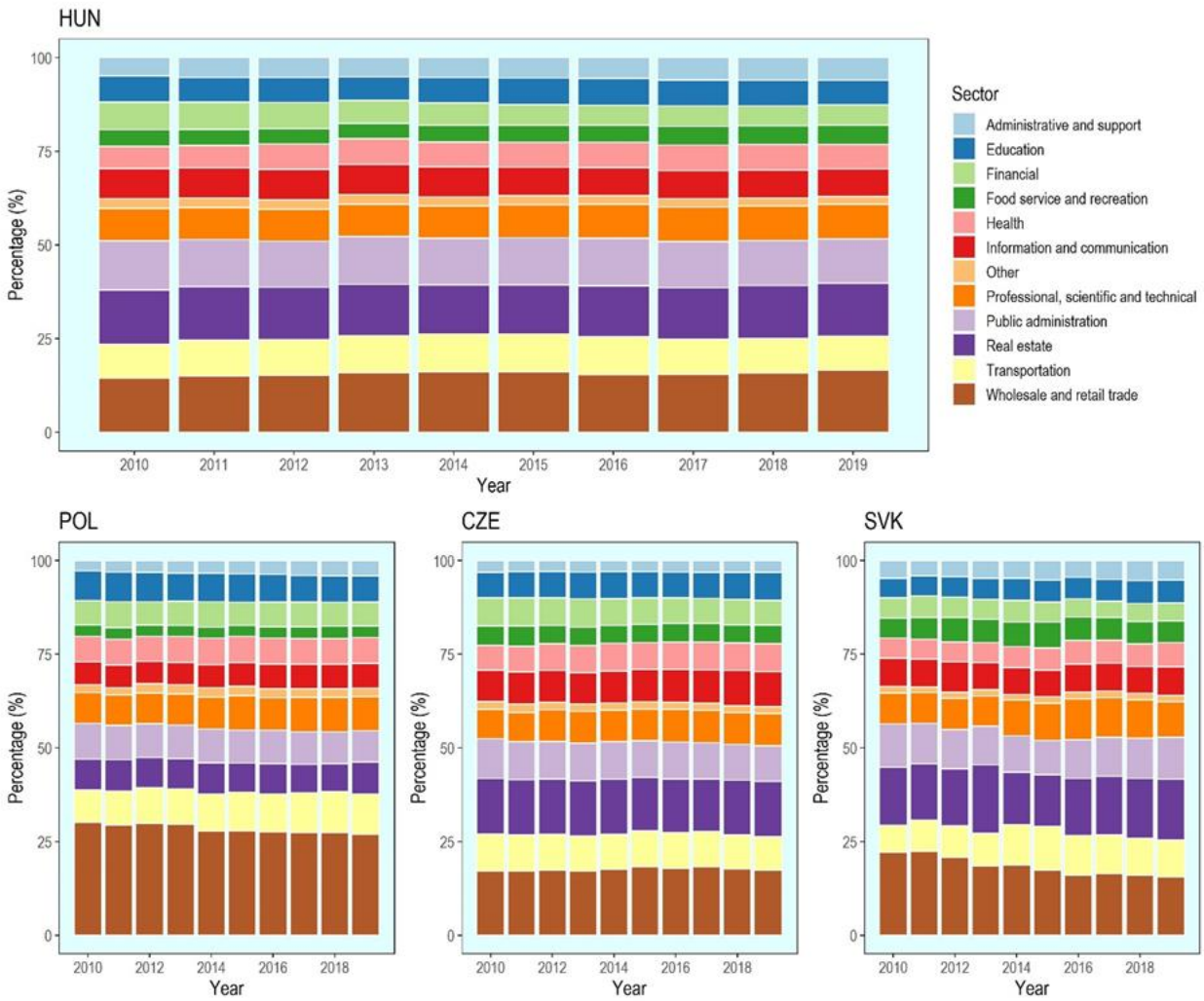
1. Using an average conversion rate of HUF 358 to EUR 1 in 2021 reported by the Hungarian National Bank.

Annex Figure 2.A.3. Gross value added of sectors in Hungary (2019)



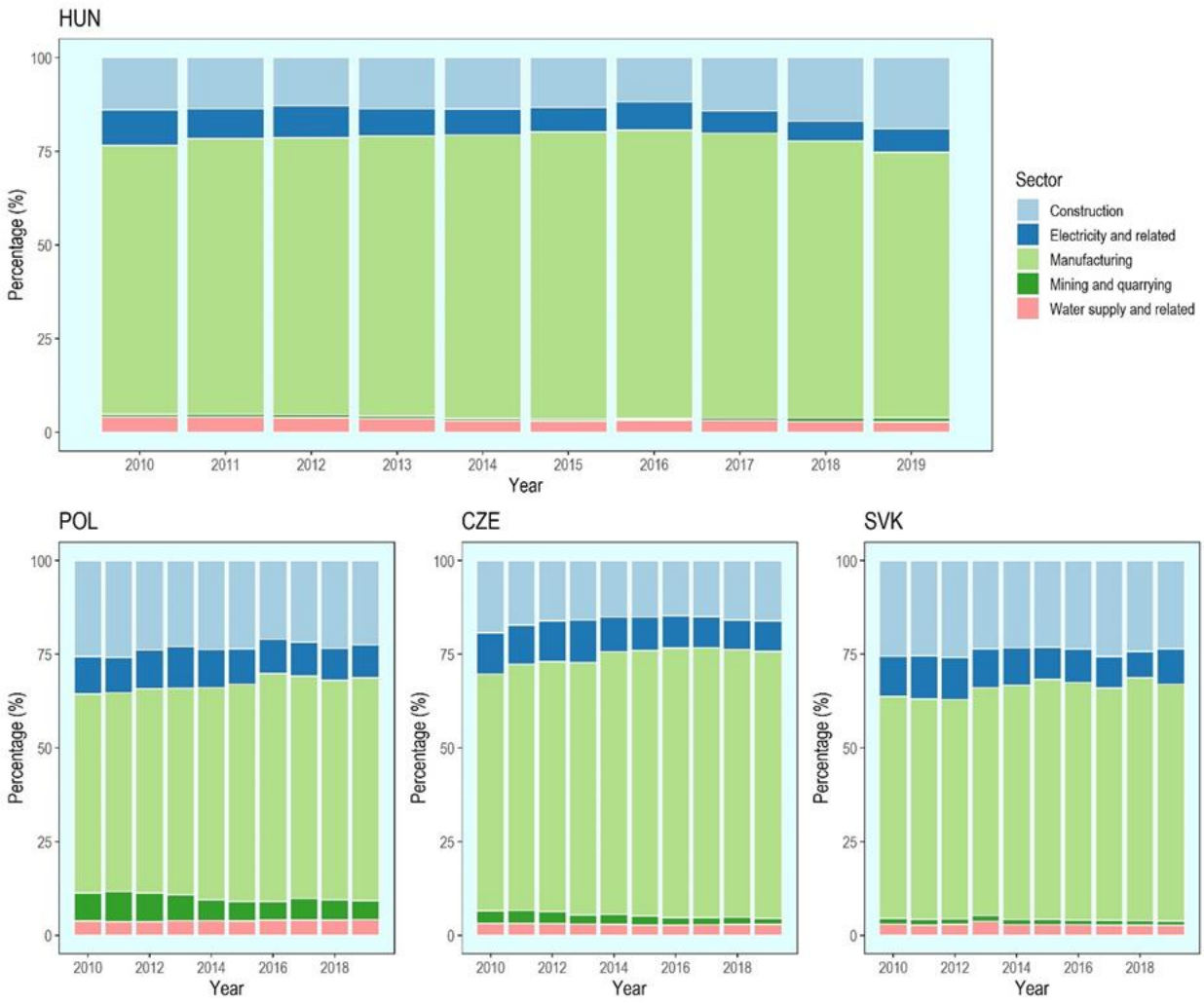
Note: Other services include: Arts, entertainment and recreation, Other service activities, Water and waste management. M&Q refers to Mining and quarrying (0.3%).
Source: Adapted from OECD (2020[31]).

Annex Figure 2.A.4. Services, Gross Value Added, Visegrad 4 (2010-2019)



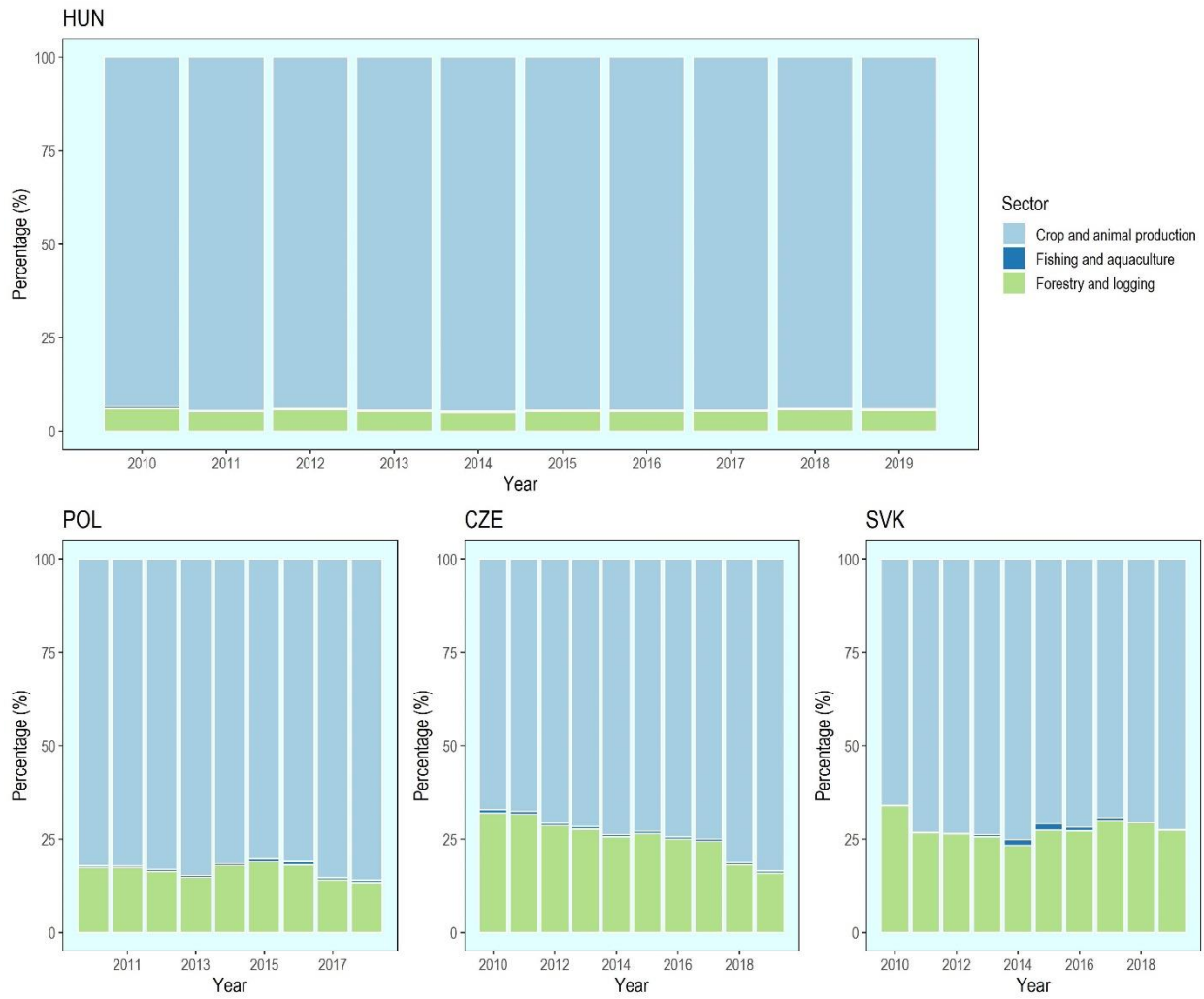
Note: Some of the International Standard Industrial Classification of All Economic Activities (ISIC) rev4 categories were grouped for easier visualization. Food service and recreation refers to ISIC Rev.4 categories "Accommodation and food service activities" and "Arts, entertainment and recreation". Other ISIC Rev.4 categories include "Other service activities", "Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use" and "Activities of extraterritorial organizations and bodies". CZE refers to the Czech Republic, HUN refers to Hungary, POL refers to Poland, SVK refers to the Slovak Republic.
Source: Adapted from OECD (2020[31]).

Annex Figure 2.A.5. Industry, Gross Value Added, Visegrad 4 (2010-2019)



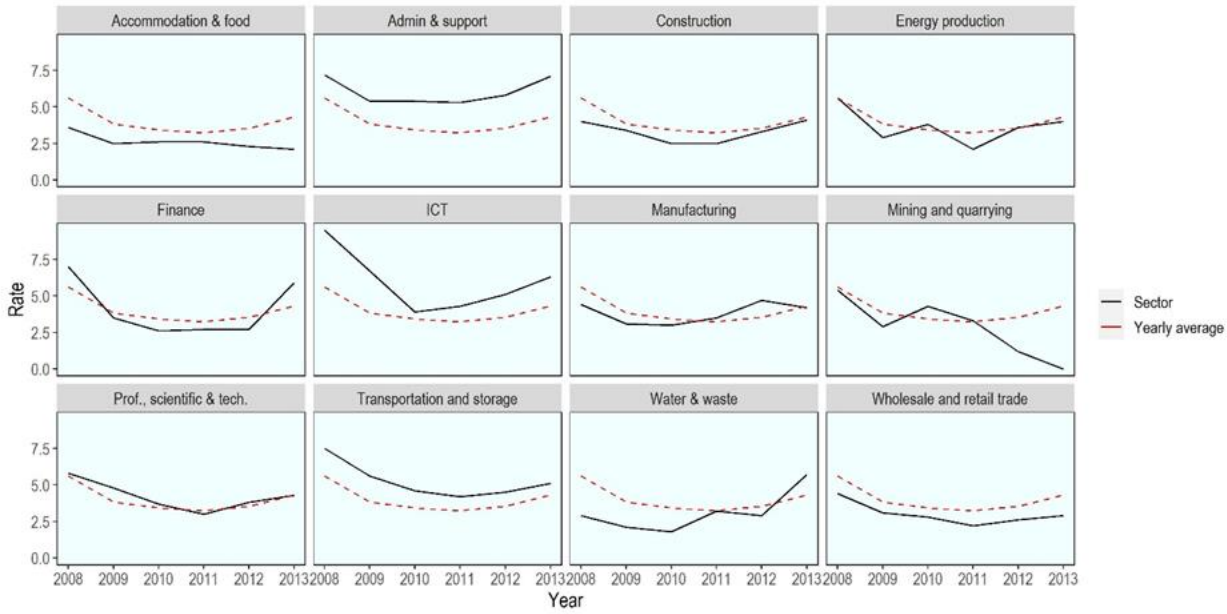
Note: CZE refers to the Czech Republic, HUN refers to Hungary, POL refers to Poland, SVK refers to the Slovak Republic.
Source: OECD (2020[31]).

Annex Figure 2.A.6. Agriculture, Gross Value Added, Visegrad 4 (2010-2019)



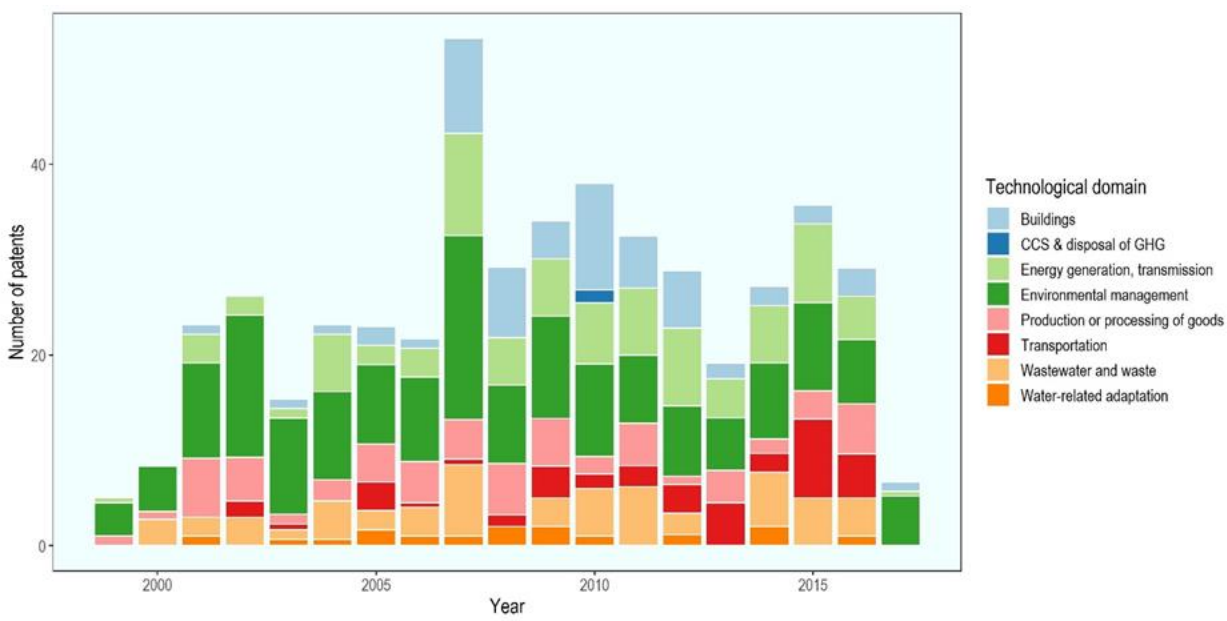
Note: "Crop and animal production" refers to ISIC Rev.4 category "Crop and animal production, hunting and related service activities". CZE refers to the Czech Republic, HUN refers to Hungary, POL refers to Poland, SVK refers to the Slovak Republic.
Source: OECD (2020[31]).

Annex Figure 2.A.7. High-growth enterprises



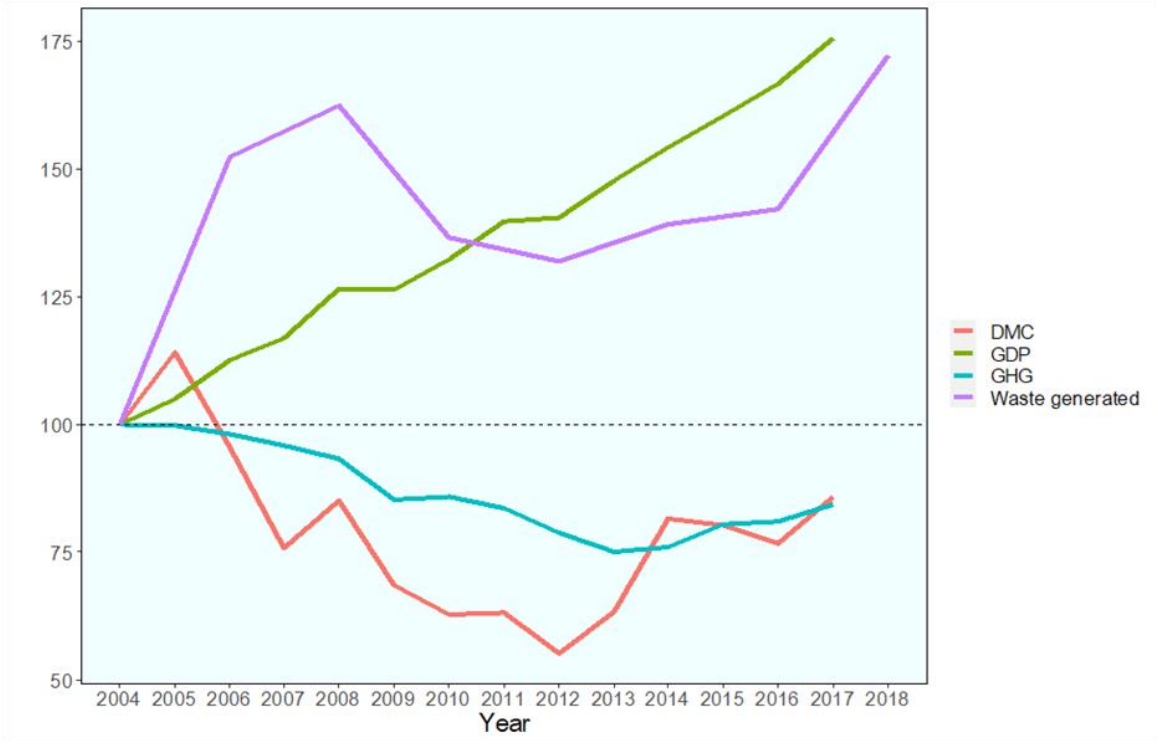
Note: The rate of high-growth enterprises (20% or higher growth based on employment) shows number of high-growth enterprises as a percentage of the population of active enterprises with at least 10 employees. "Yearly average" refers to the average rate of high-growth enterprises across all sectors.
Source: OECD (2021[56]).

Annex Figure 2.A.8. Patents related to environmental technologies



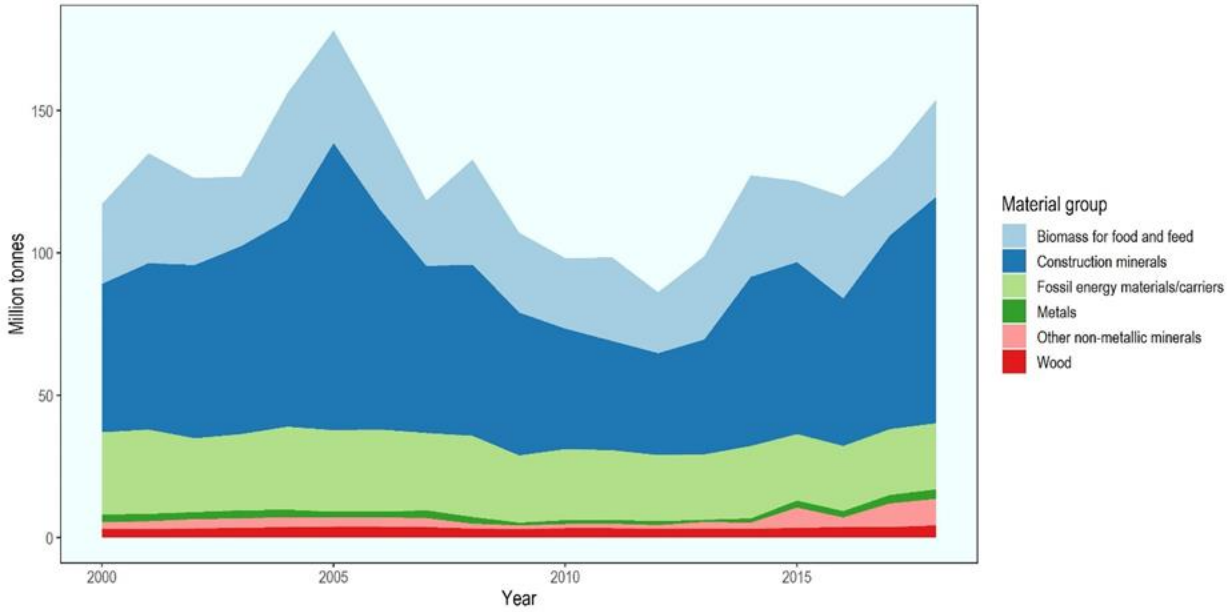
Note: Values refer to data from 1999 to 2017. Data from 2014 and onwards may be incomplete given the time lag between applications of patents submitted and accepted.
Source: OECD (2021[40]).

Annex Figure 2.A.9. Decoupling of material uses, energy uses and waste generation from economic growth



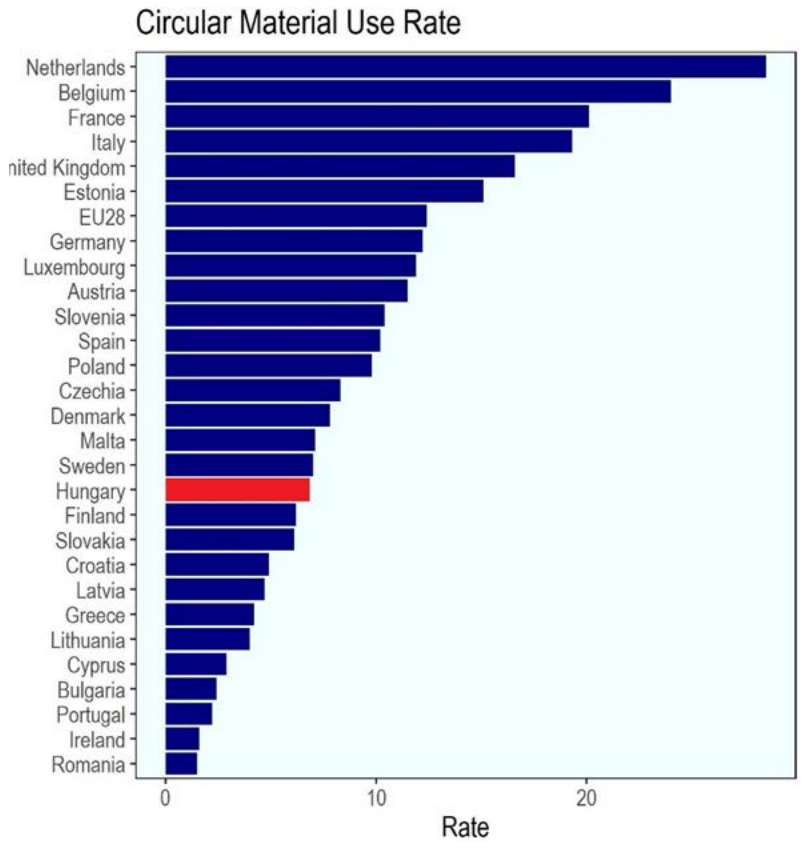
Note: Values for 2004 = 100.
Source: OECD (2020[46]; 2022[57]; 2020[58]) and Eurostat (2021[59]).

Annex Figure 2.A.10. Domestic material consumption



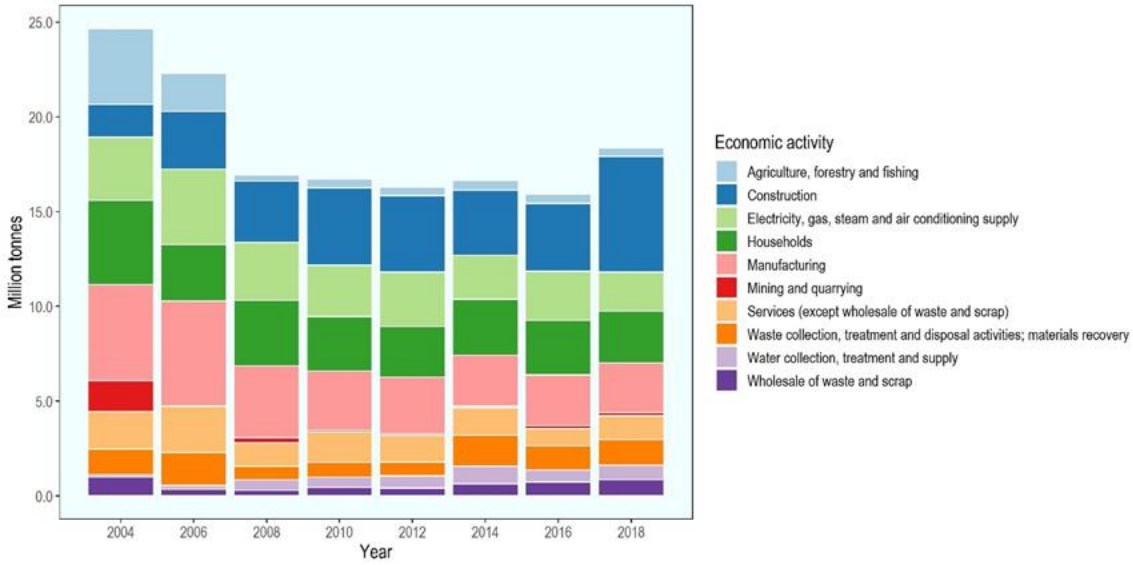
Note: Domestic material consumption (DMC) refers to the amount of materials directly used in an economy, reflecting the apparent consumption of materials.
Source: OECD (2020[46]).

Annex Figure 2.A.11. Circular material use rate



Note: Circular material use (CMU) rate is an indicator of the share of material resources used from recycled and recovered products.
Source: OECD (2020[46]).

Annex Figure 2.A.12. Waste generation by sector

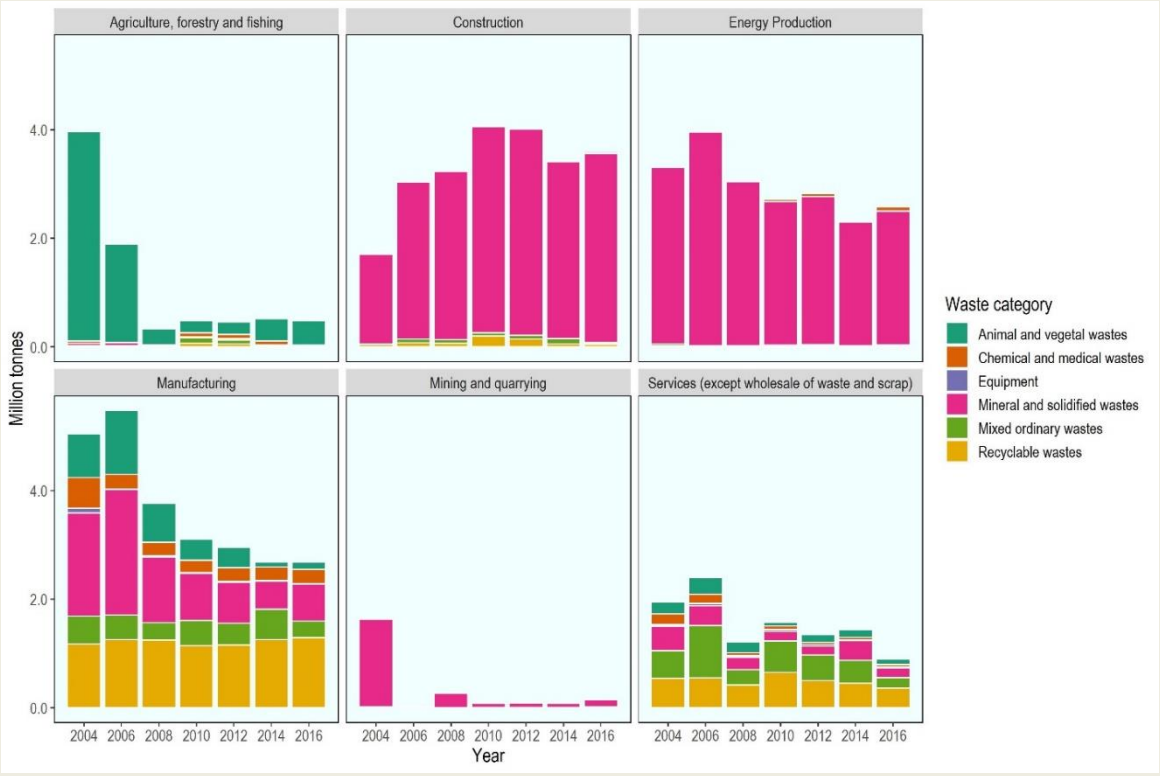


Note: Includes both hazardous and non-hazardous waste. "Water collection, treatment and supply" refers to "Water collection, treatment and supply, sewerage", and "Remediation activities and other waste management services" in the NACE Rev. 2. classification of economic activities.
Source: Eurostat (2020[60]).

Annex Box 2.A.5. Waste generation by sector and by waste category

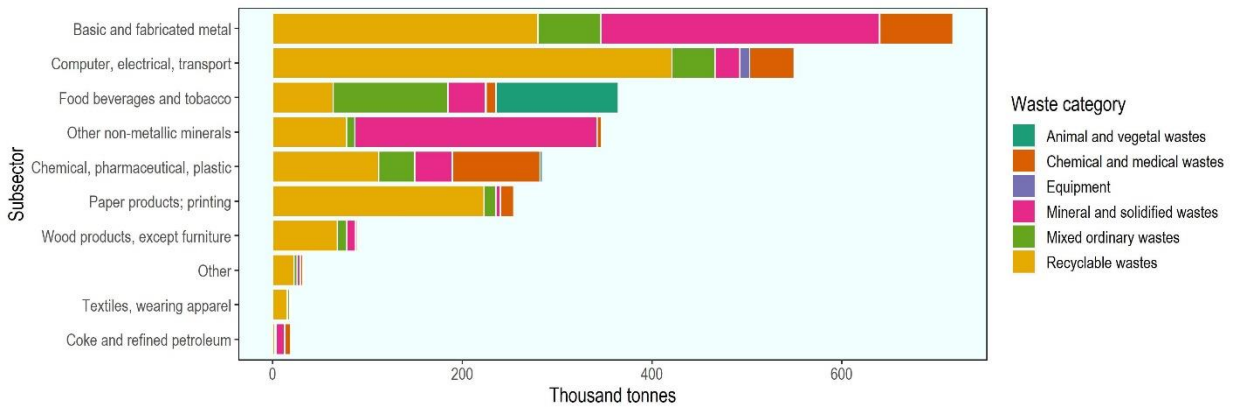
The nature of waste matters. Mineral and solidified wastes dominate the construction, energy and mining sectors. Recyclable wastes, as well as mixed ordinary wastes, are the most important waste categories in “Services”. They represent around 25-40% of Services-related waste. Within “Agriculture”, animal and vegetal wastes are the most significant waste category (as indicated in Annex Figure 2.A.13). Within "Manufacturing”, the composition of waste categories has been changing due to structural changes of the economy. The share of recyclable wastes has doubled, while mineral and solidified waste, as well as animal and vegetal wastes, have decreased in the span of ten years. The manufacturing of basic and fabricated metals, the manufacturing of computer and electrical equipment, and the manufacturing of food and beverages generate above average quantities of waste. Recyclable ferrous metal wastes dominate from the manufacture of transportation vehicles and electric equipment, and the manufacture of basic and fabricated metals (as indicated in Annex Figure 2.A.14).

Annex Figure 2.A.13. Waste generation by sector and by waste category



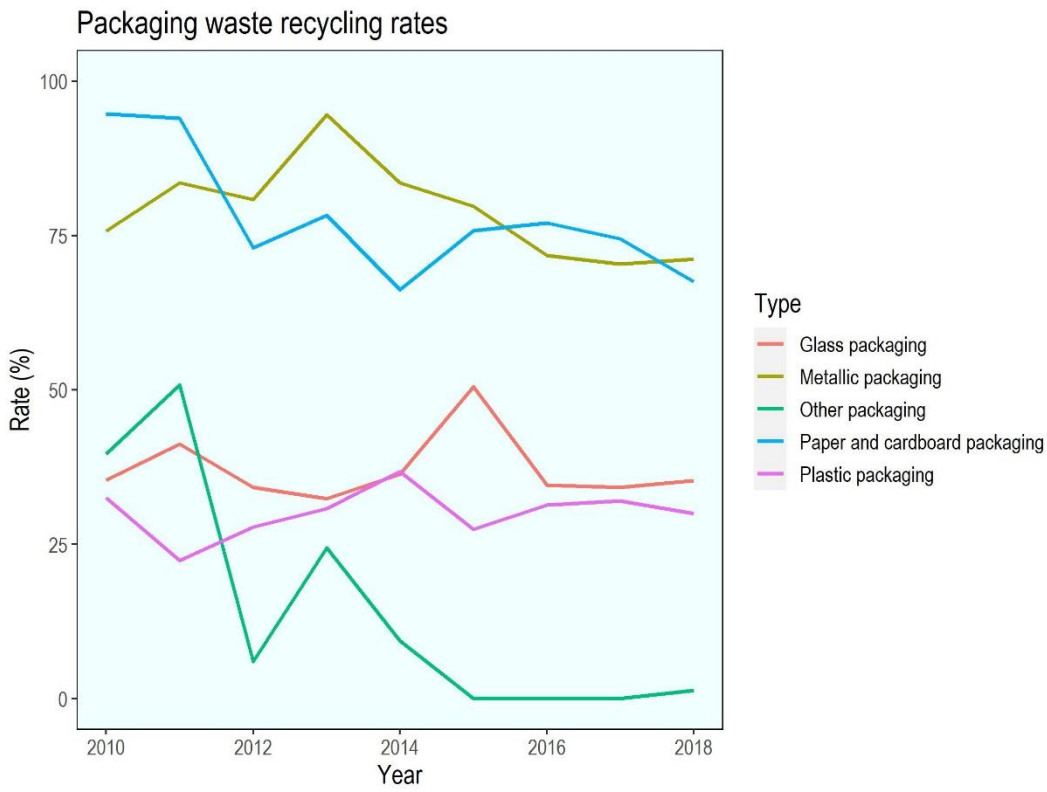
Note: Includes both hazardous and non-hazardous waste. “Water collection, treatment and supply” refers to “Water collection, treatment and supply, sewerage” and “Remediation activities and other waste management services” in the NACE Rev. 2. classification of economic activities.
Source: Eurostat (2020[60]).

Annex Figure 2.A.14. Waste generation by waste category and manufacturing subsectors



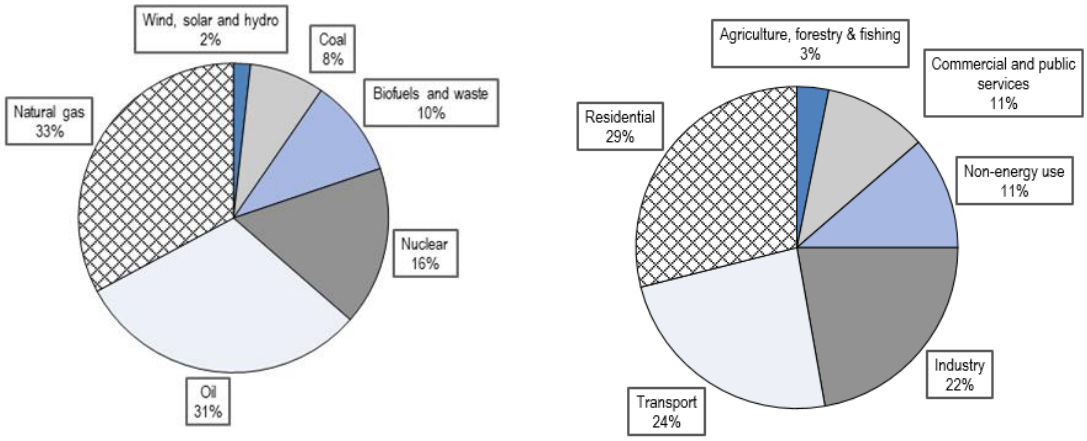
Note: Includes both hazardous and non-hazardous waste. Values refer to 2016 data.
Source: Eurostat (2020[60]).

Annex Figure 2.A.15. Recycling rates of packaging waste



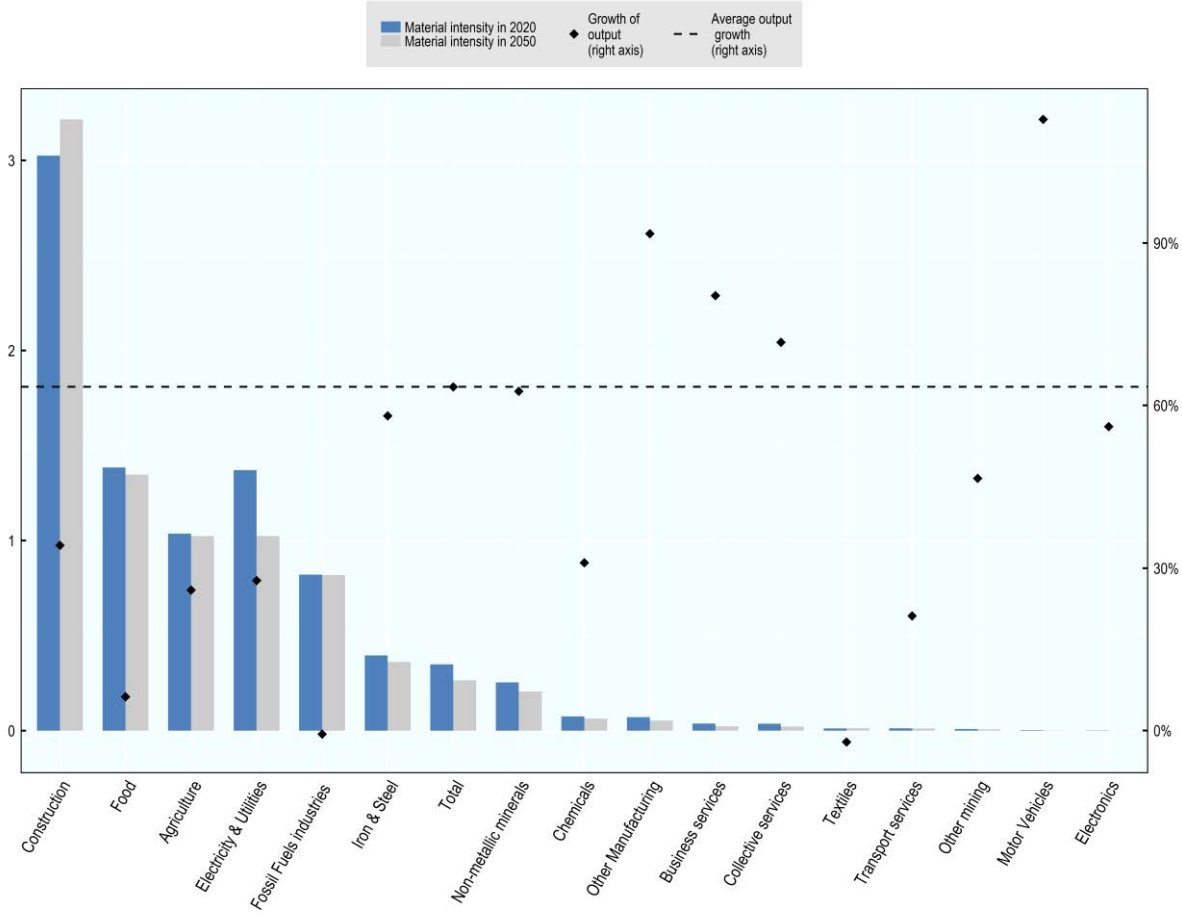
Note: Aluminium packaging and steel packaging rates are omitted due to missing data.
Source: Eurostat (2021[59]).

Annex Figure 2.A.16. Total energy supply by source and total final consumption by sector



Note: Values refer to 2019 data for total energy supply and 2018 data for total final consumption.
Source: IEA (2021[61]).

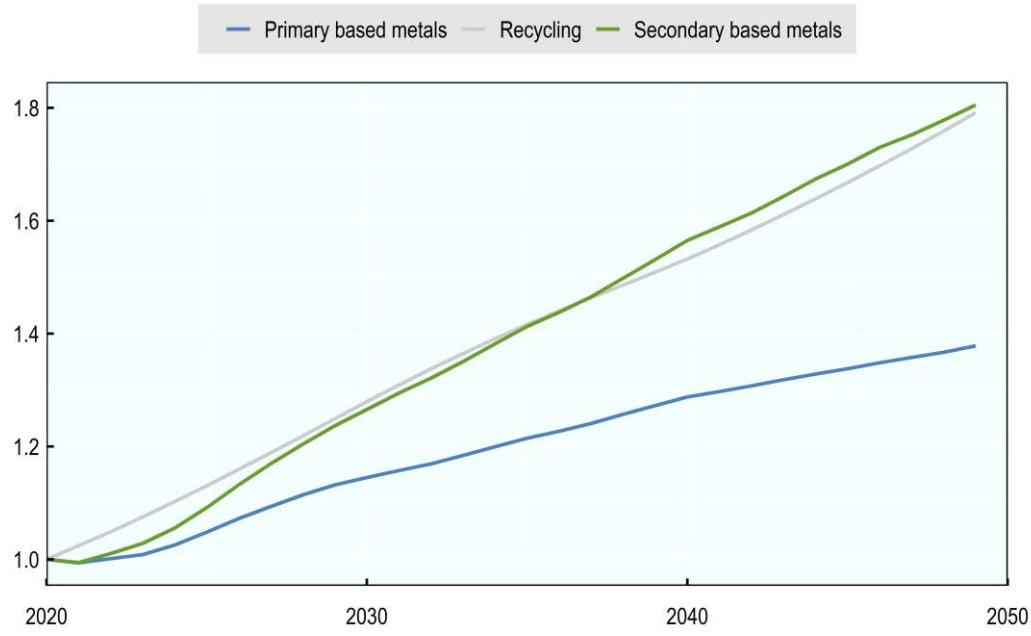
Annex Figure 2.A.17. Materials intensity and output per sector in Hungary



Note: Left axis: Materials intensity (tonnes/USD); Right axis: Gross output growth 2020-2050.
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/g2suz8

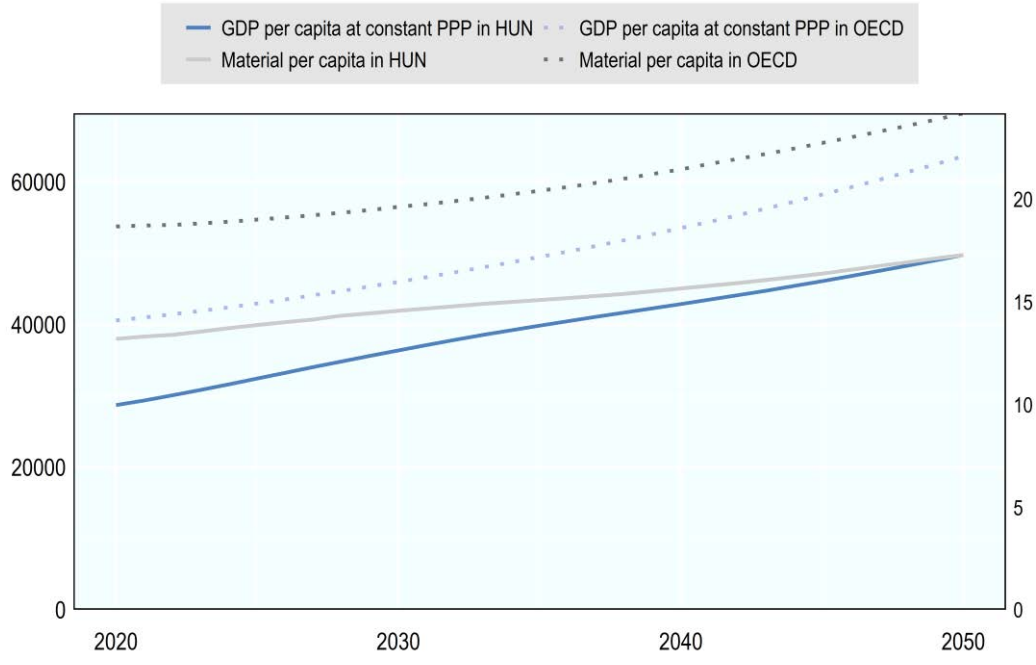
Annex Figure 2.A.18. Evolution of selected materials sectors in Hungary



Note: Index (1=2020).
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/q876bc

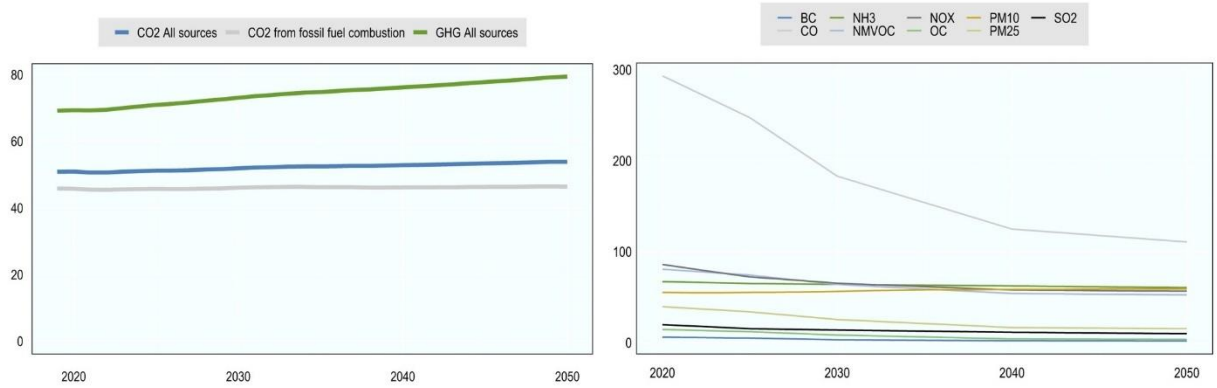
Annex Figure 2.A.19. Decoupling trends: Evolution of materials use and output per capita



Note: Left axis: GDP per capita at constant PPP (USD); Right axis: Materials use per capita (tonne/USD).
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

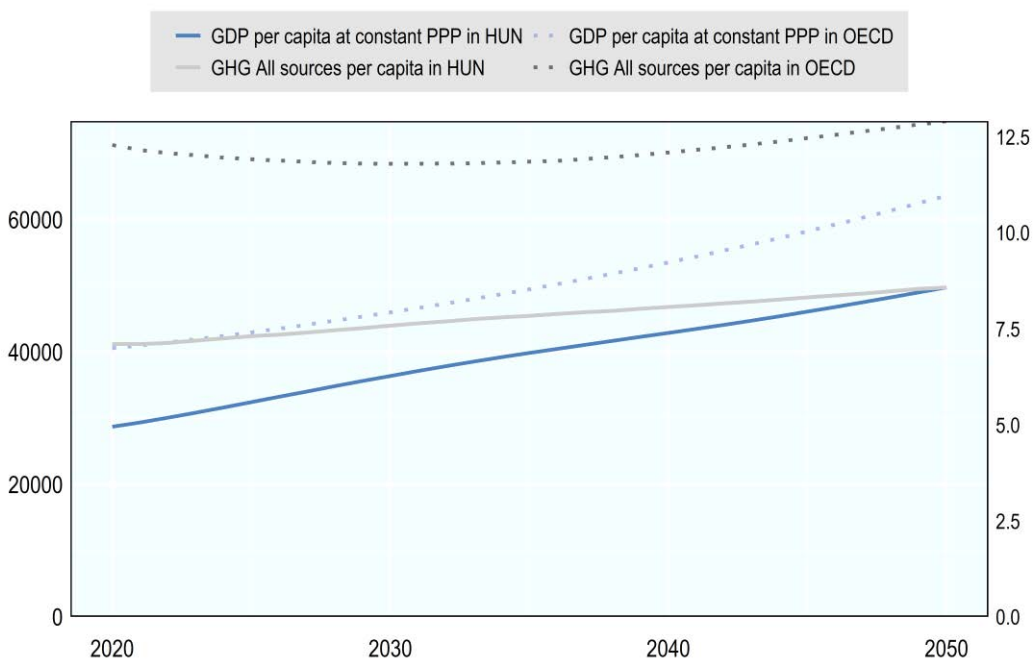
StatLink https://stat.link/dn7kty

Annex Figure 2.A.20. Total GHG emissions and air pollutants per category in Hungary



Note: GHG emissions in million tonnes, and emissions of substances to air in 1 000 tonnes. The categories "CO_2 All sources" and "GHG All sources" do not include CO_2 emissions from "Land Use and Land use Change and Forestry". BC = Black carbon, NH_3 = Ammonia, CO = Carbon monoxide, NMVOC = Non-methane volatile organic compound, OC = Oleoresin capsicum, $PM_{2.5}$ =atmospheric particulate matter (PM) that have a diameter of less than 2.5 micrometres, PM_{10}= atmospheric particulate matter (PM) that have a diameter of less than 10 micrometres, SO_2= Sulphur dioxide, NO_X = Nitrogen oxides.
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

Annex Figure 2.A.21. Decoupling trends: Evolution of GHG emissions and output per capita



Note: Left axis: GDP per capita at constant PPP (USD); Right axis: GHG emissions per capita (Gt).
Source: OECD ENV-Linkages (Chateau, Dellink and Lanzi, 2014[51]).

StatLink https://stat.link/yrowsm

Notes

[1] Relative decoupling takes place when the value of economic output and the amount of materials are both rising, but with economic output rising faster than materials use. In contrast, with absolute decoupling the value of economic output is growing while the amount of resource inputs used is shrinking.

[2] The dominant sub-sectors include: “Wholesale and retail trade, repair of motor vehicles”, “Transportation and storage”, “Professional, technical and scientific activities” and “Administrative and support service activities” (refer to Annex Figure 2.A.3 and Annex Figure 2.A.4).

[3] The most sizeable sub-sectors include “Manufacturing of transport equipment”, “Computers, electric and electronic products”, “Manufacturing of rubber and plastics”, and “Basic metals” (refer to Annex Figure 2.A.3 and Annex Figure 2.A.5).

[4] Agriculture is dominated by crop and animal husbandry (refer to Annex Figure 2.A.3 and Annex Figure 2.A.6).

[5] Defined as the amount of economic value generated per unit of materials used, or gross domestic product per unit of domestic materials consumption (DMC).

[6] The DMC refers to the amount of materials directly used in an economy, reflecting the apparent consumption of materials.

[7] The CMU rate is an indicator of the share of material resources used from recycled and recovered products.

[8] The efforts required by Hungary to meet post-2020 municipal waste recycling targets are considered even greater (European Commission, 2019[44]).

[9] Hungary failed to meet the overall recycling objective for packaging waste during 2012-2014. This was mainly due to the low recycling rate for glass (OECD, 2018[32]).

[10] This projection does not take into account the economic impacts of the COVID-19 crisis. For a discussion on the implications of the COVID-19 pandemic and recovery measures on environmental pressure refer to Annex Box 2.A.4.

[11] However, policy action for construction materials requires a perspective beyond production, as growth in this sector coincides with advances in economic activity and is driven mainly by housing investments and public infrastructure.

[12] However, owing to global value chains, decisions taken in Hungary may be limited to production issues, while decisions on design and use of materials may be taken elsewhere, and independently of the policy context in Hungary.

3 The circular economy policy landscape in Hungary

To fully realise the circular potential of the economy, Hungary will need to adopt a comprehensive circular economy policy framework. This chapter reviews the existing circular economy-related policy landscape in Hungary and highlights policy gaps across six policy fields.

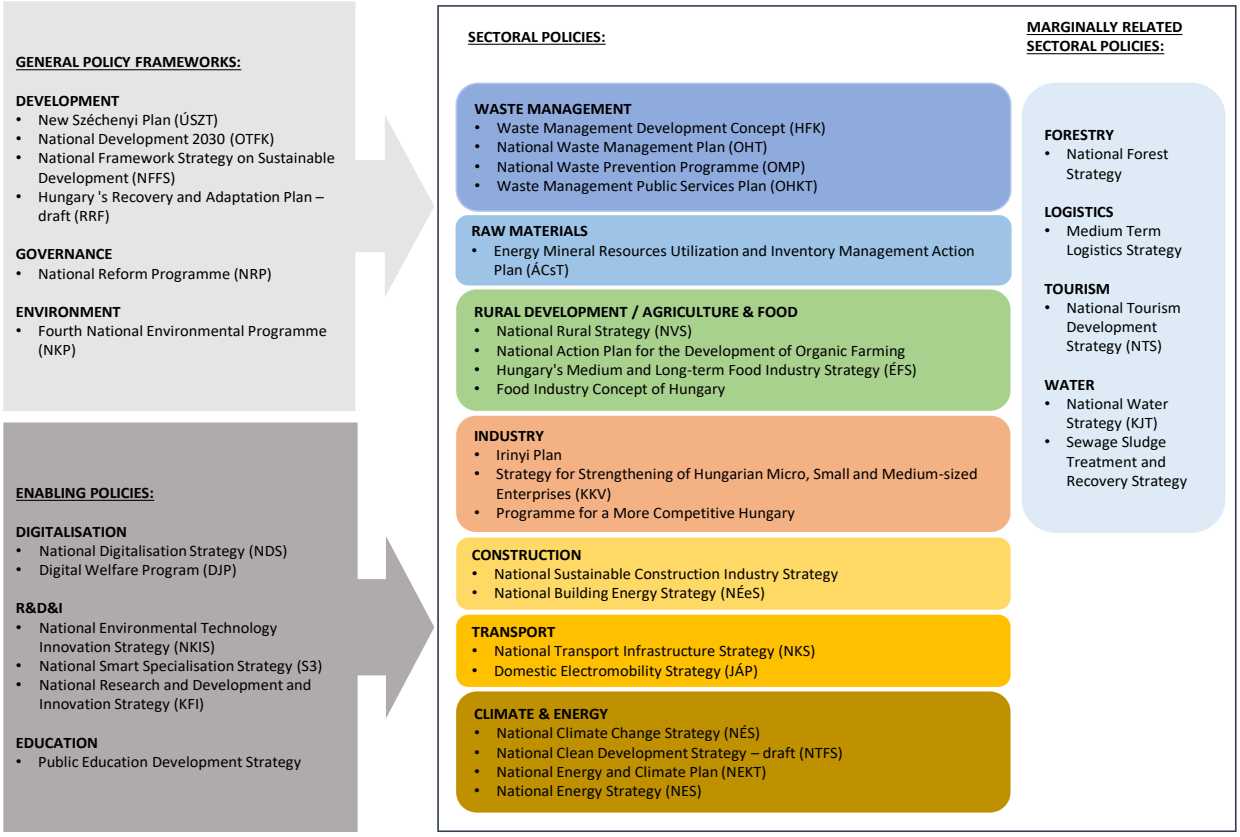
3.1. Many of the principles of the circular economy are anchored in Hungary's policy landscape

Hungary has long-established policies for waste management and has taken into account recommendations from the European Commission (EC) and the OECD to further strengthen its legal framework. The EC Environmental Implementation Review 2019 for Hungary (2019[1]), the EC Country Report Hungary 2020 (2020[2]) and the OECD Environmental Performance Review 2018 for Hungary (2018[3]) identified some progress made in the country's materials and waste management owing, in particular, to the major reforms in the waste sector (the outcomes of which are yet to be examined). At the same time, inefficiencies in the financing of the country's municipal waste management,[1] the recent recentralisation of waste-related governance and the lack of collaborative mechanisms between relevant ministries to steer the transition towards a circular economy are seen as potentially undermining future progress. The EC and the OECD therefore recommend that Hungary strengthens its policy framework to speed up the uptake of circular economy practices, incentivise resource efficiency measures, and introduce new business models (European Commission, 2019[1]; European Commission, 2020[2]; OECD, 2018[3]).

Several recent national policies have considered these recommendations when determining their strategic objectives. While many of the policy documents do not explicitly use the term "circular economy", seven "core" policies explicitly address the circular economy and at least one of its core principles.[2] The documents do so at different levels of specificity. For instance, while the National Development Plan 2030 (Government of Hungary, 2014[4]) and the National Framework Strategy on Sustainable Development 2012-2024 (Nemzeti Fenntartható Fejlődési Tanács, 2013[5]) are broad in scope (calling for the sustainable use of natural resources, the preservation of values and the protection of environment), sectoral policies, such as the National Waste Management Plan 2014-2020 (Government of Hungary, 2013[6]) and the National Environmental Technology Innovation Strategy 2011-2020 (Ministry of Rural Development, 2011[7]), are more specific (aimed at advancing the development of waste management, reducing materials use and waste generation, and furthering environmental technology innovation, respectively).

The Hungarian government and its administrative bodies have also worked on other policies relevant to circular economy processes and concepts. They include "directly related" policies (focusing on one of the circular economy sectors or principles, but applying them to a wider range of areas besides circular economy) and "complementary" policies (having less direct links to the circular economy, acting more as enabling factors). Directly related policies are clustered around raw materials, industry, agriculture and food, energy and climate, transport, construction, R&D&I, and digitalisation. They target resource efficient production and the development of environmental and waste industries, address import dependence on energy minerals, advance new business models by SMEs, promote the sustainable use of natural resources, and focus decarbonisation through circular economy measures in waste management. Complementary policies constitute an enabling framework for the circular economy transition, such as education, or a marginally related sectoral strategy, such as forestry, water and tourism. An overview of the circular economy policy landscape is provided in Figure 3.1.

Figure 3.1. Hungarian policy landscape relevant to the circular economy



3.2. Hungary needs to address the prevailing policy gaps to succeed in fully exploiting the circular potential of its economy

Currently, the levers to realise the transition to a circular economy are dispersed across a wide range of policy fields and documents. Moreover, many aspirations remain conceptual ideas and lack implementation on the ground. The following paragraphs elaborate on the policy gaps vis-à-vis the circular economy[3] across six policy fields.

First, the **industrial policy** landscape in Hungary addresses some aspects of the circular economy transition. While policies for energy, minerals and agricultural raw materials are well established, at present, they only consider recycling and the use of secondary raw materials in an abstract way without setting out concrete actions or targets. Several policies tackle sustainable product design, process innovation, smart production, and the product use and end-of-life strategies, but many of these policies are either outdated or have not been implemented. On a more general level, links between the circular economy and the competitiveness of key industrial segments are weak, and measures related to SMEs are insufficient as they do not leverage their circular economy potential. Additionally, Hungary does not have a comprehensive strategy for the construction sector. To remediate these policy gaps, policies should focus on the creation and promotion of secondary raw materials markets, on developing measures to leverage the circular economy potential across key industrial segments, on incentivising the circular transformation of SMEs and start-ups, and on promoting a circular value chain approach within the built environment.

Second, **agriculture and food** frameworks in Hungary connect well with the circular economy on a conceptual level, including in the sustainable use of natural resources, innovative technologies, viable

agricultural, food and energy production, and the development of local food chains. However, these concepts lack integration and implementation in practice. Most notably, the biological treatment of agricultural by-products and food waste, and their use as compost or feedstock for energy, are the focus of several policies. However, the policies fail to spell out specific measures or have quantitative targets. Moreover, Hungary does not yet have a dedicated bioeconomy policy framework in place.[4] Hungary should therefore consider strengthening current policies at the nexus of food waste reduction, food waste and biomass use for composting or energy valorisation, and the development of the bioeconomy.

Third, as opposed to industry and agriculture, the focus on the **services and commercial sectors** is more scattered across policy domains. Although several high-level development and sectoral policy documents address the concepts of resource efficiency and eco-innovation of the service sector, more work is needed to explore its full circular economy potential. In particular, policies should focus on the promotion of innovative circular (digital) business models related to services.

Fourth, to promote **supply chain management** practices that reduce the ecological and energy footprints of goods, Hungarian policies could focus on creating local value chains (for instance, for biomass and food), incentivising green packaging, and promoting sustainable transport and reverse logistics.

Fifth, Hungary has a long-established policy and legal framework for **waste management**, supported with quantitative targets and economic instruments, which is well aligned with EU legislation and relevant OECD Council decisions. Nevertheless, significant challenges remain in this area, particularly with regard to diverting waste from landfills towards recycling. This is especially true for municipal waste management, including biodegradable and packaging waste. To incentivise waste management practices, in line with the waste hierarchy, and to fulfil EU waste obligations, Hungary would benefit from strengthening existing obligations and introducing new regulatory measures and economic instruments. This applies both for waste streams already targeted by the National Waste Management Plan and its Waste Prevention Programme as well as for those not yet covered by these instruments (such as textiles and plastics).

Lastly, the **R&D&I** framework stresses the importance of environmental technological innovations for more efficient resource and waste management, and has specific area-based smart specialisation strategies, one of which focuses on the circular economy. Nonetheless, challenges remain in the practical application of these objectives. Although public support for research and innovation is considerable, the shortage of highly skilled labour stands in the way of a faster uptake of innovative activities. In addition, Hungary has a strong dependence on European and international funds to support its projects and programmes. Hungary's policies should therefore aim to: i) strengthen talent and skills related to engineering and science; ii) implement a number of support measures related to increased participation in the use of EU funds; iii) diversify the funding of collaborative research and knowledge exchange; and iv) make the innovation, digitalisation and circular economy policy agendas more coherent.

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Ministry of Rural Development (2011), *National Environmental Technology Innovation Strategy 2011–2020*, https://kornyezettechnologia.kormany.hu/admin/download/b/4f/50000/NETIS_English.pdf (accessed on 14 April 2021). [7]

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Annex 3.A. Supplementary information

Annex Box 3.A.1. "Core" circular economy related policy documents in Hungary

The core policy documents were identified as those that focus largely on circular economy-related thematic areas or on at least one of its core principles. They include the following:

Economic development frameworks

- The National Development 2030 – National Development and Territorial Development Concept defines a long-term vision with goals and principles based on the country's social, economic, sectoral and territorial development needs. The concept goes beyond the circular economy, but its cross-cutting nature and strategic importance places it in the "core" category of policy documents (Government of Hungary, 2014[4]).
- The National Framework Strategy on Sustainable Development of Hungary promotes a common national understanding of sustainability. The strategy integrates some of the key circular economy principles into its core goals, including issues of resource use, production technology and consumption patterns, highlighting the interconnectedness with certain strategic considerations, such as food, energy, and environmental security (Nemzeti Fenntartható Fejlődési Tanács, 2013[5]).

Overarching environment policy framework

- The Fourth National Environmental Programme (4NEP) represents a comprehensive framework comprising all the environmental strategies, programmes and plans in Hungary. Developed for the previous period (2015-2020), it covers specific aspects related to the circular economy, such as materials production and uses, waste management, as well as industry, agriculture and forestry, transport and logistics, and environmental industry and infrastructure (Government of Hungary, 2015[8]).

Waste management related policies

- The Waste Management Development Concept is the highest level policy for the development of waste management in Hungary in the long term (for the period 2014-2027). The main directions identified by the concept are waste prevention, waste collection and transport, materials and energy recovery, as well as improvements in landfilling. Policy objectives related to waste management up to 2020 are detailed in the National Waste Management Plan 2021-2027. The plan represents the legal background of waste management in Hungary, covering all significant waste streams, and providing the background knowledge for efficient waste management, long-term planning goals, and steps to achieve them (Government of Hungary, 2013[6]).
- Part of the plan is also the National Waste Prevention Programme, which sets out the main direction of domestic waste prevention practices. One of its main objectives is the decoupling of materials use and waste generation from economic growth (Government of Hungary, 2013[6]).
- The Waste Management Public Services Plan determines the optimal territorial delimitation for the provision of public services, as well as the minimum waste management tasks to be performed in a given area (Nemzeti Hulladékgazdálkodási Koordináló és Vagyonkezelő, 2020[9]).

Sectoral policy on research, development and innovation

- The National Environmental Technology Innovation Strategy explores the crucial linkages between innovation and green growth by promoting measures related to the development of environmental technology. Developed for the previous period (2011-2020), the strategy focuses on environmental innovations related to resource efficiency and materials and energy management, as well as waste management and sustainable construction. Besides technologies and products, it also puts forward measures for organisational innovation and services (Ministry of Rural Development, 2011[7]).

Note: Policy documents under preparation but not formally adopted by the Hungarian government at the time of the analysis and were therefore excluded from the scope (including the new National Environmental Programme [5NEP], the new National Waste Management Plan 2021-2027 and its Waste Prevention Programme [NWMP]).

Notes

[1] The Hungarian waste management system is currently being reformed into a new concessionary system, which is an opportunity to optimise and rationalise its financing and operation. This will also need to be accompanied by adjustments in legislation and existing economic instruments.

[2] At the time of analysis, the "core" policy documents include: two economic development frameworks (the National Development 2030 and the National Framework Strategy on Sustainable Development of Hungary), one overarching environmental policy framework (Fourth National Environmental Programme), three policies related to waste management (Waste Management Development Concept, National Waste Management Plan along with the National Waste Prevention Programme, and Waste Management Public Services Plan), and one sectoral policy on R&D&I (National Environmental Technology Innovation Strategy). See Annex Box 3.A.1 for details.

[3] What constitutes a policy gap is loosely defined either as an area that has not yet been covered at all, or has been covered only partly within the existing policies, or where achieving targets might become challenging. In the latter two cases, a policy framework exists but only partially addresses the needed measures required for transitioning to a circular economy.

[4] Hungary has recently founded the Hungarian Bioeconomy Cluster. It is a member of the Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy (BIOEAST) (BIOEAST, 2021[10]).

4 A circular economy in Hungary by 2040

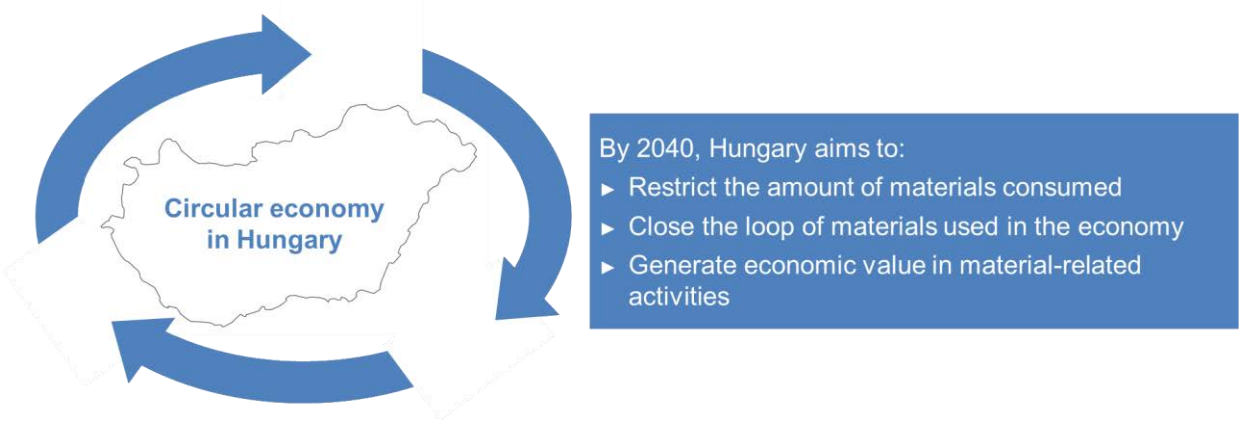
An integrated vision, supported by clear goals, quantified targets and concrete actions is required to guide the circular economy transition at the national level. This chapter puts forward the high-level vision and strategic goals required to transition to a circular economy in Hungary by 2040. In addition, it identifies and elaborates on three priority areas where actions are needed to achieve these goals.

4.1. A vision with clear goals steers the circular economy transition

The strategic vision and goals of the National Circular Economy Strategy (NCES) (as outlined in Figure 4.1) were developed by the OECD in consultation with the project steering committee and the stakeholder working group, and validated by the Prime Minister's Office and the Ministry of Energy. All the stakeholders will collaborate to reach the following targets by 2040 (compared to 2019 levels):

- To restrict the amount of materials consumed, the government will invest in research and implement incentives to encourage resource efficiency through innovation, eco-design, product sharing and reuse. Hungary aims to double its resource productivity (GDP/DMC).
- To close the loop of materials use and to use materials more sustainably, measures will be taken to double the Hungarian circular materials use rate to 15%.
- To capture a broader array of benefits related to the transition to a circular economy, the government will implement support mechanisms for innovation and new business models. Hungary aims to increase the number of circular jobs by 30% across industry, agriculture and service sectors, to achieve 2.5% of total national employment.

Figure 4.1. Strategic goals for the circular economy transition in Hungary by 2040



By 2040, Hungary will become a more competitive and sustainable economy. It will have adopted a holistic approach to the circular economy transition, focusing on industrial, agricultural and service sectors, as well as waste management. As a small open economy with few domestic material sources available, Hungary can secure and improve its competitiveness by encouraging circularity throughout its production and consumption processes. Education and digital technologies will be critical to create green jobs and resource-efficient value chains.

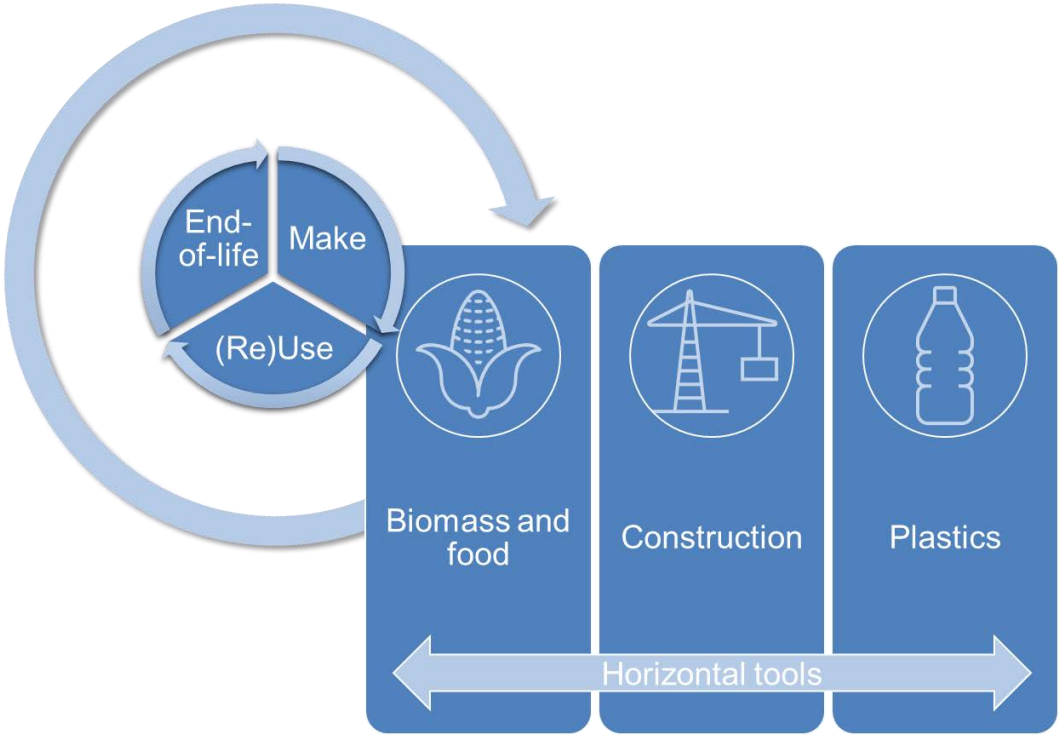
Realising this vision requires the support from all levels of government in order to facilitate the adoption of circular business models by the private sector and incentivise citizens to take ownership of the transition through a shift in behaviour.

4.2. Concrete action in priority areas drives economy-wide circular transition

By combining the insights of chapters 2 and 3 with the outcomes of the stakeholder dialogue and a multi-criteria assessment, the OECD has identified a set of priority areas and high-impact actions that are crucial for the circular economy transition in Hungary (see Figure 4.2).[1] The selected areas include **biomass and food**, **construction,** and **plastics**. The in-depth analysis of these areas advocates a life cycle approach with a focus on **design, production**, **(re)use** and **end-of-life** stages. This approach identifies the circular

potential and policy recommendations for all stages of the value chain, including but not limited to waste management. The analysis also addresses key horizontal tools and topics that cut across product and materials life cycles. This horizontal perspective is integrated within the three vertical priority areas, and concerns a high-level view on the needs for **education**, **research and development** and **circular business models** (with a focus on SMEs and digitalisation) related to the circular economy transition. These horizontal tools go beyond the individual sectors and can contribute to the economy-wide transition.

Figure 4.2. Priority areas covered by the NCES



4.2.1. Circular economy potential of biomass and food

Biomass and food are key to the circular economy transition due to their high potential to contribute to climate change mitigation, socio-economic development and environmental protection. The economic relevance of biomass and food in Hungary is substantial, with the country's value added in the agricultural sector outperforming other countries in the EU. Moreover, industrial processing and the distribution of food products, beverages and tobacco represents the third largest sector of Hungary's economy. The rising potential of circularity in biomass and food is underlined by Hungary's increasing rates of materials recovery, which are critical for achieving the EU municipal waste targets and obligations. The strategic and public importance of biomass and food are evident from the multitude of strategies, concepts and plans introduced in Hungary, which target various parts of the value chain. Increasing circularity in biomass and food also appear to be the top priority area for the consulted stakeholders of the circular economy.

4.2.2. Importance of construction for circular economy transition

Construction is another priority for the circular economy transition in Hungary due to its high relevance to the country's economy and its important circularity and strategic considerations. The value added and employment in the industry have grown over the past years. At the same time, the construction industry plays an important role in both materials consumption and waste generation in the country. Reducing

primary raw materials use along the construction life cycle, and minimising construction and demolition waste (CDW) have become two of the key priorities of Hungary's National Waste Management Plan 2021-2027 and its Waste Prevention Programme. Moreover, construction also has a high decarbonisation potential, with buildings accounting for about one-fifth of global GHG emissions. The dialogue with stakeholders confirmed the importance of targeting construction in general and buildings in particular for a circular economy transition in Hungary.

4.2.3. The strategic importance of a more circular life cycle for plastics

Plastics in Hungary are assessed as more strategically important than construction with a similar circularity potential as building materials, albeit their economic relevance is lower. Plastics are a key input to several sectors in Hungary's economy, of which the most important applications are packaging, construction and transportation. Plastic packaging currently makes up one-quarter of total packaging used in Hungary. Although waste generated from plastic packaging has increased at a much faster pace than the EU average, only about one-third of it is currently recycled in Hungary. The recent plastics-specific legislation only has limited policy instruments in place, which might impede Hungary's ambition to meet the relevant EU targets. The circularity potential and strategic importance of plastics, especially plastic packaging, is therefore very high in Hungary. In consultation with the stakeholders, plastics have been determined as an important priority within the NCES.

The following three chapters 5(on biomass and food), 6 (on construction) and 7 on plastics) discuss in detail the respective priority areas, and outline the actions needed for structural change.

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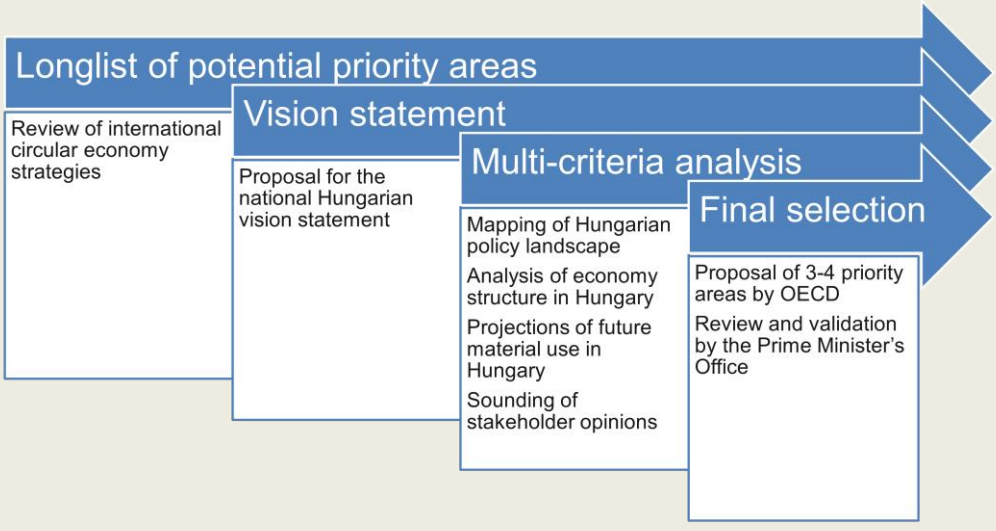
Annex 4.A. Supplementary information

Annex Box 4.A.1.Methodology for the selection of priority areas

As illustrated in Annex Figure 4.A.1, the OECD has carried out the following customised process to develop the proposal for the priority areas:

- A long list of potential priority areas has been identified based on a review of circular economy strategies across selected European countries (OECD, 2021[1]). This long list contains four categories of priority areas: materials, manufacturing sectors, service sectors and horizontal tools.
- A vision statement along with a proposal for quantitative targets for 2040 has been developed and discussed with stakeholders to determine the ambitions and direction to take (OECD, 2021[2]).
- The policy landscape and economy have been analysed in different steps:
  - Hungary's current socio-economic characteristics and performance related to the circular economy have been analysed to provide a snapshot of circularity in the country (OECD, 2021[3]).
  - Trends towards 2050 have been projected, including for economic indicators (such as GDP per capita, value added, trade structure) and for environmental indicators (such as materials use, GHG emissions, air pollutants) (OECD, 2021[4]).
  - The Hungarian policy landscape related to the circular economy has been mapped, and policy areas that need to be strengthened for a circular transition have been identified (OECD, 2021[5]).
  - Stakeholders have been consulted to collect deeper insights on the current status and challenges.
- The elements above have been integrated in a multi-criteria analysis to select the priority areas (OECD, 2021[6]).

Annex Figure 4.A.1. Stepwise process to identify and select the priority areas for the NCES



Note

[1] The methodology for the selection of priority areas is outlined in Annex Box 4.A.1.

5 A circular transition for biomass and food

This chapter develops policy recommendations to support the transition to a circular approach in Hungary's biomass and food priority area, with a specific focus on the bioeconomy. It provides an overview of the current context and policy framework, identifies critical areas for potential improvement, and puts forward a set of concrete policy recommendations. Findings from relevant international good practices guide these recommendations.

5.1. Role of the bioeconomy in the transition to a circular economy

5.1.1. Defining biomass, food, food waste and bio-waste

Biomass, food, food waste and bio-waste are defined in this chapter based on EU legislation.

- **Biomass** is defined as "the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin" (Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources) (European Parliament and the Council, 2018[1]).
- **Food or foodstuff** is defined as the "[...] means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. 'Food' includes drinks, chewing gum and any substance, including water, intentionally incorporated into the food during its manufacture, preparation or treatment". It also includes water for human consumption (EU Regulation on the general principles and requirements of food law, EC/2002/178) (European Parliament and the Council, 2002[2])[1].
- **Food waste** is defined as "any food that has become waste under these conditions: it has entered the food supply chain; it then has been removed or discarded from the food supply chain or at the final consumption stage; it is finally destined to be processed as waste" (revised EU Waste Framework Directive (WFD), EC/2018/851) (European Parliament and the Council, 2018[3]).
- **Bio-waste** is defined as "[…] biodegradable garden and park waste, food and kitchen waste from households, restaurants, wholesale, canteens, caterers and retail premises, and comparable waste from food processing plants" (revised WFD, EC/2018/851) (European Parliament and the Council, 2018[3]).

5.1.2. The circular bioeconomy in the biomass and food priority area

According to the 2018 update of the European Bioeconomy Strategy, the bioeconomy covers all sectors and systems that rely on biological resources: animals, plants, micro-organisms and derived biomass, including organic waste, their functions and principles. The bioeconomy includes and interlinks land and marine ecosystems and the services they provide, all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture), and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services (European Commission, 2018[4]).

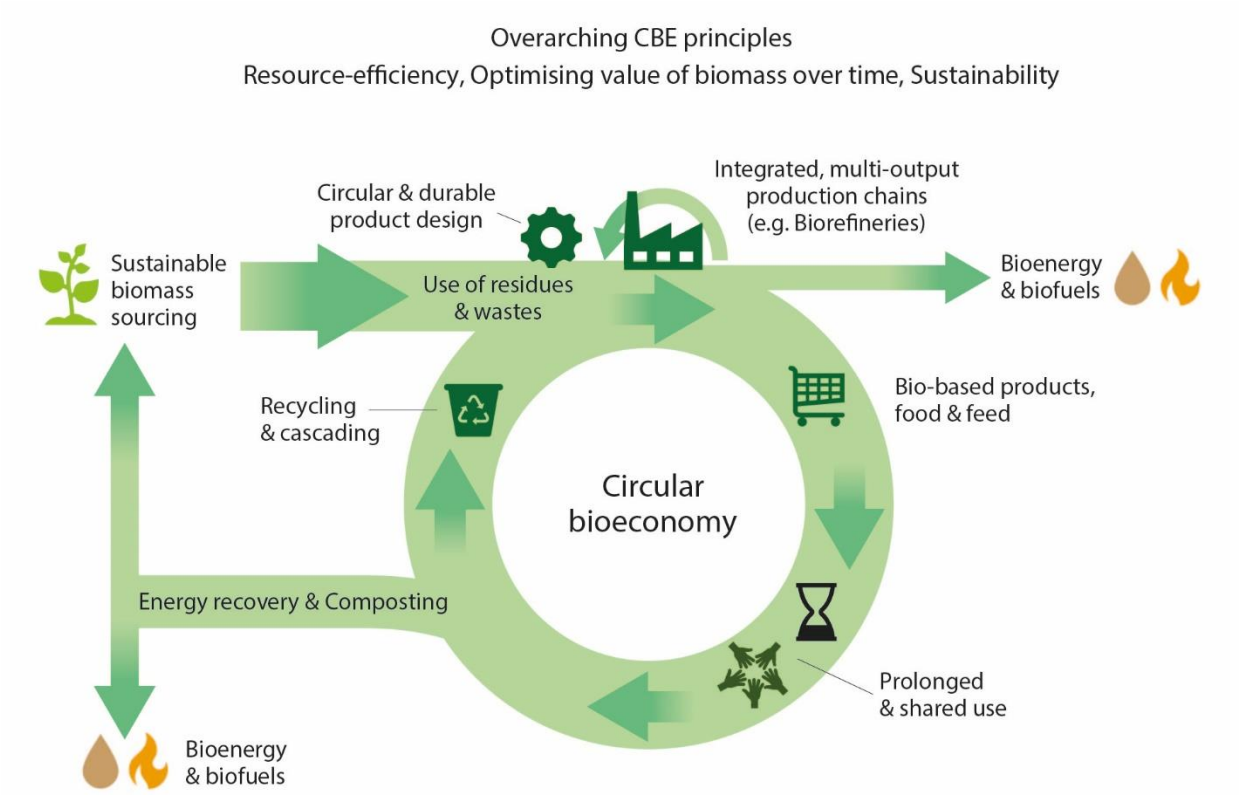
The bioeconomy is not, however, inherently renewable or sustainable. In the Updated Bioeconomy Strategy 2018, the European Commission states that "the European Bioeconomy needs to have sustainability and circularity at its heart" to manage concerns around increasing demands for biomass for short-lived and linear use. In contrast, a comprehensive circular economy needs to include the bioeconomy, which consists of organic material from agriculture, forestry, fisheries, the food and feed industry and organic processes of waste, as well as knowledge-based processes and applications (Carus, 2017[5]). Annex Box 5.A.1 provides an overview of the concepts related to the circular bioeconomy, such as the green economy, the bio-based economy and the circular economy, and the linkages between them.

The Hungarian Ministry of Agriculture understands the circular bioeconomy as the economy that uses renewable biological resources to sustainably produce food, feed, bio-based materials, products, fuels and bioenergy, and in which waste products are kept within the system. Hungary focuses on the sustainable conversion of biomass and bio-based resources into marketable products, and places biomass production and processing in a single system, while underscoring the role of technology in biological resources to create added value and encourage new business models.

Figure 5.1 summarises the central elements of the circular bioeconomy. A closer look through the life cycle processes along the biomass and food priority area helps identify many opportunities for the circular bioeconomy:

- **Primary production**. This refers to the sustainable management of land and forests, including the distribution of land, water, biodiversity and other environmental resources, the efficient and sustainable use of natural resources in agricultural and forestry management practices, and carbon farming and sequestration. Several bio-based sources originating from any life cycle stage, such as biomass waste and residues, can be utilised in this stage as feed, fertiliser, soil conditioner or other purposes without pre-treatment.
- **Industrial processing and distribution**. This includes the bio-based production of processed food, feed, fertilisers, chemicals, pharmaceuticals, nutraceuticals, cosmetic compounds, biomaterials, packaging processes and consumer delivery. The design of a product and its production process is crucial to ensuring a longer lifespan, both in terms of its primary use and the potential to reduce waste and increase recycling. There is also potential for greater efficiency in processing, and using processing residues and waste from agriculture and forestry by cascading (i.e. reprocessing of biomass at its highest material value before its conversion into bioenergy). Packaging and products distribution can be directed towards greater circularity and less food waste, including by ensuring recyclability and limiting overall environmental impact.
- **Consumption**. At the core of this stage are changing consumption patterns, waste prevention, and prolonging the use of products by cascading their use in line with the waste hierarchy: with redistribution, reuse and recycling at the top of the hierarchy, followed by recovery and disposal. This is particularly relevant for the consumption, use and disposal of food and bio-based products.
- **End-of-life**. This stage refers to the treatment of materials and products when they become waste products. This includes waste from primary biomass production, processing, consumption and bioenergy production stages. The circularity of waste produced from biomass and bio-based products means improving waste sorting to facilitate use and recycling, enhancing recycling technologies and processes, and extracting valuable chemicals as components from processing. Furthermore, biomass and organic waste are critical inputs for bioenergy production. However, energy recovery should be used only when the options higher up in the waste hierarchy cannot be achieved.

Figure 5.1. The circular bioeconomy (CBE) and its principles



Source: Stegmann, Londo and Junginger (2020[6]).

5.1.3. The rationale for a circular bioeconomy in the priority area of biomass and food

The rationale for a circular bioeconomy in the priority area of biomass and food lies in its potential to contribute to climate change mitigation, socio-economic development and environmental protection over time by maintaining the value of bio-based products, materials and resources in the economy for as long as possible. From a systems-thinking approach, Hungary understands the circular bioeconomy as a new techno-socio-economic paradigm of production and consumption. This requires: i) rethinking its development orientations and principles; ii) taking advantage of its technological solutions; iii) setting economic thinking on a new pathway; iv) strengthening political and institutional support; v) ensuring policy coherence across objectives, instruments and practices; and vi) involving relevant stakeholders in policy design processes to a greater extent.

Biomass brings an opportunity for the EU by providing additional natural resources for the economy and products, and closing the biological cycle of biodegradable materials. Biomass also helps diversify Europe's energy supply, create growth and jobs, and lower GHG emissions. According to the latest available data, the total biomass supply in the EU27 added up to 1 billion tonnes of dry matter[2]. The agriculture sector is the biggest producer of biomass (69%), followed by forestry (31%) and fisheries (<1%). Around 60% of the biomass in the European Union is used for food and feed, with 24% of identified biomass used for energy and 16% for biomaterials[3] (Gurria Albusac, 2022[7]).

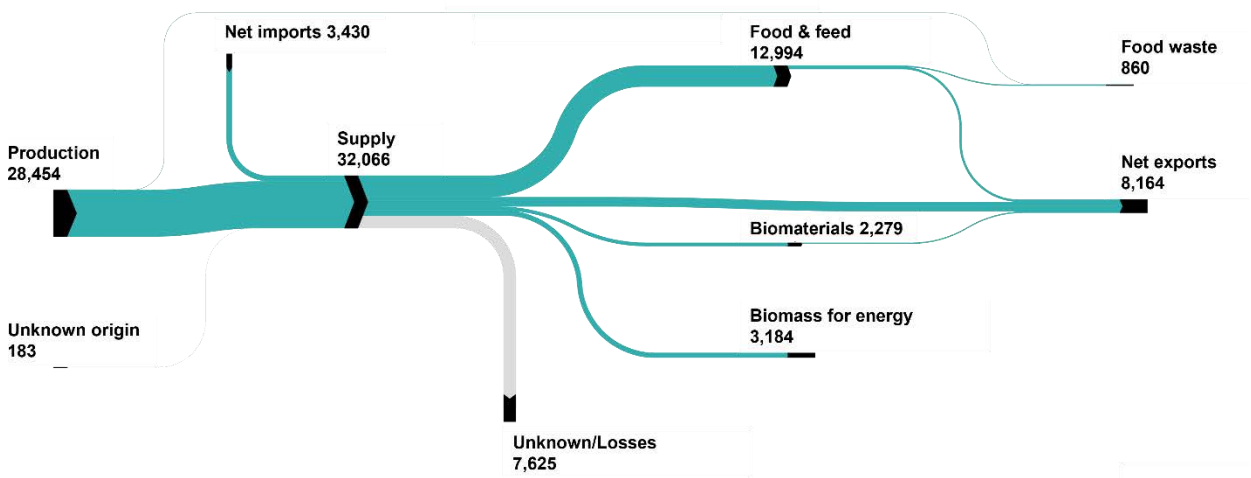
Today's food system is unsustainable and is both affected by and a driver of climate change, resource scarcity, environmental degradation, loss of biodiversity, and pollution and waste (European Commission, 2016[8]). Indeed, the food system is one of the most frequently targeted priority areas in national circular economy strategies given its high land, water and energy consumption and large waste production

(Salvatori, Holstein and Böhme, 2019[9]). The available estimates show that the level of food waste generated annually in the EU and its Member States is cause for concern. Around 88 Mt of food waste was 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[10]). The most recent estimates of European food waste levels reveal that 70% of EU food waste originates in the household, food service and retail sectors, with production and processing sectors contributing the remaining 30% (Stenmarck et al., 2016[10]).

5.2. Biomass and food in the Hungarian economy

This section approaches the biomass and food priority area from the perspective of the agriculture sector, which is the primary source of biomass resources and raw materials for the food industry and an important part of the Hungarian economy. Forestry is also addressed due to its essential contributions to biomass and the construction and packaging industries. This section also looks at the material recovery of agricultural and industrial food waste and biomass consumption, which amounts to above one-third of Hungary's consumed materials in 2016, and on which Hungary relies for its renewable energy supply (OECD, 2018[11]) (see Figure 5.2).

Figure 5.2. Biomass flows in 1 000 T of dry matter (net trade) for Hungary



Source: "EU Biomass Flows tool" (European Commission – Joint Research Centre, n.d.[12]) presenting harmonised data from the various Joint Research Centre (JRC) units contributing to the BIOMASS Assessment study (European Commission, JRC, Data from the BIOMASS project) (Gurria Albusac, 2022[7]).

5.2.1. The agricultural sector remains essential in Hungary's economy, yet its labour productivity is relatively low

Hungary's value added in the agricultural sector outperforms the rest of the EU. The value added in the net agricultural sector, including crop and livestock production, forestry and fisheries, was 3.9% in 2020, the third largest value in the EU (the EU average is 1.7%) (World Bank, n.d.[13]) and one of the highest among OECD countries (OECD, n.d.[14]). The agriculture sector provides 90% of Hungary's biomass when considering production and net trade, as estimated in dry matter equivalent, in the EU. This is higher than the 65% share in the former EU 28 (Camia, A. et al., 2018[15]). Furthermore, while the country's agriculture and food industry is firmly integrated into European markets, the national food industry purchases two-

thirds of agricultural production. However, the production potential of Hungary's food economy could be 60% higher than it is today (Ministry of Agriculture, 2017[16]). Almost 80% of Hungary's land area is productive land (Hungarian Central Statistical Office, 2018[17]), and small farms prevail across the agricultural sector (83% in 2016) (Eurostat, 2020[18]). Employment in agriculture remained stable at around 5% between 2010-2019 (World Bank, n.d.[19]), excluding the significant sectors' undeclared work (Eurofound, 2013[20]).

Despite the positive developments, the Hungarian agri-food sector suffers from low labour productivity compared to other European countries (European Commission, n.d.[21]). This is notably due to less advanced production technologies and a lack of financial resources for technological development and innovation. In terms of production technologies, the limited resources to invest in R&D are related to the relatively low profitability of the sector, particularly in small companies (fi-compass, 2020[22]). In addition, there is also a risk of soil depletion because of the low levels of phosphorus in the soil, even if Hungary is among the top three EU countries with the highest phosphorus consumption per hectare (Eurostat, n.d.[23]).

Forestry also plays an important role owing to its biomass contribution to renewable energy production, and to the construction and packaging industries. However, Hungary is one of the least forested countries in Europe (OECD, 2018[11]), and forestry and logging, as well as fishing and aquaculture, contribute negligibly to gross value added (GVA). Forestry contributes 0.5% of national employment (Research Institute of Agricultural Economics, 2019[24]), with solid employment growth observed between 2008 and 2018 (Eurostat, 2020[18]).

5.2.2. Food production is central in Hungary's industry and represents the lion's share of national household-level consumption

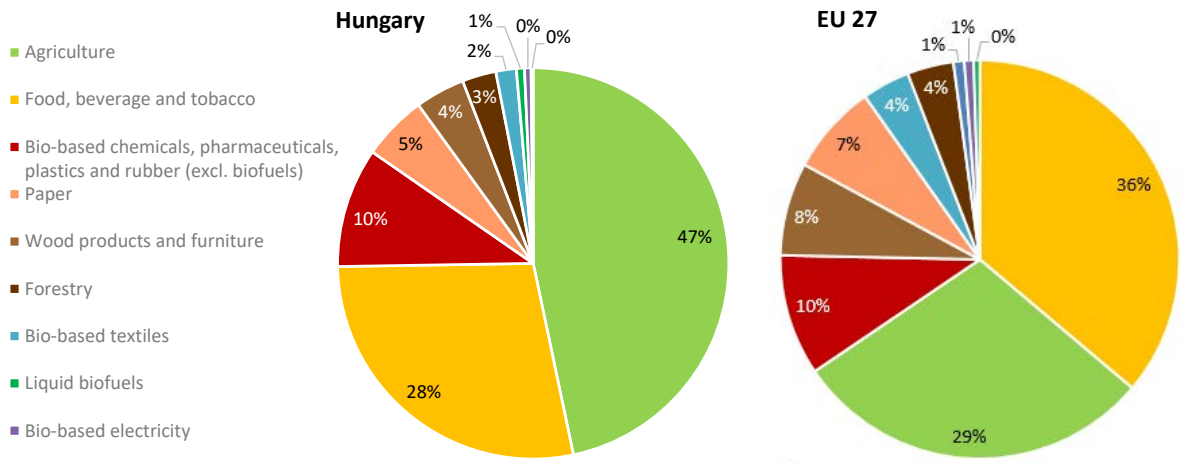
Industrial processing and distribution of food products, beverages and tobacco is the third largest sector in Hungary's manufacturing sector. The share of food, beverages and tobacco reached 10.5% of Hungary's GVA in manufacturing in 2020 (World Bank, n.d.[25]), with the share of the food industry at 2% of GVA in 2019 (Hungarian Central Statistical Office, 2020[26])[4]. The employment rate in the biomass and food processing sectors is in line with the EU-27 average, adding up to 3.1%[5] of the total workforce in Hungary in 2020 (Eurostat, n.d.[27]).

Food industry products is the most significant sector of consumption in Hungary. Expenditure for food, beverages and tobacco accounted for 28% of per capita expenditure of households in 2019 (Hungarian Central Statistical Office, n.d.[28]), a higher share than housing, maintenance and household energy (18.5%). Consumer preference for eating locally produced fruits and vegetables, as well as seasonal products and organically farmed produce, has increased in recent years (Hungarian Chamber of Agriculture, n.d.[29]). However, the annual consumption of meat and meat-derived products has remained stable in the last decade (Hungarian Central Statistical Office, n.d.[28]).

5.2.3. Hungary's bioeconomy grew by about one-third in the last decade, but its focus remains on agricultural production

The value added of Hungary's bioeconomy was around EUR 10 billion in 2019, a 35% increase from 2008 (Ronzon et al., 2022[30]). The liquid biofuels sector (bioethanol and biodiesel production) had the highest growth rate in terms of value added during this period (2 405% increase), however, this sector corresponded only to 1% of the total value added in Hungary's bioeconomy. Almost 50% of Hungary's bioeconomy by value added in 2019 related to the agricultural sector (Figure 5.3), and this share has not changed in the past ten years. In the EU, the focus lay primarily on the food, beverage and tobacco sector in 2019 (36% of the total value added in bioeconomy-relevant sectors), with agriculture at around 30%.

Figure 5.3. Bioeconomy value added by sector in Hungary and EU 27 in 2019



Source : Based on JRC Dataset (Ronzon et al., 2022[30])

Looking at the value added per person employed, Hungary's average was around EUR 26 000 in 2019, which was considerably lower than the EU 27 average of EUR 38 000 (Ronzon et al., 2022[30]). This may be the result of the combination of the high share of agriculture in Hungary's bioeconomy (close to 50%) and the relatively low value added per person employed in the agricultural sector. In the EU 27, the agricultural sector had the lowest value added per person employed in all the bioeconomy-related sectors in 2019.

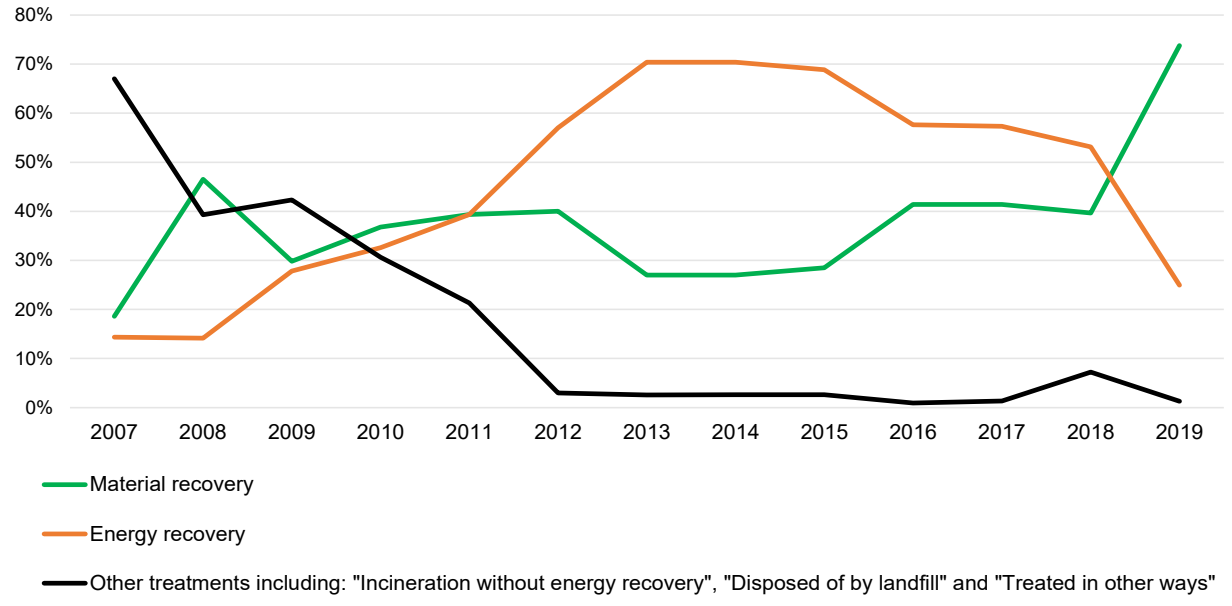
This implies that Hungary's bioeconomy, while growing, has remained material-focused, with an overemphasis on the primary production of biomass and the processing of primary biomass over bio-based products and services in higher end value added sectors of the bioeconomy.

5.2.4. Materials recovery of agricultural and industrial food waste is increasing in Hungary, but half of per capita food waste could also be avoided

Hungary produced 749 000 tonnes of agricultural and industrial food waste in 2020, half of which, on average, was treated by materials recovery in the last decade (Hungarian Central Statistical Office, n.d.[28])[6]. Estimates show that annually, in per capita terms, almost half of the 68 kg of food waste generated by Hungarian households in 2016 could have been avoided (Kasza, G. et al, 2020[31]). In 2020, Hungary's household food waste in per capita terms stood at 66 kg, just below the EU 27 average of 70 kg (Eurostat, 2022[32]). Nevertheless, Hungary's annual per capita total food waste amounts to 93 kg, which is far below the EU 27 average of total food waste at 127 kg in 2020 (Eurostat, 2022[32]). In line with the concept of supporting cascading use, materials recovery in Hungary has increased, and energy recovery has decreased since 2007 (Figure 5.4). In the last decade, more than 92% of agricultural and industrial food waste was utilised as materials or energy recovery, which is an important achievement, even though further efforts are needed.

Figure 5.4. Percentage volume of agricultural and food industrial wastes treated by materials recovery, energy recovery and other options in Hungary

As registered by the Hungarian Central Statistical Office



Source: Adapted from data in table no. 15.1.1.28. of the HCSO (Hungarian Central Statistical Office, n.d.[28]).

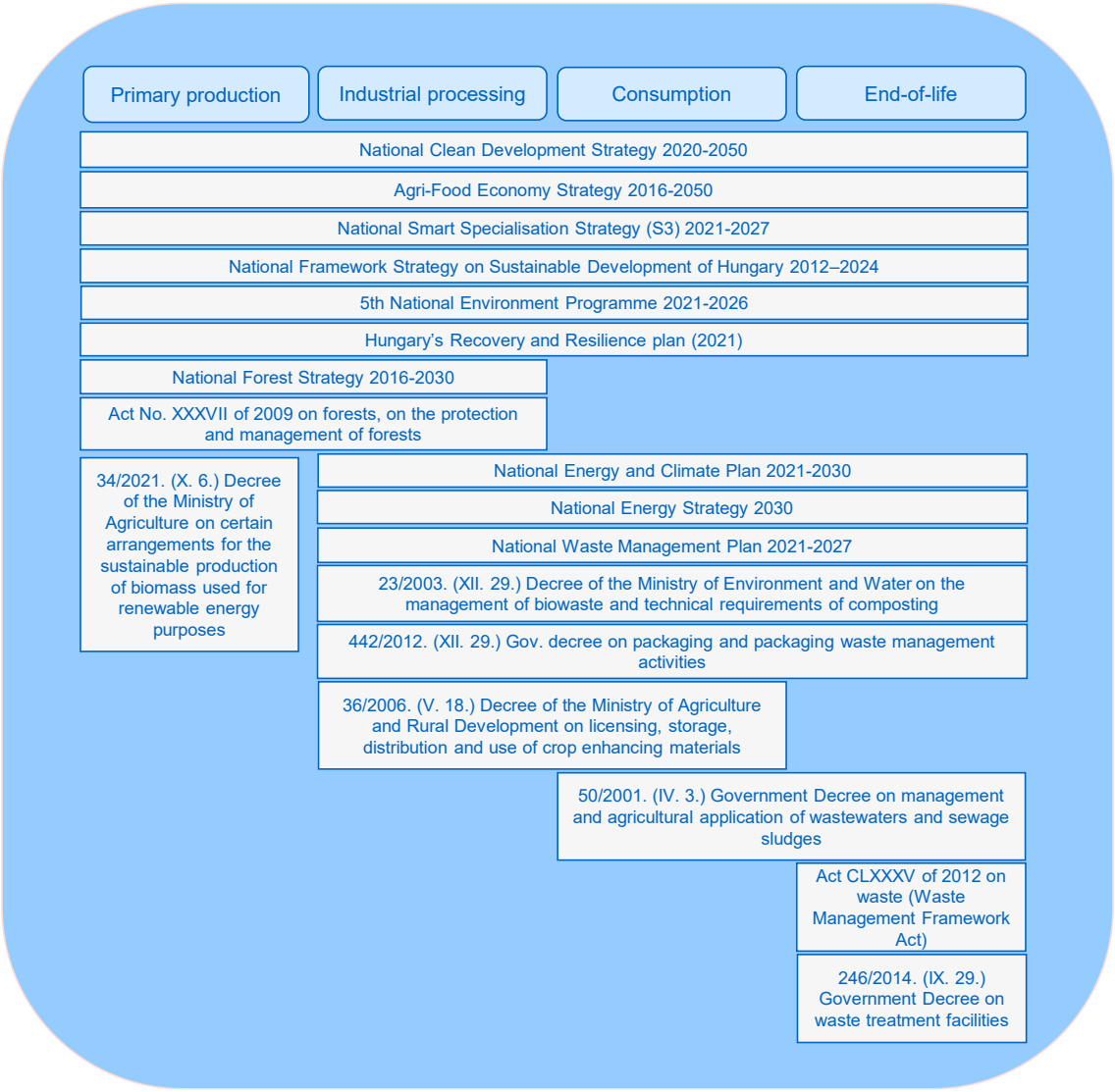
5.3. Hungarian policy and the legal context relevant to biomass and food

This section presents the central objectives, targets and shortcomings in Hungary's policy and legal context relevant to the biomass and food priority area, in particular, the agri-food sector, waste management, consumer behaviour, and biomass' contribution to the bioeconomy. While this section does not aim to exhaustively list all the strategies and policies in Hungary that directly or indirectly relate to the biomass and food priority area, it does cover the most important ones.

5.3.1. Hungary's strategies and policies in the biomass and food priority area are in line with EU legislation

Hungary has adopted legislation and strategies relevant to the biomass and food priority area. Hungary can count on six main national strategies that deal with materials and resource management across the entire biomass and food life cycle (Figure 5.5) and which are aligned with relevant EU legislation and policy (see Annex Figure 5.A.2 for an overview of the applicable EU legislation).

Figure 5.5. Overview of the biomass and food related policy landscape in Hungary



5.3.2. Hungary's policy framework focuses on primary production and industrial processing, but implementation is not enough

The Hungarian agri-food sector addresses circular economy principles through environmental protection, the sustainable use of natural resources and viable agricultural production. These elements are outlined in the National Rural Development Strategy 2012-2020 (Ministry of Rural Development, 2012[33]) and linked to the Irinyi Plan (Ministry for Innovation and Technology, 2016[34]) and complementary policies and laws, for instance, targeting organic farming (Ministry of Agriculture, 2016[35]), genetically modified organisms (GMO)-free agriculture (Parliament of Hungary, 2011[36]) and the digitalisation of agricultural production (Ministry for Innovation and Technology, 2021[37]). In addition, food production processes, local food chain development and food consumption in Hungary are examined in its Medium- and Long-term Development Strategy for Food Industry 2014-2020 (Ministry of Agriculture, 2015[38]) and the Food Industry Concept of Hungary 2017-2050 (Ministry of Agriculture, 2017[16]). Hungary also benefits from additional complementary strategies in the agri-food's industrial processing stage. In this regard, the National Smart Specialisation Strategy (S3) refers to food from innovation and technology, and the National Energy

Strategy 2030 (Ministry of National Development, 2012[39]) introduces the concept of "bipolar agriculture" to enable a flexible switch between food and energy crop farming as required by the market.

Although agriculture and food policy frameworks in Hungary connect well with the circular economy on a conceptual level, these concepts lack implementation in practice. For instance, the biological treatment of agricultural by-products and food waste, and their use as compost and feedstock for energy, are referred to in some policies. However, those policies do not outline specific measures or targets for their operationalisation. Moreover, Hungary does not yet have a dedicated bioeconomy policy framework[7] nor is there an effective integration of bioeconomy principles, beyond the references in the National Smart Specialisation Strategy (S3) 2021-2027.

5.3.3. Hungary's strategies and policies on waste management focus on separate collection, recycling and composting of bio-waste

Hungary has a long developed legal and policy framework for waste management, notably driven by EU legislation (OECD, 2018[11]). Complemented with the National Framework Strategy on Sustainable Development (Nemzeti Fenntartható Fejlödési Tanács, 2013[40]) and the New Széchenyi Plan (Government of Hungary, 2011[41]), the main legal instruments are the National Waste Management Plan 2021-2027 (Ministry for Innovation and Technology, 2021[42]) and the Waste Management Framework Act (Act CLXXXV of 2012 on waste) (Parliament of Hungary, 2012[43]). The Act underlines the need to respect the waste hierarchy, and provides the principle for biodegradable waste utilisation.

Consumer behaviour plays a central role in the separate collection of bio-waste. The National Clean Development Strategy 2020-2050 (Ministry for Innovation and Technology, 2021[44]), in line with the Fifth National Environmental Programme 2021-2026, acknowledges that consumption patterns must evolve to reduce waste and food loss in Hungary. Moreover, the National Waste Management Plan (NWMP 2021-2027) introduces the separate mandatory collection of bio-waste by 2024, and emphasises that waste management can effectively support the circular economy only if all stakeholders are encouraged to apply the higher levels of the waste hierarchy. The plan also aims to halve food waste per capita by 2030 at the consumer and retail level as well as reduce food losses along production and supply chains (Ministry for Innovation and Technology, 2021[42]). Despite progress in this area, Hungary could further improve the management of bio-waste at the municipal level, including through enhanced infrastructure for separate collection and expanded bio-waste sorting.

Hungary's waste policy framework emphasises recycling and composting. The NWMP 2021-2027 spells out actions for non-hazardous bio-based wastes from the agriculture and food industry, for example, by: i) increasing the rate of bio-based wastes treated by composting; ii) promoting household and local community composting; or iii) collecting and recycling agricultural foil wastes at the country level. To move towards a strengthened circular bioeconomy, Hungary could introduce complementary strategies and policies higher up in the waste hierarchy on waste prevention, redistribution and reuse.

5.3.4. There is scope for expanding the contribution of biomass to the bioeconomy beyond its use in the renewable energy sector

Bioenergy and bioeconomy goals compete for biomass resources in Hungary's policy context. On the one hand, the current Hungarian policy framework on biomass focuses on its energy applications. Indeed, biomass-based energy production remains critical among renewable energy resources in Hungary, notably due to the country's dependence on fossil fuel imports. On the other hand, biomass can be directed to the production of bio-based products, maintaining resources longer in the economy based on the waste hierarchy principle. Hungary aims to increase renewable energy sources to at least 21% of gross final energy consumption and to diversify renewable energy consumption, reducing biomass dominance in renewable energy sources to 75% by 2030 (National Energy and Climate Plan 2021-2030) (Ministry for

Innovation and Technology, 2020[45]), in line with the National Framework Strategy on Sustainable Development (Nemzeti Fenntartható Fejlődési Tanács, 2013[40]) and the New Széchenyi Plan (Government of Hungary, 2011[41]).

Developing and implementing solutions for managing sewage sludge and other bio-waste provide an opportunity for the Hungarian circular bioeconomy, particularly with regard to livestock production and soil fertilisation in agriculture. This is well reflected in the National Clean Development Strategy 2020-2050 and the NWMP 2021-2027, which underline the potential of sewage sludge on agricultural land. Hungary could benefit from spelling out these strategies by tackling soil depletion with sewage sludge and feeding it back to agricultural soils. These efforts would contribute to increasing the targeted rate of bio-based wastes treated by composting from 200 000~300 000 to 700 000~800 000 tonnes per year (Ministry for Innovation and Technology, 2021[42]). In the long term, Hungary would need to refocus its strategies on targeting higher levels of the waste hierarchy.

5.4. Life cycle gap analysis and policy recommendations for a transition towards more circular biomass and food

The previous sections defined the key concepts and established the key elements of a circular bioeconomy, including the four key life cycle stages along the priority area of biomass and food. They provided an overview of the current state of play of this priority area in Hungary, mapping out the key trends and policy landscape for each stage of the biomass and food life cycle. The overview showed that, while Hungary's policy landscape is in line with EU legislation – and the circular economy principles are to some extent embedded in the national policy framework – the focus is on the primary production of biomass for energy purposes as well as waste management. Concrete measures to implement a circular bioeconomy in Hungary are also absent. There is also a lack of more granular data in this priority area, which would provide a stronger basis for policy decision making.

This section identifies 12 key areas for improvement for the biomass and food priority area, which address these challenges thanks to the analysis made of the circularity potential and the existing regulatory framework, including stakeholder consultations and evidence gathered from international good practices. The 12 identified areas for improvement and the related policy recommendations are structured along the biomass and food life cycle, but they also include areas that cut across the entire life cycle.

5.4.1. Promoting the circular bioeconomy in primary production

The analysis of the circularity potential in the Hungarian primary production sector and the stakeholder consultation process identified the need to promote the use of natural bio-based solutions for soil in agriculture, such as compost. It also identified the need to support new initiatives for alternative protein production. The national circular economy strategy should focus efforts on these two key areas of primary production. According to the consulted stakeholders, soil plays a critical role in Hungarian sustainable food production and the circular bioeconomy. The production of alternative protein sources could provide a more sustainable solution to the current system, which is based on animal production.

The need for a regulatory framework to increase the use of products from bio-waste in agriculture

The National Clean Development Strategy 2020-2050 and the consulted stakeholders underlined the need to increase the use of natural bio-based solutions in soil management in Hungary. Natural bio-based solutions for improving soil resources include the use of bio-based fertilisers, soil conditioners, plant bio-stimulants, as well as the extended use of composts and possibly digestate. Their use enhances the soil's quality, but it also provides opportunities to utilise bio-waste for other applications and to decrease the

amount of sludge, as well as to capture CO_2 emissions (Ministry for Innovation and Technology, 2021[44]). The NWMP 2021-2027 also emphasises the potential benefits of using composts produced from bio-waste and the use of sewage sludges in agriculture to recycle the nutrients from bio-waste back into the soil. However, despite these benefits, the composts produced from bio-waste and sewage sludge have only been used to a limited extent in Hungarian agriculture, particularly because of restrictions introduced in the legislation on using bio-waste for composting[8] and sewage sludge on agricultural land.[9] In addition, Hungary lacks a supportive regulatory framework providing the necessary conditions, technical requirements and quality assurance for the use of compost and sewage sludge in agricultural applications (Ministry for Innovation and Technology, 2021[42]). Supporting organic farming and integrated farming is also essential as they pay extra attention to the intake of local biomass and organic manure, which is also beneficial for soil life.

Hungary can enhance the use of composts (and digestate) produced from bio-waste in agriculture by improving the quality assurance system for their use as well as for inputs to the composting facilities. This can be achieved through the legislation regulating the management of bio-waste and by specifying the technical requirements for composting. This may include: i) introducing a compost classification system; ii) stricter quality standards for impurities, including plastics; iii) a positive list of suitable input material for compost; iv) a check-list for the operational quality of the composting plant, as well as product control requirements for compost/digestate quality; and v) application recommendations for product use, which are the essential elements of the ECN-QAS quality label for compost and digestate (ECN, 2018[46]). For example, the quality standards for impurities have recently been strengthened in the quality assurance systems of Flanders and Germany, expressed in terms of weight but also in terms of surface area (European Environment Agency, 2020[47]). Enhancing the use of products from bio-waste in agriculture may also include the development of supportive legislation for the use of digestate on land, which is an output from the anaerobic digestion process (alongside the production of biogas), and that can be classified as an organic fertiliser.[10] A strengthened quality assurance system for compost (and digestate) would reassure farmers when using these products on their agricultural land as these products need to be good quality in order to be used as a soil improver or fertiliser (European Environment Agency, 2020[47]). Hungary could follow the example of Austria, Germany or Slovenia in developing a supportive regulatory framework for the use of compost and digestate in agriculture (see Annex Box 5.A.2). However, the experience of countries suggests that a policy mix of measures is needed to manage bio-waste effectively, including the need to improve the separate collection of bio-waste as inputs for composting (see the section "Incentivising separate collection of municipal bio-waste"), and to implement national standards for compost and digestate quality (European Environment Agency, 2020[47]). The cost of disposing bio-waste in landfills or for energy recovery would also need to increase in order to make it more economically attractive to compost.

Hungary can also investigate the potential to enhance the use of sewage sludges on agricultural land and, if needed, amend its legislation. Hungary has adopted more stringent requirements on using sewage sludges in agriculture compared to the EU Council Directive (86/278/EEC) (currently under evaluation for a potential revision). Hungary's Government Decree 50/2001 (IV. 3) limits the use of sludge and wastewater for agricultural uses by establishing strict requirements for their use as well as requiring a permit from authorities. The NWMP 2021-2027 has increased pressure on farmers to extend the use of sewage sludges on agricultural land. However, they are less willing to use these wastes due to the environmental and human health risks associated with the use of sludges in agriculture. The literature outlines some of the benefits of the use of sewage sludges in agriculture, for example, their use can lower the production costs of farmers by decreasing the amount of synthetic fertiliser that is typically needed, as well as helping decrease the amount of accumulated sludges (Iticescu et al., 2018[48]). However, evidence from EU countries shows that the use of sewage sludge in agriculture varies, ranging from 0% in Malta, the Slovak Republic and Slovenia, to 80% in Ireland, according to data for 18 EU Member States from 2014 (Hudcová, Vymazal and Rozkošný, 2019[49]). Recently, a few countries, such as Germany and Austria, have introduced even stricter requirements for the use of sewage sludge in agriculture, and

refocused their efforts towards recovering phosphorus from sewage sludge (see Annex Box 5.A.3). The recovery of phosphorus might be particularly relevant for Hungary as the country is among the top three EU countries with the highest phosphorus consumption per hectare (Eurostat, 2022[50]). Hungary also faces a risk of soil depletion due to a negative balance of phosphorus in the soil (i.e. more phosphorus is removed from the soil than is added) (Eurostat, 2022[51]). The use of sludge in agriculture is a complex issue with many risks and any regulation promoting it will therefore need to have the right safety measures in place to prevent possible leakage of contaminants into the soil, surface water and groundwater (Hudcová, Vymazal and Rozkošný, 2019[49]). The safe application of sludges on agricultural land will also require the implementation of a mix of measures, including the continuous monitoring of the composition and microbial characteristics of sludges with special attention paid to human pathogens (Iticescu et al., 2018[48]). It may also require the development of a quality assurance system for sewage sludge products (BDE e.V., 2020[52]).

Support for new initiatives for alternative protein production

Current animal production systems are not considered sustainable as they use huge quantities of water and directly contribute to climate change (FAO, 2022[53]). For sustainability and other reasons, alternative protein sources to animal proteins are expected to claim a substantial part of the protein market in Hungary in the future. The five-year National Protein Feed Programme, which started in 2018, provides HUF 8 billion (EUR 25 million)[11] as financial support for alternative protein production, with a focus on increasing the area of soy production in Hungary (Government of Hungary, 2018[54]). However, according to some stakeholders, it was clear from the start of this programme that soy in itself is not an adequate solution for the country (AGRARSZEKTOR.HU, 2017[55]). As a result, Hungary will need to consider policy support for alternative initiatives in the field of innovative protein production, including:

- The production of crops other than soy (e.g. pea is a versatile protein option that does not lead to allergies like the consumption of soy or wheat-based products [containing gluten]).
- The production of a single cell microalgae with a high protein content, also including various nutrients and bio-active compounds, which provide an added health benefit.
- The use of insects as an alternative protein source for animal feed.
- The extraction of high added value protein products from agricultural and industrial food by-products, in line with the circular bioeconomy.

To support such initiatives, Hungary can be inspired by the Dutch government, which encourages sustainable food production by supporting alternative protein production in two national policies: the 2018 Transitie-agenda Circulaire Economie – Biomassa en Voedsel [Transition Agenda for Biomass and Food] and the 2020 Nationale Eiwitstrategie [National Protein Strategy]. The evidence from the Netherlands shows that clear and long-term targets and objectives are needed, while also encouraging banks, investors and multinational companies to provide the capital for the transition to a sustainable production of protein (see Annex Box 5.A.4).

5.4.2. Industrial processing and distribution for the development of the circular bioeconomy

A key area for improvement in the industrial processing and distribution stage of the biomass and food area relates to the lack of sufficient technical and financial support for research and innovation in Hungary's circular bioeconomy as well as multi-stakeholder cooperation between industry and the research community. Currently, the approach to the bio-based economy in Hungary (part of the bioeconomy that relates to converting biological resources into products and materials, see Annex Box 5.A.1) is material focused, which undervalues the provision of bio-based products and services, and overemphasises primary production of biomass and the processing of primary biomass. While a few champions operate in

Hungary's bioeconomy market, almost half of Hungary's bioeconomy has been associated with the agricultural sector in terms of value added in the past decade (see Figure 5.3). The agricultural sector provides a relatively low value added per person employed compared to other bioeconomy related sectors, such as bio-based chemicals and pharmaceutical products, liquid biofuels or even the paper sector (Ronzon et al., 2022[30]). Moreover, according to some of the consulted stakeholders, the Hungarian approach favours homogeneous biomass streams and monocultures as the most important natural resource for agriculture and forestry, which could possibly lead to the depletion of natural resources, especially soil.

Strengthening research and innovation around industrial biotechnology and biorefineries

Research and innovation policy – with a focus on the circular bioeconomy – must be strengthened to support biofuels and the processing of biomass into bio-based products with a higher end-value added in Hungary, as well as the transition to a circular bioeconomy. This will need to be combined with technical and financial support offered to companies as well as greater multi-stakeholder cooperation with the international research community (and across sectors) to help drive the development of biorefineries and biotechnology in Hungary. In particular, local SMEs face challenges to succeed in the bioeconomy market as they typically face barriers to access finance, with a lack of skills in mobilising finance, restricted market access and knowledge, and supply chain management issues (European Commission, Directorate-General for Research and Innovation, 2019[56]). In Hungary, it is particularly important to support research and innovation in the business environment, especially as the country is lagging behind in eco-innovation and government spending on R&D.

Hungary can strengthen its support for research and innovation in the area of industrial biotechnology and biorefineries by developing a dedicated bioeconomy research and innovation programme with associated funding and technical support. Numerous regional and EU bioeconomy experts have also advocated for the establishment of research and innovation programmes targeted to the bioeconomy across Central and Eastern Europe as a precondition of further developments in this area (BIOEAST, 2021[57]). Several EU Member States, including Germany, Italy and the Netherlands, have introduced bioeconomy strategies with dedicated research and innovation funding programmes for their domestic bio-based industries, such as the German KMU-innovativ: Bioökonomie [SME Innovative: Bioeconomy] funding scheme or the Dutch TKI Biobased Economy programme (see Annex Box 5.A.5). Similar initiatives are being launched in many other European regions, for example, in Baden-Württemberg and North Rhine-Westphalia in Germany, Bio-based Delta in the Netherlands, Flanders in Belgium and in some regions in Italy (Commission Expert group for bio-based products, n.d.[58]). As is already the case in Hungary, the research and innovation support can also come through dedicated calls under the national/regional Operational Programmes (OPs), which are co-funded by the EU structural and investment funds (see the example of a voucher scheme in the Netherlands in Annex Box 5.A.5).

Dedicated national bioeconomy research and innovation programmes would be particularly impactful in increasing innovation and R&D funding for the bioeconomy and promoting cooperation within the research community for the uptake of industrial biotechnology (cross-sectoral and cross-border cooperation). They would also support the development of new business models and stronger partnerships, and support the improved collection of data and market information.

5.4.3. Towards a sustainable consumption of biomass and food

At the consumption stage of the biomass and food value chain, two key areas for improvement have been identified: i) the need to strengthen the regulatory framework and economic incentives for food donations; and ii) the need to promote Green Public Procurement (GPP) of food and catering services. Both of these areas affect, on the one hand, the producers of food (such as supermarkets, restaurants and catering services) and, on the other hand, the users of such food (charities, vulnerable populations but also public

entities, among others). Awareness-raising initiatives directed at consumers are discussed in the section "Horizontal tools for facilitating the transition to a circular bioeconomy".

Supportive regulatory framework and economic incentives for food donations

When food surpluses cannot be avoided, food redistribution for human consumption (i.e. food donations) is the second-best option according to the waste hierarchy and before food is directed towards non-food applications (e.g. animal feed) (OECD, 2022[59]).

The analysis of the Hungarian policy landscape and the discussions with several stakeholders led to the identification of a number of barriers to food donations in Hungary. These include a lack of an efficient distribution system and scheme at county level to increase the capacities for food redistribution (National Waste Prevention Programme) as well as an existing regulatory framework that makes food donations difficult and economically unattractive for the food industry. The recent amendment to the Act 2008 XLVI and Act 2020 XLV (Act 2021 CLI) tries to support food donations by making them mandatory in some circumstances. For example, businesses with a net revenue of more than HUF 100 bn (EUR 250 million) (where revenues originate from food retail) are obliged to both offer food with a longer shelf life (more than 48 hours) to the Food Rescue Centre Non-profit Kft 48 hours before its "best before" date and to create their own food waste reduction plans. This obligation does not concern food with a short shelf life (less than 48 hours) or companies with a revenue of less than HUF 100 bn. Smaller companies can donate food 48 hours before its "best before" date but are not obliged to do so. According to the VAT Act 2007 CXXVII, food donations are exempt from VAT and, according to Act 1996 LXXXI, businesses that donate food receive tax deductions. However, to benefit from tax deductions, the receiving entity must be a charitable organisation.

To further support food donations in Hungary, instead of obliging large companies to donate food (for food with a longer shelf life that is close to reaching its "best before" date within 48 hours), the country may consider food donations after the "best before" date under specific conditions (for food that is still safe for human consumption but cannot be sold). This has been allowed in a few countries, including the Slovak Republic, and can be considered a good practice in food redistribution. Hungary can also consider introducing additional tax incentives. This could be in the form of tax credits or enhanced tax deductions of more than 100%, as has been the case in a few EU Member States (see examples in Annex Box 5.A.6). The Czech Republic and France have also introduced mandatory food donations. However, mandatory food donations are not recommended as this may lead to additional logistical challenges, i.e. increased organisational and operational capacities for charitable organisations. For a discussion of the challenges of introducing mandatory donations, see OECD (2022[59]) and European Commission (2020[60]). The EU has also developed guidelines on food donation and redistribution (European Commission, 2017[61]), which can be used by Hungary to better understand how to interpret and apply relevant legislation related to food donations.

Stimulating circular food solutions through green public procurement

Sustainable consumption and production of biomass and food can also be promoted by Green Public Procurement (GPP). The GPP of food and catering services is a well-established intervention, playing an important role within public procurement in the EU. A recent study by the Joint Research Centre analysed the extent of green criteria used in the public purchase of food products and catering services in the EU. It revealed a variety of GPP schemes that target different governance levels (national, regional and local), food products, environmental criteria as well as life cycle phases of public procurement (2017[62]). As in many EU countries, GPP is a voluntary environmental tool in Hungary. Even though Hungary's public procurement law (Act CXLIII of 2015) includes the possibility of incorporating environmental criteria in public procurement tenders, overall, contracting authorities in Hungary considered environmental aspects

in only 9% of the procedures for which information was collected in 2015 (European Commission, 2019[63]). Further, Hungary does not have a national GPP action plan.

To support the sustainable consumption and production of food, Hungary could promote the use of GPP criteria in the procurement of food and catering services. On the one hand, this measure would provide food producers with incentives to decrease the environmental impact of food production, packaging, transportation and waste, and, on the other hand, it would encourage buyers towards more sustainable diets, such as organic and seasonal food products. The GPP of food and catering services in Hungary could be enhanced by increasing the understanding of public authorities on how to implement GPP in this area and by raising awareness about GPP's benefits. This could be done by developing a guidance on GPP methodology or training materials for public authorities, and by using the EU guidance and EU GPP criteria for food, catering services and vending machines (European Commission, 2019[64]) as the basis for these materials. Hungary could also develop a catalogue of good practices to show potential suppliers of food and catering services the options and benefits of supplying sustainably produced food and catering services. Hungary could also consider introducing some form of mandatory GPP criteria in contracts, for example, by focusing on technical specifications or the selection of award criteria. Annex Box 5.A.7 provides some examples of existing GPP schemes for food and catering services.

5.4.4. Improving the management of bio-waste

When food waste and other bio-waste cannot be prevented, or redistributed through food donations, or valorised for feed or other bio-based applications, it needs to be treated or disposed of. Bio-waste can be treated through processes like composting (for compost) and anaerobic digestion (AD) (for digestate and biogas), as these products can be used on soil or as a source of energy. While the use of compost and digestate helps to close the biological cycle of bio-waste through their potential to be introduced back into the soil as a soil improver or fertiliser, the production of biogas contributes to increasing the share of renewable energy in the country and, as such, diverts energy production away from fossil fuels. Bio-waste can also be incinerated for energy recovery. From a circular economy perspective, composting needs to be prioritised over AD, and AD over energy recovery. The EU Landfill Directive requires that biodegradable municipal waste is diverted away from landfills.

The analysis of the Hungarian policy context and the stakeholder consultation led to the identification of three key areas for improvement in the management of bio-waste. First, a separate collection of municipal bio-waste must be improved as it is a crucial pre-condition for bio-waste recycling through processes like composting and AD and for the generation of high-quality compost and digestate for use on agricultural land. Second, the composting capacity for bio-waste will need to be increased to cope with the increased amount of separately collected municipal bio-waste and to produce high quality compost for use in agriculture. Lastly, competing goals of circular economy and bioenergy production need to be reconciled with the cascading principle, which favours material recovery and recycling over energy recovery.

These three areas for improvement are also associated with the requirements of the EU waste legislation obliging all Member States to introduce a mandatory separate collection of municipal bio-waste by the end of 2023 and to recycle or prepare at least 60% of municipal waste for reuse by 2030 (65% by 2035) (Waste Framework Directive). The EU Landfill Directive also introduces a landfill target of 10% or less for municipal waste by 2035. These goals and targets will have important implications for municipalities and the waste management industry in Hungary.

Incentivising separate collection of municipal bio-waste

Hungary has not yet introduced a mandatory separate collection of municipal bio-waste but it is planning to do so by the end of 2023 in line with the EU waste legislation (Ministry for Innovation and Technology, 2021[42]). Municipalities will need to ensure that an adequate infrastructure for the separate collection of bio-waste is in place as well as effective incentives for households to separate their bio-waste. Hungary

had already introduced a ban on landfilling of untreated waste in 2004 and has stepped up investments into mechanical biological treatment (MBT) plants for mixed municipal waste (OECD, 2018[11]). This has ensured that mixed municipal waste is treated prior to disposal, but it also means that municipalities might not be fully motivated to introduce a separate collection of bio-waste as they will need to build additional waste infrastructure, while the existing MBT infrastructure will need to be gradually phased out (as the need for MBT capacity for mixed municipal waste would be less as more bio-waste is separated). There would also be less incentive for municipalities to separate waste if discussions focus on increasing the waste-to-energy capacity in Hungary, as plants compete for bio-waste for the purpose of energy recovery.

To improve the infrastructure for the separate collection of bio-waste, Hungary will need to ensure a regular collection of bio-waste, the provision of properly sized containers and bags, and an appropriate distance to the waste infrastructure or a "door-to-door" collection of bio-waste. The regular collection of bio-waste will limit biodegradation issues (odours, flies or leaks) and preserve the value of the bio-waste, which decreases over time. The provision of small kitchen caddies or bags for each household is relevant, especially for households living in apartment buildings. Additionally, an appropriate distance to the containers (in case of kerbside collection) or a door-to-door collection of bio-waste are all measures that will make it more convenient for households to separate their bio-waste. In particular, Hungary can improve the separate collection of municipal bio-waste by introducing a door-to-door collection system, a proven good practice in the EU, especially in Italy. For example, in the Italian city of Milan, the door-to-door collection of bio-waste, including the provision of kitchen caddies for every household, has succeeded in achieving an almost complete sorting of kitchen waste (see Annex Box 5.A.8). The door-to-door collection can also be limited to certain households. For example, the Slovak Republic is planning to introduce a mandatory door-to-door separate collection for bio-waste for households living in single-family dwellings from 1 January 2023 to further incentivise municipalities and households to separate their waste (amendment to the Ministerial Decree of the Slovak Ministry of Environment No. 371/2015).

Municipalities can also strengthen the use of economic incentives to motivate their residents to better sort their bio-waste. This can be done in the form of gradually increasing the landfill taxes for municipal waste, the cost of which will be reflected in the household waste charges, or, preferably, by expanding the coverage of well-designed "pay-as-you-throw" (PAYT) schemes, where households pay according to the amount of mixed municipal waste they generate. The landfill taxes in Hungary were planned to be linearly increased from HUF 3 000 (EUR 10)[12] per tonne to HUF 12 000 (EUR 39)[13] per tonne (Parliament of Hungary, 2012[43]). However, currently they are frozen at around EUR 15 (HUF 6 000)[14] per tonne for municipal waste, construction and demolition waste, hazardous waste and sludge. For residual waste generated from the use of secondary feedstock that can still be used as feedstock, landfill taxes are set at HUF 4 000 (EUR 13.5) per tonne, and for residual waste that cannot be used as feedstock, landfill taxes are at HUF 3 000 (EUR 10) per tonne. These landfill tax rates are relatively low compared to the landfill tax rates in other EU Member States (Cewep, 2021[65]). The way the proceeds from the landfill taxes are spent also provides an important incentive for municipalities to recycle or landfill. To motivate municipalities to introduce separate collection of bio-waste and to recycle bio-waste rather than sending it for landfilling is to distribute the revenues (or part of them) from the landfill tax back to the municipalities for good performance on bio-waste management. This could take the form of a subsidy for introducing a separate collection of kitchen bio-waste or a door-to-door collection system, or for achieving a high rate of composting, as has been the case in the Slovak Republic (OECD, 2022[59]). The revenues collected from the landfill taxes could also be spent to support municipalities in setting up a PAYT-based scheme.

While examples of introduced volume and frequency subscription based PAYT schemes exist in Hungary, they do not lead to the desired performance of a separate collection system. This is especially true in densely populated urban areas where household waste charges are split among several households (this is the case of apartment buildings, in particular). Household waste charges should differentiate between recyclables and mixed municipal waste, and make mixed municipal waste more expensive. For example, in Flanders, which has a mandatory PAYT scheme in municipalities, the collection of residual waste is the

most expensive, followed by the collection of household biodegradable waste, in order to encourage separate collection and home composting (OVAM, 2004[66]). Municipalities will also need to be financially supported in their introduction of PAYT schemes (as was the case in Flanders), particularly as the investment costs of such schemes can be burdensome. Providing economic incentives for home composting could also facilitate separate collection of bio-waste by households (see the next section on composting). For example, in Parma (Italy) where both door-to-door collection and PAYT schemes have been introduced, households get a 12% reduction in their waste charges if they compost at home (Ricci, 2020[67]) (see Annex Box 5.A.8). Any introduction of PAYT, as well as increased landfill taxes, will require an effective monitoring and enforcement system to limit illegal waste dumping to avoid the payment of waste charges, preceded by effective awareness-raising campaigns to educate households on the "why and how" of separate collection of bio-waste (see the section "Towards more effective education, awareness raising and skills").

Increasing the recycling capacity for bio-waste

Once bio-waste is separately collected, it will need to be recycled in facilities designed for this purpose. In general, there are two ways to treat separately collected bio-waste: through composting or through AD for biogas and digestate. The increased amount of separately collected bio-waste will require an increased capacity for composting and AD to prevent such waste ending up in landfills. There seems to be a lack of capacity in Hungary at present to process bio-waste into high quality composts. Both the Waste Management Plan 2021-2027 and the National Clean Development Strategy 2020-2050 identify the need to increase (and measure) the actual composting capacity and the level of treatment and recovery of biodegradable and compostable waste. To achieve a high recycling rate of bio-waste, this waste must be treated primarily through composting, after which the product can be used as a soil improver (compost produced in MBT plants, however, cannot typically be used directly on land). In addition to central large-scale composting plants, it is also important to increase local small-scale composting capacities in Hungary.

Hungary can strengthen the financial support for bio-waste recycling facilities to ensure that adequate investments in composting capacities are made. This can be done by allocating more funds to this area within the context of the Operational Programme for 2021-2027 or by simplifying the rules for applying for such funds (e.g. widening the scope of who may apply for funds) especially if available funds are not being fully disbursed. Increasing such capacity would ensure that organic and bio-waste, in particular, (and waste other than food waste) is treated in line with the waste hierarchy (i.e. prevented from ending up in landfill or valorised for other applications before being sent for composting or AD) (OECD, 2022[59]). This will need to be combined with measures supporting the use of compost in agriculture (see the section "The need for a regulatory framework to increase the use of products from bio-waste in agriculture"), as compost that is not used (in agriculture or at home) tends to end up in landfills. Increasing the composting capacity will also help Hungary move away from landfilling of bio-waste and towards increased recycling rates.

The capacity to recycle bio-waste can also be increased by supporting home composting. While the quantities of composted bio-waste at home do not currently count towards the official recycling rates (as home composting is not measured), home composting can decrease the amount of mixed municipal waste generated, which is measured. However, as home compost is typically not sold but used at source for private gardens and plants, generating too much home compost can sometimes end up in mixed municipal waste, which can end up in landfills. Support for home composting therefore needs to be carefully considered and promoted, primarily in homes where it can be used. In other instances, Hungary may want to prioritise industrial composting and the separate collection of bio-waste. Annex Box 5.A.9 provides an example of a successful home composting initiative that relies on the provision of free composter bins and on awareness-raising and educational materials to inform and educate households on home composting.

Redefining the policy approach for bioenergy production in line with the circular economy

Biogas production from agricultural wastes, landfills and wastewater treatment plants, which is then fed into the gas network after purification, may contribute to reducing natural gas imports and CO_2 emissions from natural gas consumption. This can also help meet renewable energy targets and the overall decarbonisation of the Hungarian economy. Even though the generation of renewable energy in Hungary (the major share of which is from biomass) is an important policy goal in the country, supported by relevant policy and targets, the treatment of biodegradable waste needs to follow the waste hierarchy and the cascading principle for the use of biomass and bio-based materials. Composting therefore needs to be prioritised over AD (which produces biogas), and AD over energy recovery. Moreover, a circular bioeconomy can only be achieved if there is a shift in focus from bio-waste treatment towards strategies aimed at higher levels of the waste hierarchy, i.e. bio-waste prevention and reduction, and the bioeconomy (OECD, 2022[59]).

Hungary will need to reconcile and possibly redefine its policy approach for bioenergy production to ensure the transition to a circular bioeconomy (this is also in line with the National Clean Development Strategy 2020-2050). This is because the bioenergy and bioeconomy goals are sometimes conflicting when they compete for the same biomass resources. The use of biomass for energy purposes is currently dominating the Hungarian policy landscape, which is not in line with the EU Circular Economy Action Plan nor with the European Bioeconomy Strategy. The circular bioeconomy may be favoured over bioenergy by setting an ambitious recycling policy or by adopting an integrated policy approach, which considers the interests of relevant sectors such as agriculture, forestry, soil preservation, energy production, nature conservation, and transportation (see the example of German's Ordinance on the generation of electricity from biomass in Annex Box 5.A.10). This redefined policy approach to using biomass needs to favour its use for materials use and recycling over energy use. Only when biomass or bio-waste cannot be used as a resource for bio-based applications or compost may it be used for energy purposes. Introducing such an approach may benefit from the development of a decision process for the use of biomass, which is based on a set of strategic priorities, including those suggested by the OECD on climate change mitigation, protection of the environment, energy security, economic stability and job creation (Philp and Winickoff, 2018[68]). As the integrated policy approach for biomass use involves a variety of different sectors and stakeholders, a coordination mechanism will also need to be in place (see section "Better cross-sectoral and multi-stakeholder cooperation, data collection and measurement").

5.4.5. Horizontal tools for facilitating the transition to a circular bioeconomy

To enable the implementation of identified policy recommendations along the life cycle of biomass and food, Hungary will also need to put in place several measures that cut across the entire biomass and food life cycle. These measures relate to raising awareness on the circular bioeconomy among companies and households, as well as educating citizens and municipalities. However, it also requires improvements in coordination and cooperation among relevant stakeholders, the capacity of business to innovate, and data collection and measurement.

Towards more effective education, awareness raising and skills

An educated, informed and skilled population can spur action towards a circular bioeconomy and help provide solutions to complex and interconnected challenges that are common in the circular economy. While the Hungarian policy framework identifies the need to introduce the basic principles of the circular economy and waste management into the school curricula (Waste Management Act CLXXXV of 2012), to raise awareness about food waste (Agri-Food Economy Strategy 2016-2050 and the National Food Chain Safety Office) and to support such initiatives financially through the EU funds, many challenges remain in this area in Hungary. The key challenges include: i) low awareness and understanding of the concepts around the circular economy and, in particular, the bioeconomy; ii) unsustainable food consumption

patterns and food waste reduction practices; and iii) a shortage of a highly skilled workforce in this area (in particular linked to innovation).

Hungary will need to improve the effectiveness of its education, information and training tools to raise awareness and improve the skills of its citizens, public entities and companies in the area of the circular bioeconomy. Hungary could start by focusing on the food waste generated by restaurants, canteens and mass catering services, which according to one consulted stakeholder, could be greatly reduced by awareness raising and education activities. Raising awareness and education can be done by showcasing successful pilot projects, initiatives and campaigns, but also by implementing targeted consumer campaigns and interactive events, thereby motivating changes in behaviour, attitudes and practices. International good practices provide numerous examples of tools targeting food waste prevention by companies and consumers, and bio-waste management, as well as better sorting of bio-waste by households and the use of date marking or marketing practices. Effective tools use insights from behavioural sciences and involve retail and food services, as well as social media influencers, providing a positive incentive (such as rewards) rather than a penalty. Annex Box 5.A.11 provides some examples of successful initiatives in Hungary and other European countries.

Incentivising innovation and circular business models for a circular bioeconomy

Innovation and the application of circular business models play an essential role in the transition to a circular bioeconomy. Innovation helps companies bring bio-based products and services with a higher value added onto the market and helps them compete in global value chains. Circular business models help the economy to reduce the extraction and use of natural resources and the generation of industrial and household wastes (OECD, 2019[69]). Despite various forms of support for innovation in Hungary, the innovation capacity of SMEs has not improved significantly in recent years. Hungarian businesses are characterised by a lack of forward planning and a general reluctancy to innovate, particularly SMEs. They are mostly engaged in low value-adding activities in global value chains, therefore, the share of domestic value added is low in Hungary, especially in manufacturing.[15] Companies involved in the biomass and food value chains face similar challenges.

Hungary will need to step up its innovation efforts in the biomass and food value chains, including the use of circular business models, by increasing the effectiveness of its existing technical and financial support for innovation in this area. The technical support may consist of better communication of information to companies about financing opportunities beyond conventional R&D grants, and helping them develop business plans of a higher quality that would help them secure external funding. According to some of the consulted stakeholders, access to finance and to business support is the key challenge that Hungarian companies face in the country. Business chambers, clusters and other organisations can play an important role in the dissemination and knowledge transfer of financing instruments that are available to SMEs, research organisations and educational institutions. Dissemination of examples of profitable business cases and innovative business models could also be a useful tool to draw the attention of entrepreneurs to the circular bioeconomy, particularly in the aquaculture and forestry sectors. Financial support may consist of a dedicated tax instrument to deduct additional investment costs. For instance, the Netherlands introduced two tax incentive schemes for investing in environmentally friendly technologies, which allow entrepreneurs to deduct additional investment costs on top of the regular investment tax reduction or to decide when to write off a part of the investment costs, which brings liquidity and interest benefits. Circularity indicators may also need to be introduced in the calls for funding to ensure that the funded projects effectively contribute to the transition to a circular bioeconomy.

Better cross-sectoral and multi-stakeholder cooperation, data collection and measurement

Cross-sectoral, cross-value chain and multi-stakeholder cooperation is at the core of a successful circular bioeconomy as actors active at the different stages of the biomass and food value chains need to work

together to meet common goals. Evidence from some European countries show that a common vision and joint actions are needed to build commitment to achieve the overarching goals and targets (OECD, 2022[59]). Monitoring progress towards targets also requires a solid base of evidence on the material flows and waste in the biomass and food area. This can help identify bottlenecks and the areas for improvement that policy makers need to address.

According to some of the consulted stakeholders, the biomass value chain is fragmented in Hungary as the different sectors along the biomass life cycle (primary production, processing, consumption and waste management) do not have a good insight and understanding of each other. Hungary also lacks a dedicated institutional steering and coordination mechanism between the different ministries to steer actors across the sectors and policies towards a circular bioeconomy. A circular economy platform has recently been established, which could support Hungary on its path towards greater cooperation in this area.

For the successful transition to a circular bioeconomy, Hungary needs to consider the establishment of a dedicated institutional steering and coordination mechanism between the different ministries and relevant organisations. The Ministry of Energy, responsible for the development and implementation of the national circular economy strategy, and the Ministry of Agriculture, responsible for developments in the national bioeconomy, should take the initial steps in this process. This entails defining the role of other governmental and non-governmental organisations. The development of a cooperation platform supported by public authorities, while encouraging actors to share good practices, could also lessen the fragmentation that exists in the biomass and food value chain.

With regard to monitoring and measuring materials and waste flows of biomass and food, reliable and more granular data collected for the different types of biodegradable wastes are needed for the efficient valorisation of these types of wastes. As in many other countries, these data are missing from the statistical databases and information systems, including from the National Environmental Information System (OKIR) or data series of the Hungarian Central Statistical Office (HCSO). One reason for their exclusion from official statistics could be the recycling of some of these wastes directly at source in agricultural processes, and thus these recycled wastes is statistically unaccounted for. Another reason is the low granularity of waste categories used for data reporting. For example, wastewater produced in the dairy industry can be very diverse in their chemical composition, pH, suspended solid material content or biochemical oxygen demand (Aleksza, 2018[70]). As a result, different uses or waste management technologies are required to process this waste category. However, statistical databases, including the OKIR database, include only the general waste categories for dairy industry wastes, which do not differentiate between industries. This does not allow for capturing information on the circular use of these wastes. The consulted stakeholders also pointed out that monitoring the volumes of food waste across the entire food production and consumption value chain would be essential for setting up a comprehensive food waste reduction system in Hungary.

Hungary will need to improve the existing monitoring and data collection system for biodegradable wastes. The country can start with monitoring and measuring food waste, as food waste reporting to Eurostat has become mandatory with the first reporting to the EC of 2020 data by mid-2022 (Delegated Decision EC/2019/1597 and Commission Implementing Decision (EU) 2019/2000). The amount of household food waste is precisely known in Hungary as it is monitored by the National Food Chain Safety Office (NÉBIH), including the quantities used for composting or animal feed. Improved data collection of biodegradable wastes can be enhanced by: i) improving reporting methodologies; ii) creating a waste catalogue containing multiple criteria, including waste compositional data, environmental impact and other sustainability indicators; iii) installing a competent authority for the collection, validation and public reporting of data; and iv) stimulating benchmarking, transparency and the levelling of information asymmetries across ministries and the value chain segments (OECD, 2022[59]). Hungary can draw on guidance documents developed by Eurostat on the reporting of data on food waste and food waste prevention (European Commission, 2021[71]) as well as the EU Platform on Food Losses and Food Waste (the sub-group on food waste measurement) (European Commission, 2016[72]).

5.5. Concluding reflections on the key policy recommendations

This chapter analysed the Hungarian policy context in the biomass and food priority area and the different policy instruments that could support its transition to a circular bioeconomy. The analysis identified areas for improvement, leading to a set of key policy recommendations (Table 5.1) that have been further developed into implementation actions (Chapter 8).

The findings show that there is considerable scope for the further development and application of several policy instruments across the biomass and food value chain, including regulatory and economic instruments, as well as information and educational tools to support this transition. In particular, there is a need to:

- Strengthen regulatory instruments to support a wider use of compost and digestate in agriculture and recycling of biodegradable wastes into high quality composts as well as introduce a mandatory separate collection of bio-waste, which is a crucial pre-condition for bio-waste recycling.
- Expand the use of economic instruments to provide economic incentives for innovation and investments in biotechnology and innovative bioeconomy applications for food donations as well as for better sorting of bio-waste.
- Enhance the effectiveness of existing education and awareness-raising tools, as well as skills by using insights from behavioural sciences, and targeted campaigns and training courses.
- Support cross-sectoral, inter-ministerial and multi-stakeholder cooperation to enhance innovation and align conflicting goals associated with the use of biomass according to waste hierarchy principles.

However, to accelerate sustainable consumption and production of biomass and food, the policy efforts in the long term will need to shift focus from waste management and recycling (composting and AD) towards strategies aimed at supporting the use of bio-based resources in agricultural practices and the development of the circular bioeconomy.

Table 5.1. Overview of gaps and policy recommendations by life cycle stage

Life cycle stage	Gaps	Policy recommendations
Primary production	Natural bio-based solutions for soil (i.e. compost and digestate produced from bio-waste and sewage sludge) are not sufficiently used in agriculture	Develop a regulatory framework to support the use of products from bio-waste (compost and digestate) in agriculture, with a focus on the quality assurance system for compost and digestate
		Investigate the potential to enhance the use of sewage sludges on agricultural land
	Initiatives for alternative protein production to animal protein production are not sufficiently supported	Consider policy support for alternative initiatives in the field of innovative protein production
Industrial processing and distribution	Lack of targeted support for research and innovation of the bioeconomy, including for the development of biorefineries and biotechnology as well as multi-stakeholder cooperation	Develop a dedicated bioeconomy research and innovation programme with associated funding and technical support to support the development of industrial biotechnology and biorefineries
Consumption	Lack of a supportive regulatory framework and economic incentives for food donations	Consider allowing food donations after food's "best before" date for food under specific conditions that is safe for consumers but cannot be sold, and consider introducing additional tax incentives
	GPP of food and catering services is not sufficiently supported	Promote GPP of food and catering services by developing a catalogue of good practices and guidance on GPP methodology or training materials for public authorities
		Consider implementing a form of mandatory use of GPP criteria in contracts
End-of-life	Separate collection of bio-waste is not sufficiently effective and in place	Provide additional incentives for the separate collection of municipal bio-waste through improving the waste collection infrastructure
		Provide additional economic incentives for the separate collection

Life cycle stage	Gaps	Policy recommendations
		of municipal bio-waste by supporting PAYT schemes and by increasing landfill taxes
	Insufficient recycling capacity for bio-waste	Strengthen financial support for bio-waste processing and recycling facilities to ensure adequate investments into recycling capacities
	Limited application of the cascading use of biomass, priority focus on bioenergy	Redefine the policy approach for bioenergy production to ensure its coherence with the transition to a circular bioeconomy
Horizontal tools	A low awareness and understanding among the Hungarian population about circular bioeconomy and its opportunities	Strengthen education, information and training tools to raise awareness and skills in Hungary in the area of circular bioeconomy
	Lack of interest in innovation and a lack of adequate technical and financial support for Hungarian companies	Improve the innovation capacity, particularly of SMEs, by making the existing technical and financial support more effective
	Lack of cross-sectoral and multi-stakeholder cooperation and data on material flows and waste in the biomass and food area that is more granular	Support cross-sectoral, inter-ministerial and multi-stakeholder co-operation across the entire biomass and food life cycle (e.g. by forming a dedicated institutional steering and coordination mechanism and by creating a platform to share good practices)
	No data on bio-based wastes that would provide sufficiently granular information	Improve the existing monitoring and data collection system for bio-based wastes to produce a highly granular understanding of these wastes

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Annex 5.A. Supplementary information

Annex Box 5.A.1. Concepts related to the circular bioeconomy

Green economy

The green economy is an umbrella concept that emphasises the lowering of environmental risks and ecological scarcities. The concept applies to low carbon, resource-efficient and socially inclusive economies.

Bioeconomy

The bioeconomy is part of the green economy. The bioeconomy relates to promoting global economic growth and technological development for primary production and industry, especially where advanced life sciences are applied to the conversion of biomass into materials, rather than focusing on limits to growth due to resource scarcity, depletion and population growth.

Bio-based economy

The bio-based economy is part of the bioeconomy and relates to converting biological resources into products and materials. Food and feed production usually involves processing agricultural goods, which enters into the bio-based economy.

Circular economy

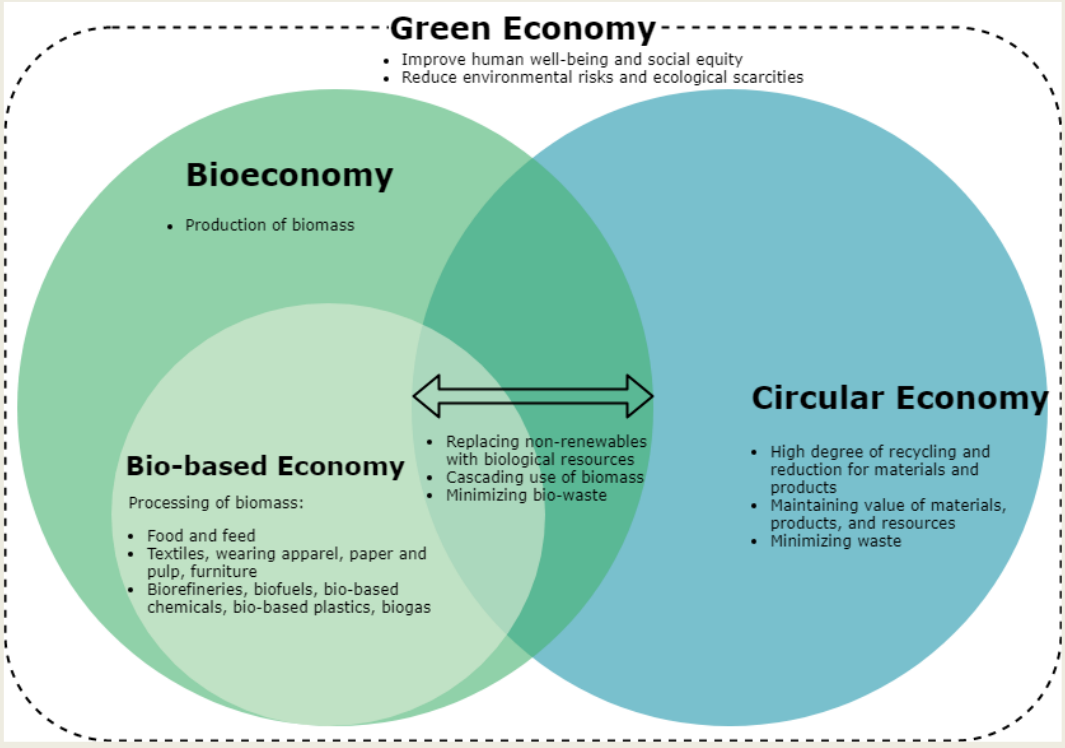
The circular economy relates to the use of products and materials that show the highest degree of recycling and lowest waste. That is, the linear production model “take, make and dispose” is replaced by a circular model in which waste products (disposed of in a linear model) are kept within the system. In this way, waste materials are drastically reduced, recycled and remanufactured. The concept of circular economy can be complementary to the bioeconomy.

Circular bioeconomy

The circular bioeconomy builds on the concepts of bioeconomy and circular economy. The circular bioeconomy refers to the economic activities in which biotechnology contributes centrally to primary production and industry. At the same time, waste materials are drastically reduced, and wastes are recycled and remanufactured and kept in the system for as long as possible.

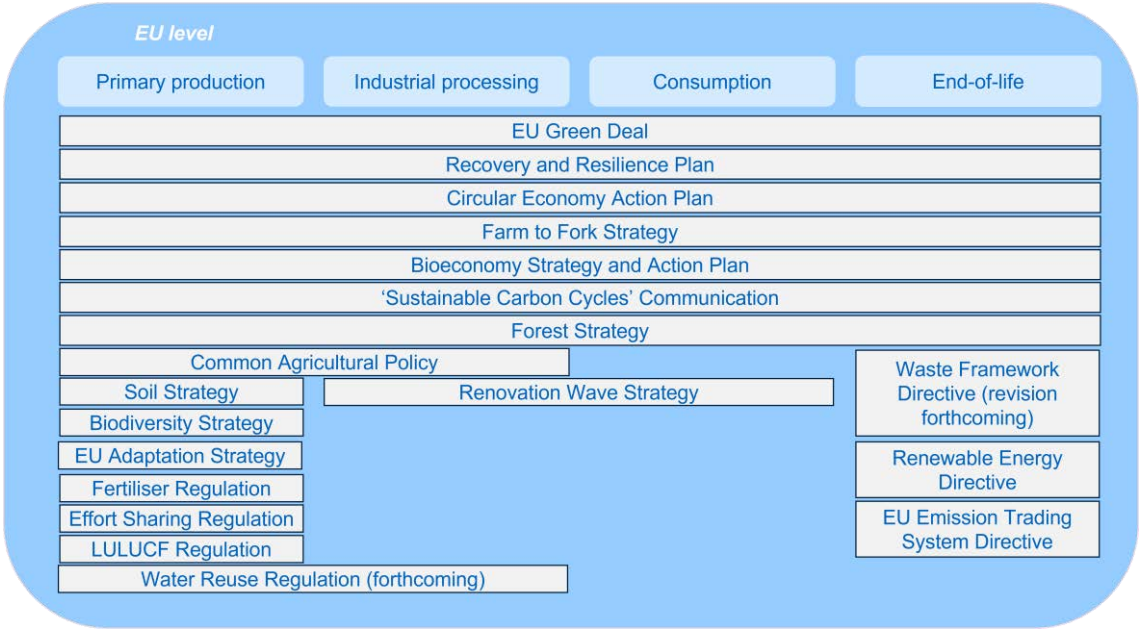
Source: Adapted from Kardung et al. (2021[73]) and Philp and Winickoff (2018[68]).

Annex Figure 5.A.1. Relations and overlaps between the concepts of green economy, bioeconomy, bio-based economy and circular economy



Source: Kardung et al. (2021[73])

Annex Figure 5.A.2. Overview of EU strategies, policies and legislative documents relevant to the biomass and food priority area



Annex Box 5.A.2. Examples of regulatory frameworks to support the use of compost and digestate

According to the EEA analysis, of the countries surveyed, 24 have national standards for compost quality, set either in legislation, stand-alone standards or are under development, while a few countries/regions have also developed quality standards for digestate (e.g. Denmark, Flanders [Belgium], Germany, Sweden and the United Kingdom) (European Environment Agency, 2020[47]).

Austrian waste legislation on compost products

Since 1995, Austria's Bio-waste Ordinance (FLG No 68/1992) requires the source separation and biological treatment of organic waste (primarily through composting and anaerobic digestion). The Compost Ordinance (FLG II No 292/2001) established the end-of-waste regulation for compost produced from defined organic wastes, as well as monitoring and external quality assurance obligations. In Austria, the aim has been to avoid recommending the imposition of excessive technical obligations to preserve the well-established decentralised, mostly on-farm composting systems. Since the early 1990s, this has been widely recognised as a sustainable bio-waste recycling system. Compost can be classified and marketed as a product in Austria, provided it meets certain quality criteria and has been processed from specific input ingredients. The minimum organic matter level of 20% (m/m) is one of the most important requirements, compared to artificial or dredged soils having substantially lower organic matter concentrations (Austrian Ministry for Agriculture and Forestry, 2009[74]).

A practical example of composting is the case of Freistadt (Austria), a town that set up a project in which local farmers can separately collect bio-waste from local towns, including both kitchen and canteen waste, as well as wood, tree and bush cuttings (EY et al., 2020[75]). This waste is then composted in simple composting facilities on their farms, with the farmers using the compost for their own use or sale. Key success factors include the supportive legal framework (e.g. mandatory training and requirement of a contract with the municipality) and the involvement of local stakeholders. This set up provides a new source of income for farmers through community activities in the services sector, promotes awareness in the public process and strengthens the regional employment situation. Reported data show a collection rate of 149 kg per capita per year, with 80% of the produced compost used in agriculture and 20% is sold to private customers.

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

Slovenia became one of the first countries to have introduced compulsory operations in the treatment of biodegradable waste and conditions for its use, as well conditions for placing treated biodegradable waste on the market (European Commission, n.d.[76]). The legislation on the recovery of biodegradable waste and the use of compost and digestate lays down the conditions for designing and operating biogas plants (e.g. applying for an environmental permit), the types of biodegradable waste that can be treated (listed in annex 1), the specific requirements for composting and anaerobic digestion, and the quality control (1st or 2nd quality class in accordance with annex 4) of compost and digestate, among others. The regulation prescribes that digestate must be further composted following anaerobic degradation (article 12), and that a quality control of the compost or digestate must be carried out by a company, public institution or private individual (article 14).

Germany's quality assurance system for compost and digestate

Since 1989, Germany has successfully run a quality assurance system (QAS) for compost and digestate made from bio-waste, which comprises a body (the Bundesgütegemeinschaft Kompost e.V., BGK) qualified to oversee the quality of compost and digestate and award a quality label. This quality

assurance organisation (QAO) was founded by composting plant operators in 1989 following the increasing uptake of separate bio-waste collection by German municipalities throughout the 1980s. BGK is an independent association that participates in the European Compost Network (ECN) and one of four national QAOs in the EU to have been awarded the ECN-QAS conformity label. It implements the quality standards which are set at national level by the German Institute for Quality Assurance and Certification (RAL). The costs of running such a QAS, including the process of on-site audits and sample analyses for quality assurance, are indirectly financed by waste management fees (Dollhofer and Zettl, 2018[77]).

Source: Adapted from OECD (2022[59]), European Commission (2021[78]) and other sources mentioned in the box.

Annex Box 5.A.3. Regulating the use of sewage sludge in agriculture – examples of practices

As part of the open public consultation on the evaluation of the Sewage Sludge Directive (86/278/EEC) from the end of 2020, the definition of "biosolids" has been proposed (i.e. treated sewage sludge-product, which underwent appropriate treatment processes, such as anaerobic digestion or composting, and meets high quality standards) as opposed to (untreated) "sewage sludge". The application of biosolids to agricultural soils represents a circular economy measure that helps counteract climate change and soil degradation while improving nutrient self-sufficiency. A system of quality assurance, including the regular review of limit values for pollutant and contaminant loads, is crucial for the use of biosolids in agriculture. Some respondents to this public consultation considered that quality standards should be harmonised across the EU . Emerging issues, which might require measures to address them at source, include risks associated with contamination from microplastics, hormonally active agents and pharmaceutical waste (ECN, n.d.[79]).

Germany

Germany is one of the largest producers of sewage sludge-derived compost in the EU. A decree (Klärschlammverordnung, AbfKlärV) passed by the German government in 2017 requires all wastewater treatment plants (WWTPs), the size of up to 100 000 population equivalent (and up to 50 000 in 2032), to recover phosphorus from sewage sludge and its ashes by 2029 (except if the phosphorus concentration is less than 2%). The regulation does not impose any technological requirement for nutrient recovery, leaving ample room for innovation. At the same time, the AbfKlärV aims to prevent pollutant leakage into the soil, tightening the conditions for the application of sewage sludge in agriculture and significantly reducing associated land use (Hudcová, Vymazal and Rozkošný, 2019[49]). However, overly strict regulations for the use of sewage sludge in agriculture may be less efficient in preventing soil pollution than removing obstacles to nutrients recycling (QDR, 2020[80]).

Austria

In Austria, the soil protection laws of the relevant federal state must be followed when using sewage sludge for agricultural purposes. For instance, the Lower Austrian Soil Protection Act and the Lower Austrian Sewage Sludge Directive both govern how sewage sludge is used in Lower Austria, where only quality classifications I and II (having low levels of heavy metal content) may be applied to soils. Sewage sludge can otherwise be turned into compost through biological treatment, which is regulated by the Austrian Compost Directive. The directive, which includes end-of-life criteria, distinguishes between high-quality sewage sludge compost that is approved for use in agriculture and sewage sludge compost, which may only be used for landscaping applications. Moreover, a certificate of origin is

required to attest the suitability of raw materials and product quality (Stürmer et al., 2021[81]). Nevertheless, the Federal Waste Management Plan draft of 2017 envisions the direct application to soil or composting of sewage sludge from wastewater treatment plants (WWTPs) with a size of 20 000 population equivalent or more to be discontinued. The draft legislation equally requires such plants to either recycle phosphorus on the spot (if the content is higher than 2%) or to recover it from sewage sludge ashes following mono-incineration (Hudcová, Vymazal and Rozkošný, 2019[49]).

Sweden

In July 2018, the Swedish government conducted an inquiry to formulate proposals for a ban on applying sewage sludge to soils. The main concern was to prevent hazardous substances, such as pharmaceutical waste and microplastics, from entering the environment. The 2018 inquiry also sought to replace the use of sewage sludge on land with alternative technologies for nutrient recycling. The inquiry's main proposal was a complete ban on sewage sludge land use and the requirement to recover at least 60% of phosphorus from WWTPs greater than 20 000 population equivalent (Forssell, 2020[82]). A complete ban on land use, however, would imply a significant shift in Sweden, where nearly one-third of the sewage sludge produced is used in agriculture. In early 2020, the inquiry's committee finalised the report and proposed that high-quality sludge be exceptionally allowed on agricultural land (Ekman Burgman, 2022[83]).

At the same time, a voluntary certification system for the use of sewage sludge in agriculture was developed thanks to the initiative of wastewater operators, farmers and the food industry. The REVAQ system, which started in 2002, provides stakeholders with information regarding the composition and end-use of sewage sludge, and sets guidelines for continuous quality improvements, such as by setting limits for the accumulation rate of trace metals in agricultural soil. After less than a decade, 65% of the sewage sludge applied to land and about 50% of the total sludge produced in Sweden originated from REVAQ certified plants (L'ons et al., n.d.[84]).

Ireland

In Ireland, the Sewage Sludge Directive was transposed into national law by the Waste Management (Use of Sewage Sludge in Agriculture) Regulations 1998, amended by S.I. 267 in 2001. Article 3 of the law restricts the use of untreated sewage sludge on agricultural land under specific circumstances. The Department of the Environment, Heritage and Local Government (DEHLG) "Codes of Good Practice for the use of Biosolids in Agriculture" contains best practices for the treatment and management of sewage sludge (FSAI, 2008[85]). These codes have no statutory basis, yet many local authorities follow them in practice (Cré, 2013[86]). For example, the requirement to provide a certificate of analysis ensures the traceability and quality of biosolid products (Kyne, 2021[87]). Furthermore, the National Wastewater Sludge Management Plan (NWSMP), published in 2016, includes measures covering, among others, the development of a quality assurance system and Standard Operating Procedures (SOPs), such as requirements for use on land, for sewage sludge and biosolids (Irish Water, 2016[88]).

Although most of the sewage sludge in Ireland is treated and used on agricultural land, Ireland's Environmental Protection Agency (EPA) expressed concerns about heavy metal accumulation in soils as well as emerging risks, such as microplastics and antimicrobial resistance development. The EPA thus advised that the revised Sewage Sludge Directive takes such aspects into account and ensures that appropriate legal requirements, monitoring and reporting systems be implemented (Derham, 2020[89]).

Source: Adapted from Hudcová, Vymazal and Rozkošný (2019[49]) and sources specified in the box.

Annex Box 5.A.4. Government promotion of sustainable food production in the Netherlands

The Dutch government promotes sustainable food production by encouraging food producers to take environmental and climate change impacts into account and by introducing two national policy agendas to accelerate the protein transition in the Netherlands (Geurts, Loenen and van Gelder, 2021[90]):

- The 2018 Transitie-agenda Circulaire Economie - Biomassa en Voedsel [Transition Agenda for Biomass and Food].
- The 2020 Nationale Eiwitstrategie [National Protein Strategy].

While the Transition Agenda for Biomass and Food focuses on significantly reducing animal protein consumption in the Netherlands, the National Protein Strategy has a more strategic ambition of reducing the Dutch livestock sector's dependency on animal feed imports.

In the Transition Agenda for Biomass and Food, the Dutch government set the targets to reduce the share of animal protein to 50%, and to reverse the current ratio to 40% animal protein and 60% plant protein in the longer term. Defining clear and long-term objectives for a protein transition creates a favourable investment environment for financial and other actors in the food supply chain, and helps them understand the direction and pace of the transition.

The National Protein Strategy proposes several concepts to support the advancement of a protein transition, including incentives for the development of alternative protein sources for food and feed production, such as microbial proteins, cultured meat or insects. According to the Dutch Ministry of Agriculture, Nature and Food Quality (MANFQ), 10% of proteins in livestock feed and 20% of proteins in human food could be replaced by insect proteins in the Netherlands by 2025 (Selten and Flach, 2021[91]).

As one of the main lines of action, the 2018 Transition Agenda states the importance of circular protein measures to be financed, scaled up and commercially implemented. For example, the agenda suggests that funding for such initiatives and the start of pilots for scaling-up and behavioural change come from banks, investors and multinationals working with start-ups. Collaborative funding initiatives between researchers, primary producers, companies and potential investors could stimulate innovation to help drive the protein transition. This example highlights the programme of the Regio FoodValley, a "Hub for Insect Knowledge" created by the government, in which eight municipalities in Gelderland work together with local partners in the food supply chain, from primary producers to local retailers, to facilitate the uptake of insect proteins for food and feed production.

Annex Box 5.A.5. Incentives for the bioeconomy

Support for the bioeconomy in the Netherlands

The Netherlands is one of the frontrunners in promoting the bioeconomy, having adopted its first "Government vision on the biobased economy in the energy transition" in 2007. The Dutch government offers support in the form of grants, tax benefits and credits to innovative businesses in the agri-food, life-sciences, health, energy and chemical industries. It primarily serves as a facilitator in networks of commercial and non-governmental organisations and provides R&D funding, mostly through labour-related tax reductions, for the development of biorefineries and associated technology (Langeveld, Meesters and Breure, 2016[92]). In particular, innovation and market development are supported by platforms such as TKI Biobased Economy (TKI-BBE), which provides financial assistance to initiatives (TKI-BBE, n.d.[93]), or so-called "Green Deals" for the bioeconomy, in which government supports innovative projects through the removal of non-technical barriers, such as those posed by legislation or a lack of market incentives (Government of the Netherlands, 2016[94]). Many regional schemes in support of bio-based industries have also emerged and mostly focus on the final stages of the innovation cycle and regional market development (Langeveld, Meesters and Breure, 2016[92]).

German bioeconomy strategy

With the National Bioeconomy Strategy adopted in January 2020, the Federal Government of Germany defined the guidelines and goals of its bioeconomy policy and specific measures for its implementation. The overarching goal is to transition from an economy predominantly based on fossil raw materials to a sustainable, circular bio-based economy (Federal Government of Germany, 2020[95]). Research and development are recognised as key drivers for tapping into and exploiting the potential of a sustainable bioeconomy. Small and medium-sized enterprises (SMEs), in particular, play an important role for new biological knowledge and advanced technologies. In order to strengthen their innovation potential, the Federal Ministry of Education and Research (BMBF) launched the KMU-innovativ: Bioökonomie funding scheme in May 2020. The scheme supports SMEs carrying out technologically demanding, high-risk projects that combine biological knowledge with innovative solutions (Projektträger Jülich, 2020[96]). Overall, within the National Bioeconomy Strategy framework, a total of six federal ministries supports the development of a bio-based economy in Germany. There are also numerous funding opportunities at European level, as well as research funding offered by federal states, all of which are listed on a dedicated government website (bioökonomie.de, n.d.[97]).

Italy's Bioeconomy Strategy and Implementation Action Plan

With an annual turnover of EUR 345 billion and 2 million employees, the Italian bioeconomy is the third largest in Europe after Germany and France. In 2017, the Italian government promoted the development of a national Bioeconomy Strategy (BIT), revised in 2019 (BIT II), to better integrate different sectors, policies and investments relevant to the bioeconomy, and to increase coordination between national and regional authorities. The Implementation Action Plan (IAP) (2020-2025) for Italy's Bioeconomy Strategy envisions specific actions to realise the national bioeconomy's potential, including measures aimed at strengthening the public-private partnerships that sustain it. Examples of priority actions include the launching of pilot projects to promote circular bioeconomy development at the local level and the identification (through stakeholder consultation within thematic "National Technology Clusters") of flagship investments, such as for the reconversion of oil refineries and industrial sites into new and advanced biorefineries, and their integration within regional agricultural and bio-based value chains. This could mobilise a total of EUR 2 billion in the short term. Finally, the IAP includes an analysis of regulatory bottlenecks and proposals to overcome the bottlenecks, which is a necessary step to support initiatives for the bioeconomy in the country (CNBBSV, 2021[98]).

Support through the EU funds in the Netherlands

As part of the European Regional Development Fund (ERDF) Operational Programme West Netherlands 2014-2020 (European Commission, n.d.[99]), a sub-ceiling of EUR 451 750 has been set for the Bio-based Industries Incentive Scheme. It is a voucher-based scheme aimed at supporting innovative SMEs, with a specific focus on industrial biotechnology and bio-based industries to further develop and scale up their products and production processes.

Three different types of vouchers are available and can be applied for separately or in combination:

- The establishment voucher, which can be used to pay rent or to set up an office or lab.
- The growth voucher, used to receive support for growing a bio-based business case, including research to address techno-economic bottlenecks or support in pre- and piloting phases.
- The pilot voucher, used to scale up a bio-based business case.

Applications are open to SMEs (based in an EU Member State) that intend to establish themselves at Planet B.io (a foundation that works to attract innovative companies, mainly start-ups and scale-ups, by placing them in an open innovation hub) or the Bioprocess Pilot Facility (an independent public pilot facility), both of which are located in Delft at the Biotech Campus Delft, an innovative business park focused on industrial biotechnology and bio-based industry (Municipality of Rotterdam, 2021[100]).

Annex Box 5.A.6. Supporting food donations

Economic incentives for food donations in Italy

Italy has a long history of economic incentives for food donations. Food donations are among value added tax (VAT) exempted activities and can be partly deducted from taxable income (Busetti, 2019[101]). In addition, the Good Samaritan Law states that non-profit food rescue organisations are responsible for the safety of donated food, which has freed donors from liabilities after their donations (European Commission, 2020[60]). Donors had remained responsible for the production and manufacturing phases and had to donate safe products, but they were legally protected if the non-profit organisations misused their donations. Further, this law eliminated several bureaucratic burdens for non-profit organisations, as they were considered as consumers rather than professionals in terms of food donation activities. Most notably, two measures (the streamlining of bureaucratic procedures and the possibility of donating food after the “best before” date) are often mentioned as fundamental improvements to the food donations process.

In 2018, Milan implemented a tax deduction (set at 20%) on food donations made to redistribution organisations. The businesses benefitting from this tax deduction must report to the municipality on the amounts of donated food. The action involved different departments of the municipality, creating a multi-sectoral working group. The measure also supported the mapping, strengthening and spreading of ongoing initiatives on food donations in the city, led by non-profit organisations.

Economic incentives for food donations in some EU Member States

Some countries (e.g. Austria, Denmark, Germany, Italy and Slovenia) consider the monetary value of donated food to be close to its “best before/use by” date and thus has low or zero value, equating to a very low or no VAT payable on the donated food (irrespective of the original value of the food product).

Some countries offer corporate tax credits on food donations (e.g. 60% in France and 35% in Spain 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).

Others 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, limited to 0.008% of the donor's turnover).

Source: Adapted from OECD (2022[59]), European Commission (2017[61]) and EU Platform on Food Losses and Food Waste (2019[102]).

Annex Box 5.A.7. Examples of Green Public Procurement practices in the provision of food and catering services

Green Public Procurement (GPP) for sustainable diets in Scotland

East Ayrshire Council in Scotland used the GPP of food and catering services to shift food consumption towards more sustainable diets in schools (European Commission, 2012[103]). The objectives of introducing GPP were to transform the menus on offer to reduce processed food, use fresh ingredients and ensure good nutritional standards.

The procurement included technical specifications around the supply of food products and services, including the need to provide organic certification, to comply with animal welfare standards and hazard analysis and critical control points (HACCP) systems, or to provide clear details of food sourcing and production and transport arrangements. Bidders were then awarded based on multiple criteria, including the net price, the ability to supply by the deadline, the quality and range of food products, food handling arrangements and facilities, and the use of resources (e.g. the supplier's reduction in environmental impacts or waste, recycling and composting, etc.).

As a result of applying these GPP criteria, 90% of food used was unprocessed and fresh and 30% was organic. In addition, research into the "social" return on investment indicated that for every GBP 1 spent, up to GBP 6 returned to the local community through employment and environmental, health and social benefits. At least 70% of the food supplied was sourced locally, although this was not a requirement under the tender. The uptake of school meals also increased in the council area since the GPP was introduced in school canteens, while the national trend has been the opposite.

GPP for organic food in Denmark

The conversion to organic food in Danish public kitchens started in childcare centres and schools (IFOAM, 2020[104]). Currently, it covers all types of public institutions, ranging from hospitals, senior homes and city halls to ministry canteens, military barracks and prisons. A key turning point came in 2012 when the Danish Government launched a new "organic public procurement" strategy. The goal of the strategy was to improve the quality of meals, reduce climate emissions and increase the organic farming area.

The success of the initiative was based on four public policy initiatives (procurement goals, financing, labelling, and NGO capacity building) and three "organic" sector initiatives (supply chain collaboration, "organic" schools for food services, and education for kitchen workers). The goal of the national government was to achieve a 60% use of organic food in all public institution kitchens ("public kitchens"). In addition, the government provided EUR 4 million annually to finance education in the public kitchens. Education was needed because the shift towards organic food was not only a replacement of

conventional food with organic food but a complete change in purchasing, food preparation, meal planning and waste reduction. Furthermore, capacity building in the "organic" sector was also financed by public funds, which allowed for intensive collaboration with the food service industry as well as with trade unions representing kitchen workers and other stakeholders.

The development of the Danish label for organic cuisine was a key motivation for kitchens, as acquiring this label was considered a "point of pride", which was highly motivating for workers and leaders interested in branding. The labelling model has now also been adopted in Norway and Germany.

As a result of organic public procurement, sales of organic food have increased in private food services, such as restaurants, hotels, catering and canteens serving private employers. This has resulted in a five-fold increase in sales of organic food in the food services sector over a period of 10 years. This market signal, and value chain collaboration on sourcing of organic products in Denmark, has been a significant contributing factor to the 70% increase in organic farming area in this same period. Active organic policy, and the positive influence on private food services, has rapidly expanded uptake for the national Organic Cuisine Labels, which are available for 30%, 60% and 90% total share of organic food. Today, more than 3 300 kitchens have labels for organic cuisine.

Barriers, such as a potential violation of EU rules, or costly and bureaucratic paperwork, were addressed and removed. In the first case, a mobile public procurement team assisted procurement managers at all levels. The costly and bureaucratic paperwork was resolved by introducing a national exemption from all fees for the inspection of the Organic Cuisine Label and by providing kitchens with a tool to calculate the percentage of organic food used, which is required for the organic label.

Annex Box 5.A.8. Door-to-door collection systems for bio-waste in Italy

Door-to-door collection in Milan

In 2011, Milan (Italy) introduced the separate collection of municipal food waste for composting and anaerobic digestion, covering 1.4 million inhabitants (European Commission, 2020[105]). Brown bins and compostable bags are used for collection, while small 10-litre kitchen bins (with a special airy structure to minimise the inconvenience of odours and liquids) are used in apartments. Collection frequency is twice a week (Circular Economy Europa, n.d.[106]).

Milan's waste management system is increasingly a door-to-door system. The introduction of this system has been the main driver, pushing up the overall recycling rate for municipal waste from 35% in 2011 to 52.5% by January 2015 (European Commission, 2021[78]).

In addition to providing convenient infrastructure, other success factors include the comprehensive communication to citizens (before and after implementation of the door-to-door collection for food waste) and the focus on the quality of the collected streams, i.e. a transparent bag to help inspect the contents of residual waste, quality controls by 24 trained staff, and sanctions in case of irregularities (European Commission, 2020[105]). The customer satisfaction survey in 2014 showed that 79% of the citizens had found the organic waste collection to be efficient.

Door-to-door collection and the pay-as-you-throw (PAYT) scheme in Parma

In 2012, the Italian city of Parma collected waste separately through large roadside containers (Ricci, 2020[67]). Since 2014, the inhabitants of Parma have had their waste collected door-to-door. In addition, a PAYT scheme was introduced. The fee for every household is composed of two main elements: a fixed part based on the number of household members and the size of apartment, and a variable part

that essentially depends on the amount of residual waste generated and home composting. The fixed part already covers a minimum number of collections of residual waste per household, which is intended to cover the fixed costs of managing the system and, concurrently, to prevent dumping and littering. In terms of positive incentives, households get a 12% reduction in their fee if they do home composting.

Following the introduction of the door-to-door collection and the PAYT scheme, sorting has doubled, to almost 100 kg per capita. This figure also includes kitchen bio-waste from restaurants and canteens, which represents about 20%. In addition, the level of contamination fell from 8.3% to 3.3%.

Annex Box 5.A.9. Supporting home composting

Home composting programme in Spain

Vázquez and Soto (2017) analysed the efficiency of home composting programmes in eight rural areas in three councils in Spain (2017[107]). The study evaluated the quality of the produced compost, carrying out home composting programmes (up to 880 composting bins) for all household bio-waste, including meat and fish leftovers. The efficiency was evaluated in terms of reduction of organic waste collected by the municipal services.

The programme included the initial provision of composter bins to households for free. Furthermore, the programme was accompanied by awareness campaigns and training programmes. In addition to the composter bin, a small home composting manual was given to the users, which recommends composting all bio-waste, including the remains of fish and meat. The educational manual explained both the composting process and the management of waste in general, as well as the related ecological and environmental aspects.

An efficiency of 77% on average was obtained, corresponding to 126 kg of bio-waste per person per year. High quality compost was obtained, as indicated by the low carbon to nitrogen (C/N) ratio, low contaminants, low heavy metal content and high nutrient content.

Annex Box 5.A.10. Ordinance on the Generation of Electricity from Biomass in Germany

In Germany, biomass use in bioelectricity is regulated through the Ordinance on the Generation of Electricity from Biomass (Wageningen Research, Bay Zoltan, AKI, 2020[108]). The ordinance helps prevent conflicts between bioenergy generation, food security and biodiversity by classifying energy crops, such as maize and sugar beets, in the group of substances with a lower tariff, thereby stimulating the processing of non-food substances.

The policy package in Germany, and not only the biomass ordinance, is a good example of how a regulation can evolve in time from overall wide support to bioenergy production without insisting on very strict requirements on efficiency and type of biomass use. Instead, stricter requirements are put in place for energy efficiency and higher feed-in premium support for the bioenergy and heat produced from more sustainable biomass types, particularly those with no or low indirect land use change impacts.

Annex Box 5.A.11. Examples of education, information and training tools

Practices to improve education about the circular bioeconomy

- The Green-Schools programme in Ireland works with primary and secondary schools across the country. It is operated and coordinated by the Environmental Education Unit of An Taisce (an independent charitable voice for the environment and for heritage issues) (Green-Schools, n.d.[109]).
- The first national Environmental Education (EE) act in the Netherlands was passed in 1988 and the first multi-year environmental education action programme was initiated in 1992 (GEEP, n.d.[110]). The Netherlands released two separate policies: one for EE and one for Education for Sustainable Development (ESD). National policy also supports new forms of monitoring and evaluation for the country's prominent EE programmes, such as Groen Gelinkt (GroenGelinkt, n.d.[111]), an online search system that allows educators from primary and secondary schools and afterschool programmes to locate EE resources by topic and audience. The "Duurzame PABO", a nationwide sustainability network, offers support for schools in initiating sustainability projects and also supports environmental educators by offering professional learning opportunities through conferences, lectures and workshops, newsletters with tips and activities, and online resources.

Awareness-raising practices

- Campaigns launched by large food retailers to save "ugly food" (Tesco, 2022[112]).
- The "money thrown in the window" [Ablakon Bedobott Pénz] programme in Hungary was launched in 2002 by KÖVET, an association of environment-focused consulting companies, to encourage the dissemination of good practices through an award for environmental performance, including on waste management and resource efficiency. Its aim is to prove that environmental measures and the economy are mutually beneficial (OECD, 2018[11]).
- The Italian city of Treviso introduced a PAYT scheme in 2014 (Zero Waste Europe, 2018[113]). When adopting the PAYT scheme, the city also prepared a well-developed and targeted communication campaign for residents (Bucciol, Montinari and Piovesan, 2011[114]). The communication campaign included emotive and engaging posters displayed in public spaces and shops, technical and specific leaflets and booklets for households explaining the new waste collection system in detail, and public events and meetings with residents in order to respond to questions and concerns.
- In the Italian region of Apulia, the door-to-door collection system is widely used in municipalities, achieving sorting rates of more than 80%. The implementation of this system was preceded by an information campaign on television and social media as well as physical events to explain the meaning and functioning of the system to the inhabitants. In the city of Altamura, a survey was designed to evaluate the effectiveness of the systems from the citizen's point of view (Laurieri et al., 2020[115]). The results of the study showed that citizens are more motivated to collect separate waste fractions when they have information about subsequent environmental benefits and the outcomes of the fractions collected, and when there are greater controls on the quality of the sorted waste fractions.
- In the Swedish city of Malmö (Beyon Food Waste, 2018[116]), the introduction of separate collection of kitchen bio-waste was accompanied by an information campaign. First, the target audience was analysed and then their messages were displayed on buses, at the cinema, and in ads and newspapers. In terms of activities, several owners of multi-family properties were personally visited and given advice. In 2018, the average amount of sorted food waste

amounted to 51 kg per person per year, accounting for a 47% rate of waste separation. The collected food waste is then treated in the biogas plant and used as fuel for the city's buses and garbage trucks.

Improving skills

- Training and workshops are offered by several networks, partnerships and research projects (e.g. the European Bioeconomy Network [EuBioNet] or the European Bioeconomy University within the context of the Erasmus+ programme).
- Covar 14, a public waste management company in Piemonte (Italy), has promoted home composting in rural areas through awareness campaigns, compost training courses and a financial discount of 20% on waste taxes for families joining the composting programme.

Notes

[1] "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; (e) cosmetics; (f) tobacco and tobacco products; (g) narcotic or psychotropic substances; (h) residues and contaminants (EC/2002/178) (European Parliament and the Council, 2002[2]).

[2] Latest available data corresponds to the latest data available from each sector: 2019 for agriculture, 2016 for fisheries and aquaculture and 2017 for forestry (European Commission – Joint Research Centre, n.d.[12]).

[3] The share of biomass use excludes biomass losses across biomass flows, for which a specific use cannot be estimated in the current statistical system.

[4] The Hungarian food industry's most relevant segments include meat processing and preservation; mineral water, soft drinks and other beverages; pet food and feed production; milk processing and dairy products; sweets, snacks, convenience and other foods; and fruit and vegetable processing and preservation (Hunyadi Borbélyné et al., 2020[120]).

[5] According to the national accounts employment data by industry, the percentage of the total workforce employed in 2020 in the country in economic activities called "manufacture of food products, beverages and tobacco products" and "manufacture of wood and of products of wood and cork, except furniture" was 2.7%, and 0.4% in "manufacture of articles of straw and plaiting materials" (Eurostat, n.d.[27]).

[6] There is no reliable and sufficiently detailed data about the different types of bio-based wastes broken down by their origin in Hungary, nor are there sector-specific industrial data about food and food industry wastes.

[7] Hungary is currently developing a bioeconomy policy strategy.

[8] According to Decree 23/2003 (XII. 29.), bio-waste reused for recultivation purposes cannot exceed 500 tonne/hectare of stabilised dry-matter. This decree also provides the list of wastes that can be used for composting as well as their respective waste codes.

[9] According to the Government Decree 50/2001 (IV. 3), which regulates the agricultural applications of wastewaters and sewage sludge, untreated wastewater and sludge cannot be put to agricultural uses. Sludge cannot be used for growing fruit (that grows close to the ground) and vegetables nor can it be used if the concentration of toxic materials is above a certain percentage (see annex 1 and 2 of the Decree).

[10] Composting and anaerobic digestion (AD) may be carried out as mutually exclusive processes. AD produces biogas 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[117]). 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.[119]). 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[47]). 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[118]).

[11] Using an average conversion rate of HUF 319 to EUR 1 in 2018 reported by the Hungarian National Bank.

[12] Using an average conversion rate of HUF 296 to EUR 1 in 2013 reported by the Hungarian National Bank.

[13] Using an average conversion rate of HUF 311 to EUR 1 in 2016 reported by the Hungarian National Bank.

[14] Using a conversion rate of HUF 399 to EUR 1 in September 2022 reported by the Hungarian National Bank.

[15] The National Smart Specialisation Strategy (S3) 2021-2027 uses the OECD "Trade in Value Added" (TiVA) indicator, measuring the value added of countries in their external trade, to present Hungary's position in global value chains. Based on this indicator, the domestic value added in total Hungarian exports fluctuated between 52% and 56% between 2005 and 2016, which is lower than in the Czech Republic, for example, where the rate was above 60% in this period.

6 A circular transition for construction

This chapter develops policy recommendations to support the transition to circularity in Hungary's construction priority area, with a specific focus on buildings along all stages of their life cycle. It provides an overview of the current situation and policy framework in the country and identifies potential areas for improvement, putting forward a set of concrete policy recommendations. These recommendations are enriched with findings from international good practices.

6.1. Circular economy opportunities in the construction industry

Construction covers economic activities related to creating, renovating, repairing and extending buildings, infrastructure and industrial facilities (OECD, 2013[1]). Construction activities play a significant role in the economy, with the performance of the industry indicating a country's level of economic development (OECD, 2019[2]).

6.1.1. Construction is one of the largest consumers of raw materials and energy

The construction industry is one of the world's largest consumers of raw materials and producers of waste. Close to half of all raw materials extracted globally are used for the built environment, with about 3 billion tonnes used in buildings construction every year (World Economic Forum, 2016[3]). At the same time, the industry is responsible for nearly one-third of all waste generated globally, more than two-thirds of which is discarded without further recovery and reuse (World Economic Forum, 2016[3]).

Construction is also the largest energy-consuming sector and an important emitter of carbon dioxide (CO_2). In 2020, the share of buildings accounts for nearly 40% of global final energy consumption and a similar share of energy-related CO_2 emissions (UNEP, 2021[4]).[1] Additionally, processes related to production, transport and the use of building materials, in particular, cement, concrete and steel, account for an ever-growing CO_2 footprint of buildings (IRP, 2020[5]; Material Economics, 2018[6]).

Driven by population growth and urbanisation, the construction industry will continue to significantly influence the demand for raw materials globally, further exacerbating its environmental impact. The industry therefore needs to enact transformational changes and move towards new ways of sourcing, consuming and managing end-of-life resources within its operations.

6.1.2. The circular economy offers opportunities to reduce the ecological footprint of construction

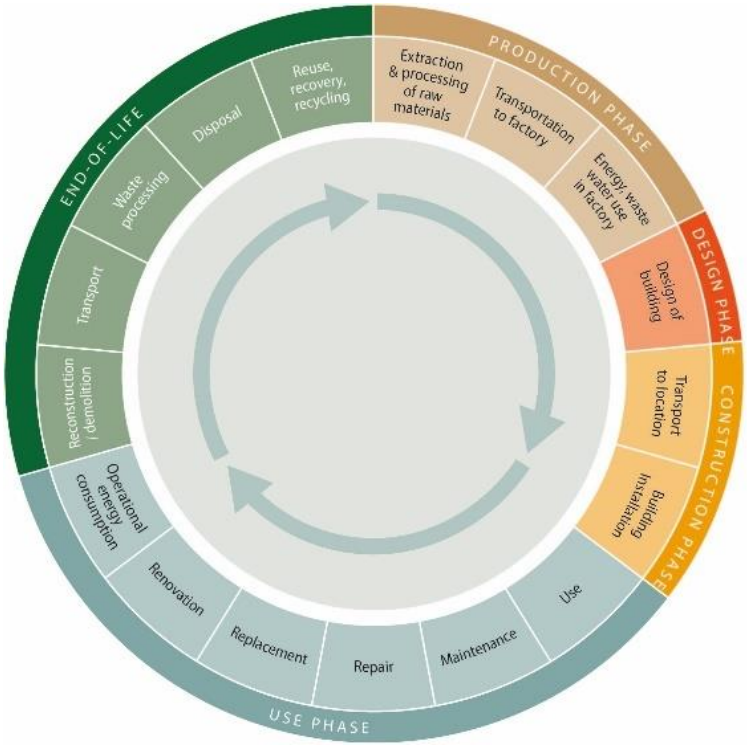
The circular economy offers several opportunities for transforming construction into a more sustainable industry. Applying the concept of circular economy to construction, and to buildings in particular, leads to a new understanding. A "circular building" is one that is developed, managed, used and reused without the unnecessary depletion of resources, environmental pollution and the degradation of ecosystems. A circular building is built in an economically responsible manner, contributes to the well-being of humans and the biosphere, and allows for the disassembly and reuse of technical elements, as well as bringing elements back into biological cycles at the end of its (extended) lifespan (adapted from ARUP (2016[7]) and Circle Economy, DGBC and Metabolic (2018[8])).

Although buildings are by definition not circular, reshaped approaches along life cycle stages can lead to their circular transformation. The life cycle stages of circular buildings (illustrated in Figure 6.1) pertain to the following circular economy principles (ARUP, 2016[7]; Circle Economy, DGBC and Metabolic, 2018[8]):

- **Production of construction materials.** The sourcing of virgin materials for the production of building materials is reduced to a minimum and substituted with secondary raw materials (such as reused materials or components, recycled materials and bio/renewable materials), with priority given to local sourcing. Production includes material extraction and domestic material consumption of construction materials.
- **Design of buildings.** The design of buildings is conceived within a long-term perspective, which considers both modularity and adaptability criteria as well as energy-efficient principles that minimise externalities. Operation and performance are embedded in the design and its processes, while open-source architectural design techniques allow designers, architects and engineers to distribute design ideas and build on each other's work.

- **Manufacturing of construction components and construction of buildings.** The process of construction accommodates more flexibility, enabling easy remodelling of buildings during renovation and easier disassembly at the end-of-life stage. Off-site manufacturing and prefabrication help eliminate waste from construction sites. Transportation of construction materials prioritises distance over price. Novel techniques, such as 3D printing, allow for the production of construction materials, components or even entire buildings at high accuracy and flexibility in design, time efficiency, lower cost and material waste production, with use of resins and substrates made from renewable or reusable materials.
- **Use of buildings.** The life of the building is prolonged through the use of internal circular resource cycles, such as waste capture and filtering, or net-energy production. Users of circular buildings lease 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. Flexible use and sharing of buildings optimise use and occupancy rates.
- **End-of-life of buildings and new lifetime of components and materials.** The demolition of buildings is minimised and mostly limited to old and inefficient building stock. New design approaches allow easy access to building services and include demountable and reconfigurable systems. Systems or models, such as Building Information Modelling (BIM) supported by Digital Product Passports (DPPs), helps to expand, contract or redesign buildings as well as to reconstruct and deconstruct them. Cloud-based BIM models offer an opportunity to collaborate remotely and with more stakeholders. The lifetime extension of construction materials, products, components and even whole buildings is achieved through reuse, repurposing, refurbishment, recovery and recycling. These approaches maximise the value of elements in use, thereby minimising the demand for virgin raw materials.

Figure 6.1. Construction life cycle phases and the circular economy



Source: Adapted from Circle Economy, DGBC and Metabolic (2018[8]).

To help increase the circularity of buildings, several circular economy strategies can be rolled out along the construction life cycle. Strategies based on using renewable and secondary raw materials during production, design for disassembly, extension of a building's life through renovation, and the reuse of materials and components at buildings' end-of-life contribute to unlocking the potential in materials as well as cost and resource savings throughout the entire life cycle of a building. Circular economy strategies also contribute towards mitigating environmental pollution and the degradation of ecosystems, while achieving the goal of net zero emissions.[2] For circular strategies to be effective in disrupting linear practices, new innovative business models and enabling policies are required.

6.2. Role of construction in Hungary's economy

6.2.1. Construction plays a significant role in the Hungarian economy

Construction is an important industry in the Hungarian economy. It represented almost 6% of the country's GVA in 2020 (up from just above 4% in 2010) (Hungarian Central Statistical Office, 2022[9]). The industry's output grew by 13% between 2020 and 2021, with growth rates in buildings at 17% and civil engineering at 9% (Hungarian Central Statistical Office, 2022[10]). Although employment within the broader industry[3] has also grown since 2010, and is currently at about 5% (European Construction Sector Observatory, 2021[11]), the industry has been facing severe shortages in skilled labour (Institute for Economic and Enterprise Research, 2019[12]). SMEs employed almost 92% of total persons employed in the broader industry in 2018, highlighting the prominence of SMEs in the industry (European Commission, 2021[13]). The Hungarian housing market has also seen a continuous increase in prices for almost a decade, reflecting a surge in demand for self-owned apartments and houses. This trend has been driven by rising disposable incomes, urbanisation, falling interest rates as well as certain government measures (European Construction Sector Observatory, 2021[11]).

6.2.2. Hungary's domestic material use is expanding and is dominated by construction minerals

Hungary's economic growth over the past decade has been accompanied by a huge expansion in the use of materials. Of the construction materials used, non-energy minerals extracted domestically include aggregates (such as sand, gravel, building and dimension stone) and industrial minerals (such as raw materials for cement, lime and the ceramic industry, as well as silica sand, gypsum, perlite, zeolite, diatomite and bentonite). In contrast, Hungary's metal mining has been in decline for decades, with only bauxite and manganese ores currently mined in the country (MinPol, 2017[14]). To satisfy domestic demand, Hungary relies heavily on materials imports (as discussed in chapter 2). In 2016, about one-third of materials used domestically were imported (OECD, 2018[15]).

Hungary's domestic materials consumption per capita (30 kg per person per day) ranked below the OECD Europe average (35 kg per person per day) in 2016 (Eurostat, 2022[16]). Following a downturn between 2008 and 2012 due to the economic crisis, the growth in the country's domestic materials consumption has resumed, as has the consumption of construction minerals (OECD, 2020[17]). At 96 000 tonnes, construction minerals represent almost 43% of materials consumed by the Hungarian economy – a share comparable to the OECD average (OECD, 2020[17]).

6.2.3. Construction output has been increasing, yet the country's residential building stock remains outdated

The value of production in construction in Hungary has been growing year on year.[4] This value in 2020 was approximately EUR 8 720 million, having more than doubled in the course of a decade (with EUR 4

270 million in 2010).[5] The split between buildings and civil engineering has remained roughly equal over time (with respective shares of 57% and 43% in 2020 compared to 50% and 50% in 2010) (Hungarian Central Statistical Office, 2022[18]).

However, the country has an ageing stock of residential buildings. There were more than 3.7 million residential dwellings in Hungary in 2021, with a total floor area of approximately 274 million square metres (m^2). The country's residential building stock (a 96% share) is dominated by single-occupancy or terraced houses (with 1 to 3 apartments). However, nearly one-quarter of housing stock was built before 1945. One-half was built between 1946 and 1980. Houses built after 2001 represent only about 8% of the total stock (Ministry for Innovation and Technology, 2021[19]). The housing stock is therefore in urgent need of renovation. Although the renewal rate of residential building stock is increasing, it remains low at around 1% (compared to the annual renovation target of 3% of total housing stock by 2030 (Ministry for Innovation and Technology, 2021[19])).

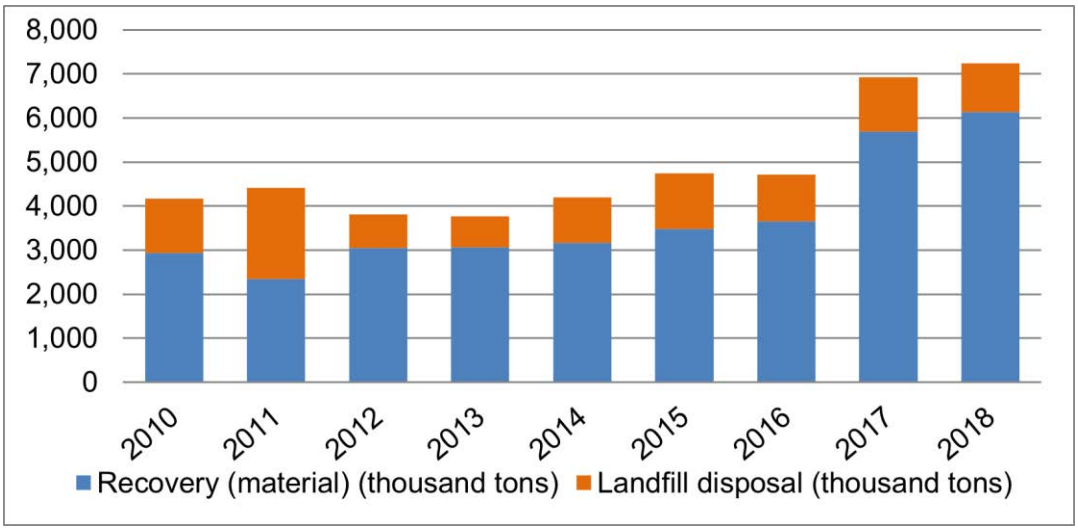
Public buildings are owned by the Hungarian State and local governments (and managed by the Hungarian National Asset Management Company), as well as by churches and private owners. Between 2011 and 2019, 780 new properties were built, most of which were office and commercial buildings (Ministry for Innovation and Technology, 2021[19]).

6.2.4. Growth in the construction industry is fuelling the surge in Hungary's waste generation

The construction industry was responsible for about one-third of Hungary's total waste generation (Eurostat, 2020[20]).[6] Driven by expansion of the construction industry, by nearly 30% in 2017 (Hungarian Central Statistical Office, 2022[9]), the growing amount of construction and demolition waste (CDW) has been the main contributor of total waste generated in Hungary. CDW grew by nearly 70% in 2018, its highest growth rate) (Eurostat, 2020[20]).[7] As the development of the construction industry remains a priority for the national economy, it is expected to have a continued significant impact on CDW generation in the near future (Ministry for Innovation and Technology, 2021[21]). The materials composition of Hungarian CDW reveals that the largest waste category (by weight) is composed of concrete, bricks and ceramics (around 55%), followed by metals and their alloys (around 35%) (BRE et al., 2017[22]).

In terms of treatment, the amount of landfilled CDW has decreased over time, while the recovery rate has increased over the same period (see Figure 6.2).[8] The recovery rate for CDW, in line with the calculation methods of the Waste Framework Directive (WFD), reached 68.5% in 2018 (Ministry for Innovation and Technology, 2021[21]).[9] By December 2020, the combined rate of preparation for reuse, recycling and other materials recovery of non-hazardous CDW increased to at least 70% by weight of the amount generated, thereby fulfilling the EU target under the WFD. However, the materials reported as recovered also includes a considerable amount of backfilling.[10]

Figure 6.2. CDW treatment in Hungary between 2010-2018 (based on EWC codes)



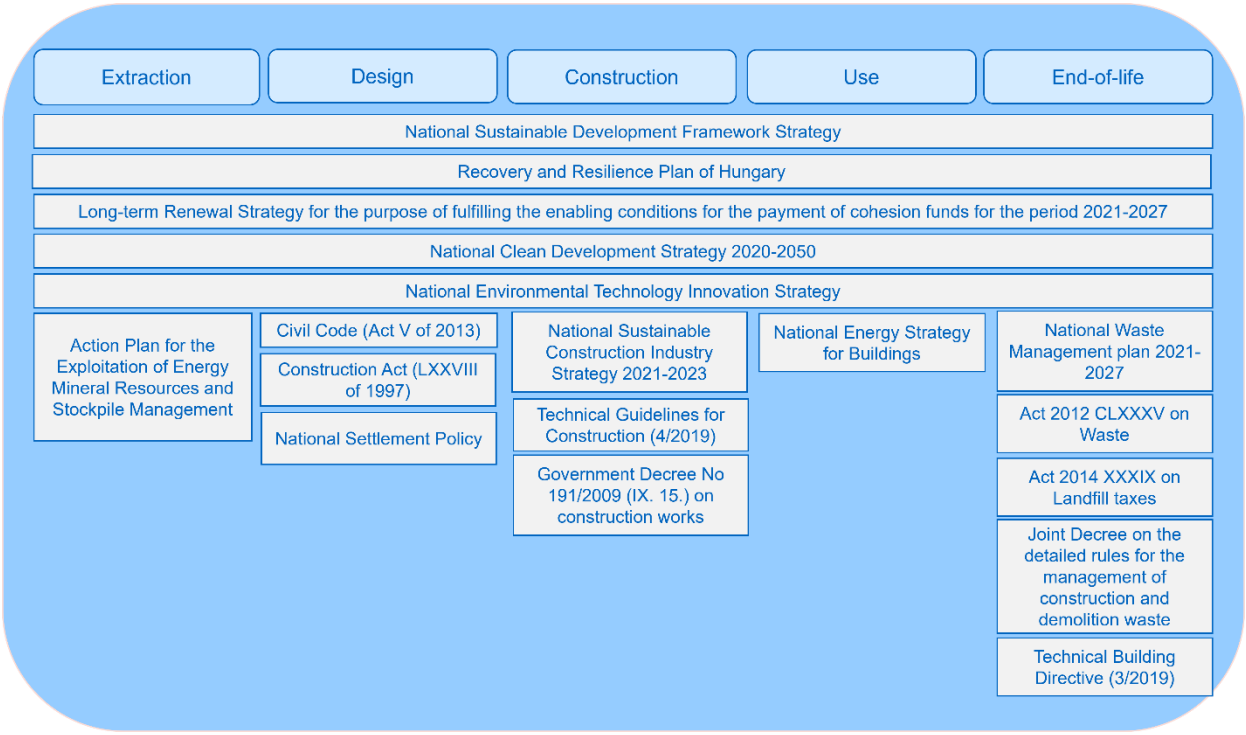
Source: Ministry for Innovation and Technology (2021[21]).

6.3. Hungarian construction-related policy and legal framework

6.3.1. Several strategies address the sustainability of buildings in Hungary, yet only a few target greater efficiency in material uses

Hungary's policy reform ambitions for more sustainable buildings are reflected across several cross-cutting and sector-specific policies and legislations (see Figure 6.3). However, only a few directly target circular economy principles. The majority of policy documents address circular economy indirectly, targeting various related topics, such as energy modernisation during renovations, energy efficiency in buildings use, renewable energy, and smart technology uses in buildings, with the ultimate goal of reducing energy imports and strengthening decarbonisation potentials.[11] As energy performance is the key environmental concern in the construction of buildings, materials life cycle considerations remain largely underrepresented in the cross-cutting flagship policy documents, including in the National Recovery and Resilience Plan (RRP) (Government of Hungary, 2021[23]), the National Clean Development Strategy 2020-2050 (Ministry for Innovation and Technology, 2021[24]), and the Long-term Renovation Strategy (LTRS) (Ministry for Innovation and Technology, 2021[19]). A comprehensive sectoral strategy, integrating material and energy efficiency, is therefore missing in Hungary.

Figure 6.3. Overview of Hungarian construction-related strategies and policies



Hungary's construction-related policy framework and related objectives align with the obligations set out in the EU legislation (see Annex Box 6.A.1 for an outline of relevant EU policies and legislation). However, its national goals and targets do not go beyond any of these obligations. The rate of preparation for reuse, recycling and other materials recovery of non-hazardous CDW remains Hungary's only quantitative target, directly supporting the transition to a circular building construction sector.[12] Although its legislative framework on CDW is currently under revision, the government has no plans for setting any sector-specific targets to drive the transition further.

6.3.2. The construction policy framework has a strong focus on the end-of-life phase

From a life cycle perspective, the Hungarian construction policy framework has a strong focus on the end-of-life phase (see Figure 6.3). Yet, no specific national strategy on CDW has been developed thus far. The management of CDW in Hungary is regulated by the Act 2012 CLXXXV on Waste (Parliament of Hungary, 2012[25]), with the NWMP 2021-2027 and its Waste Prevention Plan guiding the implementation of strategic objectives for CDW (Ministry for Innovation and Technology, 2021[21]). These documents outline the strategic objectives for a more sustainable management of CDW, including a higher rate of preparation for reuse and recycling, the promotion of selective demolition and on-site recovery, a reduction in the amount of waste landfilled, a greater number of drop-off opportunities for the public, and improved control, monitoring and quality control. The documents also put forward specific courses of action, including a number of measures to reach the 70% target rate of preparation for the reuse and recycling of non-hazardous CDW (as outlined in Annex Box 6.A.2).[13]

Hungary also has regulations in place detailing specific rules for the management of CDW. For buildings, these set out the obligations for builders after the completion of construction and demolition activities, and regulate the classification and certification of some CDW streams for their reuse (45/2004. [VII. 26.] BM-KvVM Joint Decree and Technical Building Directive [3/2019]). For road construction, legal provisions and technical guidelines regulate the procurement and use of secondary construction raw materials

(Government Decree No. 93/2012 [V. 10.], Article 5(5) of Act CXXVIII of 2003, e-UT 05.02.31, e-UT 05.02.15, e-UT 05.02.41).

6.3.3. Concrete measures for circular construction are largely absent from Hungary's upstream policies except for the construction phase of the life cycle

Principles for the circular use of raw materials are so far missing from Hungary's upstream policy framework. No comprehensive strategy or policy exists for the use of either primary or secondary raw materials in the production of construction materials.[14] For the design of buildings, the provisions regulating the design and implementation of building projects (Civil Code [Act V of 2013]) and the protection of the built environment (Construction Act [Act LXXVIII of 1997]) lack focus with regard to the use of secondary raw materials, circular design principles, and the recovery of building materials or CDW. The country is also missing an all-encompassing national urban policy document.

In the construction phase, the recent National Sustainable Construction Industry Strategy addresses some of the principles of a circular construction sector (Ministry for Innovation and Tehcnology, 2021[26]). While the strategy lists some objectives that are directly or indirectly related to a circular transition (including green building materials and technologies, use of innovative technologies and efficient manufacturing processes), it falls short of outlining concrete measures for their implementation or metrics for evaluating their progress. Requirements and conditions for the use of recycled construction materials and products, their incorporation into construction works, production control requirements, as well as the classification of the CDW generated, based on its material quality, are regulated by the Technical Guideline for Construction as well as by Government Decree No 191/2009 (IX. 15.).

6.4. Life cycle gap analysis and policy recommendations for a transition towards a circular building construction sector

Although the government is committed to advancing environmental sustainability perspectives, as shown in the overview of Hungarian policies in the previous section, applying circular economy principles in the building construction sector is not yet a political priority for the country. Hungary has no comprehensive national strategy in place for the transition to a circular building construction sector. Moreover, Hungary's strategic goals and quantitative targets, spelled out in policies and strategies supporting the circular economy transition, remain at a high level (in contrast to the indirectly related targets for energy consumption, efficiency and decarbonisation).

The implementation of circular economy principles within this priority area in Hungary will require a "whole of life cycle" approach with the involvement of stakeholders from across the entire value chain and different parts of the government. Hungary will need to implement the planned revisions in its legislative framework on CDW and to strengthen the focus on the remaining parts of the construction life cycle.[15] This will require introducing new policies in the production of materials and in the design of buildings, as well as strengthening existing measures targeting construction, renovation and the end-of-life of buildings. Dedicated horizontal tools to improve collaboration among stakeholders, strengthening capacity, knowledge transfer and education, and enhancing data availability must also be established to facilitate the transition towards a circular building construction sector.

This section identifies areas for improvement to further the circularity of construction in Hungary with a focus on the life cycle of buildings. The advancement of horizontal measures facilitating the circular transition of buildings is also discussed. Additionally, some perspectives on the end-of-life of road construction are considered.

6.4.1. To make the production of construction materials more circular requires policies to further the uptake of secondary materials and to curb the extraction of their virgin alternatives

The economic growth and the continuous expansion of the country's construction output have been putting pressure on Hungary's domestic extraction of virgin raw materials and their imports. These have been further exacerbated by the fact that Hungary does not have a secondary raw materials policy in place nor a functioning market for secondary construction materials.

To make the production of raw materials more circular and less dependent on imports, and to ensure a stable material input flow, Hungary will need to optimise the extraction of virgin construction materials and support the development of a secondary construction materials market.

Stimulating use of secondary construction materials

As noted by interviewed stakeholders, Hungary has considerable resources that can be used as secondary construction materials (including blast furnace slag and raw materials from road construction and renovations) to replace their virgin alternatives (mainly sand or gravel). However, instead of maximising their exploitation, the government's response to increasing global prices of construction raw materials has been to open new mines and expand the extraction of virgin natural resources. This comes at both a considerable environmental and monetary cost.

The creation of a secondary construction materials market in Hungary will require a mix of economic and regulatory policy instruments. This could start by eliminating administrative and economic barriers that hinder the uptake of secondary construction materials in the country, which will require revisions to some of Hungary's existing regulations. First, simplifying the authorisation procedure for incorporating secondary raw materials into construction projects would help reduce the heavy administrative burden on contractors. This, in turn, could encourage greater use of recovered materials in the planning of new construction projects. Second, adapting the Act on National Property (Act CXCVI of 2011) to better reflect market needs could stimulate a higher degree of recoverability and the reuse of secondary raw materials. As noted by the interviewed stakeholders, dismantled materials originating from public investment projects are treated as national assets, so their sales prices are set by the State. The higher price of these secondary materials relative to their virgin alternatives makes contractors reluctant to use recovered materials in construction projects. The current regulation would therefore benefit from allowing CDW, originating from public investments, to be managed by market operators.

Among the new policy instruments, Hungary will need to adopt a secondary raw materials policy, implement new quality standards for secondary raw materials and consider introducing a tax on selected virgin construction materials.

Secondary raw materials policy to improve self-sufficiency in construction materials

Secondary raw materials are recycled materials or by-products that can be reused in construction processes instead of, or alongside, virgin raw materials (European Commission, n.d.[27]). Their use presents several advantages, including increased security of supply, less primary materials extraction and related energy use, less adverse impacts on climate and the environment and, ultimately, lower production costs.

The use of secondary raw materials, i.e. circular materials use rate, in Hungary remains low and well below the EU average (as discussed in chapter 2). This is largely due to the absence of a policy encouraging secondary material uses. Hungary remains one of the few EU Member States that does not have such a policy in place.[16] Developing a secondary raw materials policy could not only help set framework conditions for promoting the recovery and reprocessing of raw materials from used construction products and waste

(not least by setting an ambitious recycling target for recyclable construction materials), it could also contribute to strengthening the local economy and help reduce Hungary's import dependence on construction minerals and metals. Moreover, given that some of the infrastructure necessary for secondary raw materials recovery is readily available in Hungary (including stone crushing equipment as well as mobile and processing units), the policy could provide guidance on the recovery of materials while taking advantage of existing structures.

Several EU Member States have already adopted secondary raw materials policies. The secondary raw materials policy of the Czech Republic, which also covers raw materials from construction, could inspire Hungary (see Annex Box 6.A.3). Hungary's future policy could also consider promoting industrial symbiosis in keeping with the economic structure of regions.

Quality standards to enhance confidence in the quality and performance of secondary construction materials

To further strengthen the uptake of secondary raw materials, it is important to create a system to assess and certify the quality of the recycled construction materials for their reuse. Standards that define and certify the quality and safety of recycled construction materials place secondary construction materials on par with their virgin alternatives, thereby enhancing market confidence in their quality and performance (Nadazdi, Naunovic and Ivanisevic, 2022[28]). Moreover, prioritising high-quality durable secondary raw materials can help extend the lifetime of buildings, postpone the need for renovation or premature demolition, and eliminate the need to extract virgin raw materials with the related environmental challenges this poses.

A number of the interviewed stakeholders believed that the lack of guidance on technical specifications and standards in Hungary on the use of recycled materials for structural applications appeared to be a major obstacle for the marketing and use of secondary raw materials. To overcome this obstacle would require a revision of the existing quality standards and the development of a new standard for secondary construction materials. This new standard with technical requirements would guarantee the technical performance of the final products with clear procedures on how to incorporate secondary raw materials. The standard should be accompanied by metrics to measure performance, and tests and calculation procedures to help ascertain impurity levels and suitability for high-grade recycling. The information obtained from complying with such quality standards could be fed into a voluntary national quality scheme for recycled construction materials. Moreover, the introduction of a new quality label for secondary construction materials could enable alternative materials to quickly access the construction market. Hungary will also need to develop structures for implementing this new standard, which may involve the National Association of Hungarian Building Contractors or the Hungary Green Building Council.

National standards for recycled aggregates have been widely implemented across countries. An international comparison is outlined by Tam, Soomro and Evangelista (2018[29]). More specifically, the Austrian Construction Materials Recycling Association has developed a voluntary quality label for recycled construction materials, which could serve as an example for implementing such an instrument in Hungary. Other examples of quality standards include the quality scheme for recycled CDW in the Netherlands, the example for recycled wood classification in France, and the standards (EN 50625 and EN 50614) for recycled waste electrical and electronic equipment (WEEE) at the EU level (see Annex Box 6.A.4).

Taxes on construction aggregates discourage extraction and use of virgin raw materials

To further promote the shift towards recycled construction materials, it is also important to disincentivise the extraction and use of their virgin alternatives. Environmental taxes, including taxes on construction aggregates, can act as a key element in achieving better sustainability in the production of construction materials (EEA, 2008[30]). Evidence shows that such taxes contribute to a reduction in the use of virgin

materials and encourages the use of recycled materials and by-products from other industrial processes (Söderholm, 2011[31]; European Commission, 2011[32]).

Reducing virgin raw materials use in the production of construction materials is one of the strategic objectives of Hungary's National Waste Prevention Programme. One of the ways to achieve this objective would be to introduce a tax on selected virgin construction materials.[17] Through a tax on aggregates, such as stones, gravel or sand, the government could send a strong price signal by making the sourcing and the use of virgin materials for construction less attractive. Moreover, aggregates are not traded internationally and would therefore not threaten the competitiveness of domestic producers. However, the timing of the measure will require a careful evaluation of the market conditions in the building construction sector.[18] Once implemented, Hungary may also consider earmarking the revenues generated from taxes for funding R&D on the circular economy and related pilot projects.

Taxes and levies on virgin construction aggregates have been introduced in several countries, which Hungary could draw upon for inspiration. For instance, Denmark and Sweden tax on an *ad quantum* (physical) basis, while other countries apply *ad valorem* (monetary) taxes. In the United Kingdom, a levy is applied to the commercial exploitation of rock, sand and gravel, which has led to the country having one of the highest shares of secondary aggregates use across Europe (see Annex Box 6.A.5).

6.4.2. To steer designers and contractors towards implementing circular economy principles in building design and construction requires better guidance at the national level

In the design phase, Hungary's policy and legal framework is well aligned with the relevant requirements of EU legislation, which mainly consider energy efficiency. Yet, there is an absence of common design principles that push for circularity in materials. In the construction phase, the recently developed National Sustainable Construction Industry Strategy falls short of outlining concrete implementation measures. In turn, the lack of circularity considerations in the design and construction of buildings has an amplifying effect on the required production of raw materials in the country. This is compounded by the strong demand in residential construction and renovation activities.

To encourage the consideration of circularity in building design and construction in practice, Hungary will need to translate circular economy principles into concrete strategies and actions at the different levels of implementation in terms of materials, buildings and urban environments.

Prioritising circularity in the design of buildings and urban environments

On micro and meso levels, early design decisions influence the circularity potential of buildings and their embedded materials. On the macro level, urban planning that considers circular design principles can help boost circularity at larger scales (Dokter, Thuvander and Rahe, 2021[33]).

Mainstreaming circular economy principles into design will require a revision of existing Hungarian legislation relevant to design and material choices in buildings, including the Civil Code (Act V of 2013), the Act LXXVIII of 1997 on the development and protection of the built environment, and the Government Decree 191/2009 (IX.15) on Construction Work Activities. These documents need to integrate language in support of the circular economy. They need to make a link to the minimum recycled content requirement for certain construction products, as put forward by the revised European Construction Products Regulation (CPR) (European Commission, 2022[34]), and mandate the development of performance-based criteria for construction materials and components in line with the EU's Circular Economy Principles for Buildings Design (European Commission, 2020[35]).

Hungary will also need to steer designers, architects and engineers towards a more circular design of buildings and urban environments by developing a new strategy for circular construction design and by adapting its urban planning strategies.

Design guidelines to mainstream circular construction principles in buildings

A circular designed building is environmentally sustainable thanks to its resource efficiency and smart design. A circular building takes into consideration the effective use of space and efficient energy consumption during the use phase, efficient resource use during its construction, and materials reuse and recovery during renovation and its end-of-life (Window of circular opportunity, n.d.[36]).

Currently there is no legally binding regulation guiding the planning and design of the built environment in Hungary.[19] Circular economy principles are only considered within sectoral recommendations and standards (see the section "Hungarian construction-related policy and legal framework"). The lack of guidance poses a challenge for the uptake of circular designed buildings in Hungary. Specific challenges mentioned by the interviewed stakeholders relate to the modularity and longevity of buildings and to the composition of their materials. For instance, less than 5% of buildings in Hungary are currently constructed with modularity in mind, i.e. with modules built off-site. Neglecting concerns for longevity during design has reduced the life expectancy of commercial and prefabricated residential buildings from a typical life span of 50-80 years to 30-50 years. The use of composite materials also hampers their disassembly, with only energy or chemical recovery possible.

Hungary should develop guidance on designing buildings with circular economy principles in mind to help reduce the pressure on raw materials and their environmental impact, as well as help designers, architects and engineers adopt a life cycle approach to the structures and systems they create. This will need to address design for modularity, flexibility, durability, adaptability and disassembly, and provide guidelines on how to incorporate secondary construction materials into buildings and their components. The measures put forward should also encourage digitalisation of construction and promote the application of BIM and digital product passports (DPP). In developing such guidance, Hungary should draw on the Circular Economy Principles for Buildings Design recently developed by the European Commission (see Annex Box 6.A.6). The country will also need to reflect on the future legislative measures proposed within the Sustainable Products Initiative (SPI) (European Commission, n.d.[37]).[20]

Urban planning strategies to support the development of smart, sustainable and circular cities

Urban planning and design are a channel to stimulate the uptake of circular construction and infrastructure within cities. Cities account for 85% of global GDP generation and 75% of natural resource consumption. They also produce 50% of global waste and 60-80% of GHG emissions (Ellen MacArthur Foundation, n.d.[38]). The pursuit of future-proof urban environments therefore needs to focus on regulating resource use and waste management, target self-sufficiency in energy and material production, and consider community involvement (Andreea Cutieru, 2022[39]). Approaches such as planning for walkability, high-quality buildings and resource efficiency in infrastructure have proven to contribute to smarter, more environmentally sustainable and circular neighbourhoods (Krisch and Suitner, 2020[40]). Moreover, nature-based solutions (NBS) applied to the built environment can counter the negative impacts of urbanisation and contribute to the circular economy through the provision of ecosystem services. Some of the solutions include green building materials (such as use of biocomposite materials, the production of which requires lower energy, carbon and water consumption) and green building systems (such as the application of green roofs, façade greenery and living walls, which helps improve air quality and stormwater management, as well as reduce pollution levels, temperatures inside and outside of buildings, and their energy usage). Other solutions for green building sites include establishing nature in cities, enhancing biodiversity through blue-green infrastructure components and providing opportunities for biophilic design, with positive impacts on human health (Pearlmutter et al., 2019[41]).

Hungary currently does not have a single national urban policy document in place. Instead, principles for urban policy are incorporated across various strategies and plans, including the National Development Strategy 2030, the Hungarian spatial planning system, and the integrated urban development strategies

on the municipality level. However, these strategies are missing a unified approach to sustainability. In particular, Hungary faces limitations and challenges in green infrastructure planning and development, and in restoring degraded ecosystems and developing ecological networks. It also lacks a harmonised development and land use approach as well as related tools (Krisztina Filepné Kovács, 2019[42]). To address these challenges, Hungary should promote more integrated spatial planning that prioritises environmental sustainability and circularity.

Copenhagen's urban planning strategy and Vienna's urban development project are examples of how urban planning and design can drive the creation of sustainable and circular spaces (see Annex Box 6.A.7). They adopt a sustainable approach to the liveability of neighbourhoods through the integration of public transport, the use of natural materials in construction, the restoration of the natural environment, and the introduction of sustainable services. The EU Urban Agenda Partnership on Circular Economy – a joint effort between the EC, the EU Member States and the European Cities Networks – has identified several actions and recommendations for cities in their circular transition (Håkon Jentoft, 2018[43]). These best practices and concrete actions can be used to source inspiration for adapting the Hungarian urban planning approach and related strategies, such as the Integrated Urban Development Strategy – Budapest 2020 (Municipality of Budapest, 2015[44]).

Encouraging a circular building construction sector

With the continuous increase in construction activities, a growing potential for integrating sustainability and circular economy principles into future construction projects emerges. Moving away from the current linear and cost-efficiency-driven construction towards greener and more circular projects requires a clear vision, a set of shared goals, and guidance on the national level.

In Hungary, the absence of a strong legislative basis for the construction phase,[21] results in a scattered policy landscape locked into outdated architecture principles. The only overarching policy document currently in place is the National Sustainable Construction Industry Strategy. While this lays out the priorities, areas of intervention and proposals for action in the industry, it lacks concrete recommendations that focus on the circular economy. The strategy needs to be revised to include specific targets on the circular economy (beyond a building's energy performance) as well as guidance for addressing construction activities from a more systemic perspective.[22] It will also need to reflect the revision of CPR (European Commission, 2022[34]).

Besides revising the policy in place, Hungary will also need to adapt its Public Procurement Act to include Green Public Procurement (GPP) criteria and possibly integrate minimum content requirements into these.

GPP to incentivise the supply of and investment into more circular construction products and building services

The GPP tool is used by authorities to procure goods, services and works with a reduced environmental impact throughout their life cycle. Circular public procurement takes the GPP a step further by targeting closed energy and material loops in purchasing decisions within supply chains, while minimising and, in the best case, preventing negative environmental impacts and waste creation across the whole life cycle (European Commission, 2017[45]).

As noted during the stakeholder interviews, the current Public Procurement Act and the procurement process in Hungary do not take on board the principles related to sustainability and circularity. Elements of green procurement have only been integrated in projects procuring secondary raw materials. To gradually increase the use of GPP criteria when awarding contracts and to incentivise service providers to supply and invest in more circular construction products and building services, a revision of the Public Procurement Act or the development of a stand-alone Green/Circular Public Procurement policy, extending

the use of GPP criteria for construction works, will be required. The scope of such revisions could be examined by the Sustainability Working Group established under the Sustainable Hungary Programme.[23]

The recent publication of the Environmental Public Procurement Ethics Code (Green Code) by the Hungarian Public Procurement Authority is a step in the right direction (Hungarian Public Procurement Authority, 2021[46]).[24] The code identifies the environmental objectives and areas that the participating contracting authorities commit to prioritise in their public procurement, one of which is the circular economy approach. While currently a voluntary initiative, this guidance should be made mandatory in the future. In the long term, Hungary should also consider integrating minimum "recycled content requirements" into GPP to encourage the further use of recycled materials in construction works.[25] Doing so will first require a revision of the current legislation on design and materials choices in buildings (as discussed in the section "Prioritising circularity in the design of buildings and urban environments").

The EU's voluntary GPP criteria for construction led many European countries to develop guidance in this area in the form of national GPP criteria embedded in their national regulation. Examples of implementation include in the Netherlands where the regulatory environment and effective cooperation between public and market actors enabled a successful integration of sustainability criteria into the public procurement of infrastructure projects (see Annex Box 6.A.8).

6.4.3. Extending a building's life and promoting more intensive and flexible uses calls for strengthened incentives

Buildings are responsible for a large share of energy consumption and CO_2 emissions.[26] While more sustainable and circular design (as discussed in the section "Prioritising circularity in the design of buildings and urban environments") can produce highly efficient new buildings, improvements in the way buildings are used and maintained are also necessary. In Hungary, the incentives in place are weak and favour neither the extension of a building's lifetime nor an improvement in how they are used. Despite the ageing residential building stock, Hungary's annual renewal rate remains around 1% for residential buildings, which is far below the 3% rate set in the LTRS as a part of the EU renovation wave.[27] Hungary also lacks effective space-sharing strategies to promote a more intensive use of buildings as well as zoning regulations to enhance flexibility in a building's uses while advancing circularity in cities.

Improvements in the way buildings are used and maintained also contribute to a prolonged life cycle of construction products (one of the objectives of Hungary's National Waste Prevention Programme). To help achieve this objective, Hungary will need to promote a systematic renovation of buildings and a more efficient use of their spaces.[28]

Extending the lifetime of buildings through renovations

The use phase of buildings in Hungary has a significant potential for more circularity. Promoting the extended lifetime of structures and materials will require a greater number of renovation support schemes specifically tailored to promote circular economy principles and to introduce other economic instruments to make renovations of public and residential buildings more economically attractive.

Renovation support schemes to incentivise renovation of public and residential buildings

Renovation of the building stock has been singled out as a key initiative to drive energy efficiency within the European Green Deal (European Commission, n.d.[47]). Besides energy-related considerations, the EU Renovation Wave strategy counts circularity, use of organic materials and environmental standards among its key principles. Adopting circular economy principles during building renovations reduces the use of materials in existing structures, thereby delaying their demolition and forgoing the use of new materials in the construction of new buildings. Renovation support programmes are an important way to incentivise the renovation of public and residential buildings.

As pointed out by the interviewed stakeholders, the Hungarian construction industry prefers investments in the construction of new buildings rather than the renovation of old housing stock. This is due to the insufficient financial incentives available for renovation projects in Hungary. Current renovation support schemes and grants are limited both in their scope and coverage. Aside from the "home improvement grant", which is set to expire by the end of 2022 (Hungarian State Treasury, 2021[48]), there is currently only one scheme subsidising home renovations. However, the Housing Subsidy for Families (CSOK) scheme is limited to households with at least one child. Additionally, this scheme seems to prioritise newly built homes over the renovation of existing residential buildings, thereby contributing to urban sprawl and an increase in demand for materials for buildings and related infrastructure in new residential areas.[29] Moreover, the latest draft of the Cohesion Fund Environmental and Energy Efficiency Operational Programme Plus (EEEOP Plus) plans to allocate support for improving buildings renovation for only about 32 000 homes in the coming 7 years (representing less than 1% of total homes in Hungary). Those funds are likely to be used exclusively for energy efficiency schemes (Cashawards, 2021[49]).

In order to better target the actual demand for renovations of the housing stock and to meet the country's renovation targets, Hungary will need to extend its renovation support schemes both in scope and coverage.[30] These schemes will also need to better reflect circular economy principles at building and product levels when considering options for renovation (ECOS, 2020[50]). For instance, it is important to prioritise innovative materials with high circularity potential, such as the use of mineral wool for its excellent recycling potential, and stone wool for insulation, which are produced as by-products from other industries (Olympia Dolla, 2022[51]). The Czech Republic is an international example of a successful wide-scale implementation of renovation financing and it has now extended its financial support programmes for both renovation and new efficient construction to all categories of buildings and across all regions (BPIE, 2017[52]).

Reduce value added tax on renovation works to make them more affordable

Renovations offer opportunities to deploy circular strategies beyond energy efficiency improvements. However, the transition towards circularity and the sustainable renovation of the building stock currently faces economic obstacles, which is coupled with political barriers and a lack of awareness (Giorgi, Lavagna and Campioli, 2018[53]). To make renovation works more affordable and boost their uptake, various financial incentives could be implemented. These include value added tax (VAT) rebates, green taxes and tax refunds.

Hungary could investigate the potential of using targeted VAT reductions for renovations to improve materials use in buildings, and possibly to target the use of secondary and renewable materials in renovation projects. Alternatively, VAT reductions could also target the uptake of deep energy renovation projects, but they entail significant costs for owners and are carried out at much lower frequency. For example, improvements in energy performance of a building by at least 60% occurs only in 0.2% of the building stock annually (BPIE, 2021[54]). To design effective schemes, it is important to first evaluate the scope and relevance of introducing VAT reductions that target specific activities.

The VAT reduction for housing renovations has been implemented in the United Kingdom (Government of the United Kingdom, n.d.[55]). The reduced tax rate of 5% (compared to 20% for domestic building works) can be obtained for any works of repair, maintenance or improvement to a property, with only a few exemptions. In France, a tax rate of 10% (down from 20%) applies to works related to improvements, conversion and repair of residential property, while a rate of 5.5% applies to building works related to energy conservation (French-Property.com, n.d.[56]).

Promoting a more intensive use of buildings

To encourage a more efficient use of the building stock, both in terms of using the building space and reducing the need for new buildings, Hungary will need to evaluate the future implementation of space-sharing strategies and reform the current zoning regulations in cities.

Shared and mixed-use concepts for buildings to enhance their use and advance the overall circularity of cities

The rapid growth in urbanisation and the urgent need to make cities smarter, more sustainable and resilient have spurred urban planners to look for new solutions. For instance, the concept of mixed-use buildings allow planners to flexibly adapt how buildings are used as times change (TKE, 2018[57]). It also contributes to the sustainable use of resources and space, and provides inhabitants with neighbourhoods that integrate work, home, shopping, transportation and green spaces. On a larger scale, zoning regulations establish the rules governing different types of activities permitted or prohibited on a designated piece of land or within a "zone", thereby controlling the development of properties and their uses. Allowing mixed uses of land within higher density zones can enhance a building's uses and introduce more flexibility into urban planning, thereby advancing the overall circularity of cities (Deloitte, 2021[58]).

In Hungary, the largest category of new buildings built between 2011 and 2019 are offices. However, during the COVID-19 pandemic, offices have been severely underutilised. Moreover, the shift towards teleworking is driving a more permanent decline in office space. To repurpose unused office and public administration buildings (representing 23% of the total stock of public buildings by number) and thus make the most of the space in educational buildings (representing 40%) (Ministry for Innovation and Technology, 2021[19]), Hungary could consider developing space-sharing strategies targeting multi-use and mixed-used concepts.

At the same time, as the population in Hungarian cities continues to grow, the higher density of residential areas presents an alternative to the many problems of urban sprawl, but requires solutions for more flexibility and space efficiency. To allow for higher density residential development with a mix of uses and housing types, Hungary should consider rezoning parts of districts or cities where space distribution and utilisation are most critical, and include affordable housing, while putting forward measures to repurpose the existing buildings for new types of uses.

A prior feasibility study, carried out in collaboration with policy makers, urban planners, academia and civil organisations, will be necessary to examine the applicability of the different concepts targeting some of the building stock across cities, as well as the willingness of the residents to adjust to new concepts. Examples of mixed-used developments, upon which Hungary can draw, include projects in Toronto (Canada) of co-location of schools, libraries, recreation centres and childcare into community hubs, and the development of a standardised approach for shared use facilities in Western Australia (see Annex Box 6.A.9). In terms of zoning regulations, Seattle's Housing Affordability and Livability agenda provides an example of amended zoning codes to allow for higher density in residential areas (City of Seattle, n.d.[59]). Flexible zoning has also been introduced in some European cities with mixed uses of land. For instance, the strategy by the city of Prato (Italy) foresees opportunities for repurposing empty buildings to reduce the use of raw materials for new builds and to extend the life of existing buildings (OECD, 2020[60]).

6.4.4. To close the loop at the end-of-life, measures are needed to divert CDW from landfills and encourage more appropriate treatment and reuse

As construction activities have expanded, so too has the amount of CDW produced, which represents a significant part of Hungary's total waste generation. Despite decreasing landfilling and increasing materials recovery rates, the existing Hungarian policy measures have not succeeded in achieving a more significant shift from landfilling to CDW reduction and its recycling and reuse (an objective set within Hungary's NWMP

2021-2027 and its Waste Prevention Plan). The slow progress has been exacerbated by the absence of both a regulation on mandatory selective demolition and an extended producer responsibility (EPR) scheme for certain construction products.

To close the loop at the end-of-life phase, Hungary will need to accelerate the diversion of CDW from landfills, and prioritise recycling and high-value reuse over backfilling operations and low-grade recovery.

Diverting CDW from landfilling

Decreasing landfilling is one of the strategic objectives of Hungary's NWMP 2021-2027. This objective can be achieved through an increased landfill tax and improved enforcement measures.

Higher landfill tax rate coupled with better enforcement measures to reduce CDW landfilling

A gradual increase in landfill taxes, in combination with better enforcement of waste management regulations, will help divert CDW away from landfills and prevent any uptick in illegal dumping (European Commission, 2012[61]).

Hungary's current system of landfill taxes incentivises the unsustainable treatment of CDW and possibly acts as an impediment to CDW recycling. Hungary's landfill tax has been in place for almost a decade. Despite the planned incremental increase that was originally foreseen, the current tax rates have been frozen at their 2014 levels, and are currently lower than in other EU Member States (Cewep, 2021[62]). Plans to implement further increases were reversed in 2016 over fears of a possible uptake of illegal dumping (OECD, 2018[15]). Although the landfilling rate of CDW is decreasing, more CDW ends up in municipal landfills as part of municipal solid waste (MSW) because there are more landfill locations, reducing transportation costs. Moreover, a large amount of CDW is sent to landfills as backfilling material (Deloitte, 2015[63]).[31] As these quantities are reported as recovered, they are exempt from the landfill tax. To correct these inefficiencies, which is also acknowledged by the government (Ministry for Innovation and Technology, 2021[21]), Hungary will need to revise its landfill tax system by raising taxes to at least compensate for the operating and capital costs of landfills, but preferably to include environmental externality costs (OECD, 2021[64]). Coupled with the tax increase, Hungary will also need to enforce its waste regulation by strengthening the control of waste arriving at landfills and penalising non-compliance and illegal dumping.

The Danish weight-based landfill tax can provide insights into how effective taxes can be in diverting waste from landfills and influencing how it is handled (see Annex Box 6.A.10). In terms of enforcement, several EU Member States have implemented regulatory responses to illegal dumping following increases in landfill taxes. For instance, Austria has organised huge awareness and information campaigns, increased monitoring and enforcement activities, and improved the electronic recording of waste streams and waste management (European Commission, 2012[61]). The Czech Republic aims to enhance cooperation among environmental law enforcement agencies and strengthen their capacity to improve the overall regulatory environment and create public awareness of waste-related matters through a short-term national strategy (Ministry of the Interior of the Czech Republic, 2019[65]).

Improving quality and increasing recycling and the safe reuse of recovered CDW

Strengthening the recycling and reuse of CDW requires its safe use and the recovery of high-quality materials from it. However, Hungary will have to work on removing existing legal obstacles to the use of recycled materials. According to the current definition in the Joint Decree 45/2004 (VII. 26.), CDW represents waste from the construction of buildings listed in Annex 1, including excavated soil, concrete debris, asphalt debris, wood waste, scrap metal, plastic waste, mixed CDW, and waste building materials of mineral origin. Although this definition includes the most important construction materials, clarifying the

status of waste and end-of-waste (EoW) criteria for other waste streams could encourage the safe reuse of additional raw materials from CDW.[32] Further waste streams to be targeted by EoW criteria could possibly include bricks, tiles and ceramics, which together with concrete represent the largest category of CDW in Hungary. The obtained aggregates could then be considered for use in building and construction works, especially for road construction, bound surfaces or concrete and asphalt mixes.[33]

To further encourage the recycling and subsequent reuse of CDW, Hungary will also need to implement new policy instruments, including: i) adopting a strategy for CDW; ii) establishing a mandatory selective demolition scheme, which is also one of the objectives of the NWMP 2021-2027; and iii) consider developing an EPR scheme for construction materials.

The CDW strategy would move away from extensive backfilling to higher-value recovery and reuse of CDW

The development of a CDW strategy can help in identifying sustainable treatment options for the management of CDW arising along the building's life cycle (from excavation to construction to demolition activities). The strategy would contribute to increasing the supply of secondary construction materials and promote an improvement in the quality of materials recovered and reused from CDW (ERA, 2021[66]).

Hungary, as in many other countries, does not yet have a strategy in place that lays out the management and treatment of CDW in a harmonised way. Developing a dedicated national strategy could help the country establish a system for the management of CDW as well as better connect national targets with specific measures and activities. In particular, a CDW strategy could help Hungary move away from excessive backfilling towards a more circular and higher-value recovery and reuse of CDW. The backfilling activity in Hungary has significantly contributed towards meeting the 70% of CDW preparation for reuse, recycling and recovery. However, in the future, the country should aim to achieve higher rates of CDW preparation for reuse and recycling while reducing its high reliance on backfilling. The strategy should also have quality standards in place and promote education and awareness raising as well as improvements in data collection (discussed in the sections "Stimulating use of secondary construction materials" and "Horizontal tools and cross-cutting measures", respectively).

Malta's recent strategy provides an example of a good practice in developing such a CDW management strategy. Like Hungary, Malta is considered to have reached a very high recovery rate of CDW driven by its high backfilling activity (see Annex Box 6.A.11).

Mandatory selective demolition scheme to facilitate high-quality recycling and reuse of CDW

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 several materials such as wood, mineral fractions, metal, glass, plastics and plaster (European Commission, 2016[67]). When successfully applied, selective demolition can drive the recovery of high-quality materials for recycling and reuse such that only a small fraction of rejects and hazardous waste would have to be disposed.[34]

Selective demolition, although one of the strategic objectives of the NWMP 2021-2027, is not carried out systematically in Hungary, with only a few individual projects emerging. According to evidence collected from the interviewed stakeholders, the recycling and recovery of CDW in Hungary is hampered by the complexity of demolitions of modern building structures, the high proportion of plastic elements and foams contained within these, as well as the presence of hazardous materials, such as asbestos, tar and bitumen. The situation is similar for CDW from road infrastructure.[35] In order to ensure an easier identification and to enable separate collection and sorting of CDW from buildings and road infrastructures, as well as facilitate their on-site reuse in high-grade applications, Hungary should establish a mandatory selective demolition scheme for specific waste streams, including inert waste.[36] Mandating material specific

separation of CDW requires a prior understanding of potential environmental impacts along the life cycle, as well as consultations with relevant stakeholders. Such a scheme should include a system of inspection/audit (before and after demolition) that is aligned with the national classification/definition of waste and CDW. Once established, selective demolition will need to be embedded within the National Sustainable Construction Industry Strategy and should also be linked to a CDW database (see the section "Horizontal tools and cross-cutting measures").

In the EU, the revised WFD has recommended the promotion of selective demolition (European Parliament, 2018[68]). Several countries, including Belgium, Denmark, Finland and Sweden, have already established legal requirements for the materials-specific separation of CDW at demolition sites (European Environmental Agency, 2020[69]). The Austrian technical standards for the design and execution of selective demolitions demonstrate the successful implementation of such requirements within national legislation (see Annex Box 6.A.4). An example of an online traceability system providing quality assurance for the selective demolition process is the database developed in Flanders (Belgium) (Hradil et al., 2019[70]). Guidelines for waste audits before demolition and renovation works have also been laid out by the EC (European Commission, 2018[71]).

Extended producer responsibility (EPR) scheme to encourage recovery activities and incentivise design changes that facilitate the reuse or better recycling of CDW

The EPR schemes for construction products and materials help shift some of the costs of managing the high volume of CDW from operators to producers. They also incentivise changes in the actual design of products and materials, thereby facilitating the reuse and recycling of waste (OECD, 2016[72]). In construction, the introduction of EPR schemes could encourage modular building designs, easier disassembly, the introduction of digital product passports, as well as the use of secondary construction materials.

Despite the substantial share of recovery in Hungary, a large portion of the CDW (including concrete and tile waste, mainly used for embankment construction) suffers from poor quality recycling and low-grade recovery. The CDW from plastics and insulation materials, as well as the recovery of glass from windows and doors. currently does not exist in Hungary (as confirmed by the interviewed stakeholders). On the positive side, Hungary has been successful in metal scrap recovery, for which a recovery strategy is available going back several decades. To improve the recovery of certain construction and renovation products and materials, including concrete and tile waste, plastics and insulation materials, doors and window glass, Hungary could consider developing an EPR scheme specifically targeting these materials. Such a scheme would require producers of construction materials to establish the necessary infrastructure that would enable the take-back of their products and improve recovery activities. In its first years, such a scheme could be voluntary, becoming mandatory in the longer term.

Currently, there are only a few examples of EPR schemes for construction materials, not least because of the challenges posed by implementing such schemes related to the long lifetime of buildings, their multiple ownership and purposes during their lifetimes, and the large scale of materials streams compared to other products for which EPR has been typically applied (Pomponi and Moncaster, 2017[73]). France has recently introduced an EPR scheme for marketers of building construction products and materials, including windows, carpets and concrete, which expands the existing collection points for free take-back of building materials waste from professionals, and establishes schemes for waste recovery from craftspeople and private individuals (Ministry of Ecological Transition, 2020[74]) (see Annex Box 6.A.12). The Netherlands has in place a general binding agreement for flat (insulation) glass. Initially started on a voluntary basis, the programme is now a binding financial contribution for post-consumer collection, sorting and treatment (Dimitropoulos, Tijm and in 't Veld, 2021[75]). Outside of Europe, Japan's EPR law requires contractors to sort and recycle wood, concrete and asphalt (Ogushi and Kandlikar, 2007[76]). In the United States a number of states have introduced mandatory EPR programmes for architectural waste paints (PaintCare, n.d.[77]).

6.4.5. Horizontal tools and cross-cutting measures need to be put in place to support a more circular building construction sector

Various horizontal tools can be used to support and further accelerate the uptake of circular construction activities in Hungary. Enhancing coordination and facilitating collaboration between all relevant stakeholders could help address cross-cutting issues in the industry and contribute to more coherent circular economy-related policy actions. Improving capacity-building, knowledge transfer and education is essential for mainstreaming circular economy principles across all life cycle stages of construction. Improving data availability on CDW generation would facilitate sustainable waste flow management, while large-scale digitalisation would contribute towards increasing resource efficiency and productivity in the industry and support the adoption of circular business models. Finally, tailoring government support helps stimulate the innovation potential of the circular transformation of SMEs.

Enhancing coordination and facilitating collaboration between stakeholders to address cross-cutting issues in construction

Better coordination and increased collaboration are essential for mitigating fragmentation in the construction industry, breaking down silos, increasing the pace and dissemination of innovation and making the entire industry more circular.

Hungary is currently one of the few EU Member States that does not have a dedicated Ministry of Environment in place. The coordination of the transition to a circular economy is carried out at the state secretary level, specifically by the State Secretariat for Environmental Policy and Circular Economy of the Ministry of Energy. According to the interviewed stakeholders, the lack of inter-sectoral and cross-agency collaborative mechanisms has led to coordination issues and made it more challenging to meet the targets and objectives related to the circular economy. Improving the coordination between the different ministries, relevant agencies and stakeholders, would help tackle some of the industry's cross-cutting issues, such as innovative circular business models, new technologies, and recovery and reuse of materials across different sectors, thereby contributing to more coherent policy actions. To steer the transition to a circular construction, Hungary should consider establishing a coordination mechanism, possibly at the level of a state actor, for example, a newly created ministry or an agency, a government commissioner or a public-private-partnership. The creation of a formal coordination body will need to be preceded by the establishment of a working group in order to build on the momentum created by the adoption of the NCES as well as to leverage synergies and bring about common actions within the industry. The working group could be composed of construction industry stakeholders in the newly created Circular Economy Technology Platform and be led by the State Secretary for the Environmental Policy and Circular Economy of the Ministry of Energy.

Several examples of successful inter-sectoral collaborations and partnerships have emerged over the past years, including "green deals" and public-private discussion platforms in the Netherlands (see Annex Box 6.A.13). In Hungary, two collaboration platforms were established to accelerate the transition to a circular economy: the Circular Economy Platform (BCSDH, n.d.[78]) and the Circular Economy Technology Platform (EGOV.HU, 2022[79]) (see Box 2.2° in chapter 2).

Improving capacity building, knowledge transfer and education to mainstream circular economy principles within the construction industry

Effective education, capacity building and knowledge sharing are essential for awareness raising about circular economy principles, and further accelerating the circular transition in the construction industry.

The application of circular economy principles within the Hungarian construction industry is poor and predominantly focused on waste management aspects. As noted during the stakeholder interviews, the lack of innovative approaches and knowledge transfer continues to determine conservative attitudes in

Hungarian design, architecture and engineering practices. Many contractors do not know what to do with recovered materials, while good practices from abroad are rarely disseminated to domestic stakeholders. The uptake of circular approaches in Hungary's construction industry would therefore benefit from stronger capacity building, knowledge transfer and education.

Training programmes, such as the Circularity Thinking Programme, developed by EIT Climate-KIC for stakeholders and practitioners of the Deep Demonstration project in Slovenia, could inspire greater capacity building in Hungary (see Annex Box 6.A.14). More specifically, this could be achieved by developing a national training programme targeted to industry stakeholders and policy makers, which could be run by the Hungary Green Building Council. Better knowledge transfer could be achieved through dedicated private-public platforms that bring together relevant stakeholders. The Holland Circular Hotspot provides an example of such a platform where knowledge on advanced, innovative and circular construction practices are disseminated. On another level, mainstreaming circular economy into curricula of higher education programmes would help prepare the next generation of policy makers, designers, architects and constructors for more circular thinking (see Annex Box 6.A.14).

Better monitoring of uses of construction materials and CDW generation will accelerate the uptake of more circular practices across the industry

Besides the life cycle specific measures discussed in the previous sub-sections, accelerating the uptake of circular practices in the construction industry requires consistent data on and monitoring of construction material flows across the entire construction value chain.

In Hungary, data collection on material uses and their flows and CDW in construction is either completely missing or is not carried out systematically.[37] The building sector has currently no database in place that would ensure a harmonised approach for reporting CDW streams. In road construction, although a database for monitoring waste streams is already underway, this currently only covers asphalt. Hungary therefore needs to reform its national database or put in place a new inventory, which would register the volumes of CDW generated across the entire economy as well as their quality specifications. The precondition for such a revised data inventory is improved data reporting on EWC codes, lifetimes, prices and usability of different waste streams by construction companies. Moreover, laboratory tests to determine the quality of secondary raw materials recovered from CDW will need to be specified. This information could, in turn, be used to inform the quality standards and labels for secondary construction materials (discussed in the section "Quality standards to enhance confidence in the quality and performance of secondary construction materials"). Moreover, it could serve as an outlet for matching suppliers with users of recycled construction materials, which would spur the creation and uptake of a marketplace for secondary raw materials. Ultimately, improved data availability would also contribute to evidence-based policy making.

When reforming the existing database for the building sector, Hungary could draw on the experience from existing initiatives in the country and abroad. For instance, the CLEAN-WAY database and map (CLEAN-WAY Kft, n.d.[80]), which was established with the aim of enhancing the reuse of secondary raw materials, might have a future potential to be used on a larger scale and be inter-connected with other databases. The National Buildings Database in France [Base de Données Nationale des Bâtiments] is an international example of an open-data project cross-sourcing information from about twenty different datasets covering more than 21.4 million buildings (see Annex Box 6.A.15).

Promoting digitalisation of the construction industry to support the adoption of new circular business models

Digitalisation drives innovation and helps tackle the industry's challenges related to labour shortage, competitiveness, resource and energy efficiency, and productivity. Digital tools are considered especially important in the planning, authorisation and design phases of construction (European Commission,

2019[81]). They are also an important enabler for the adoption of new circular business models (OECD, 2019[82]), such as the industrial symbiosis and digital marketplace for infrastructure (World Economic Forum, 2021[83]).[38]

To ensure a systematic digital circular transition of the construction industry in the country, it needs to become one of key themes of Hungary's National Digitalisation Strategy. More specifically, it will need to indicate the links and inter-dependencies between the different technologies, the national context and the industry's structure. In terms of specific technologies, Hungary could possibly focus on BIM (helping to improve decision making in buildings and public infrastructure projects for renovation, refurbishment and maintenance),[39] digital twins (enabling easier maintenance, repair, reuse, safe dismantling and disposal of constructions, products and materials),[40] and open-source design (facilitating collaboration on designs of buildings, neighbourhoods or cities)[41]. To facilitate a stronger uptake of digital solutions, policy measures targeting digitalisation need to be accompanied by financial support in the form of grants, loans or equity, but also by technical assistance.

The Danish Strategy for Digital Construction and Bulgaria's Digital Transformation Strategy are examples of cross-sectoral digitalisation agendas, with measures targeting the digitalisation of the construction industry. On a different level, the Estonian Digital Construction Cluster (EDCC) aims to develop an innovative digital environment targeting the entire construction life cycle and value chain (see Annex Box 6.A.16). Moreover, several national governments have embedded BIM requirements into their public procurement processes (European Commission, 2021[84]). National and local governments have also facilitated the uptake of digital technologies by providing e-services, such as digital building permit systems, digital logbooks and registries of properties (in some cases enriched by the inclusion of Geographic Information System [GIS] and 3D models for digital registry of properties) (European Commission, 2021[84]).

Tailoring government support to stimulate the innovation potential of the circular transformation of SMEs

The SMEs are the backbone of the European economy. Recognising the necessity and the economic opportunity arising from becoming more sustainable, SMEs are increasingly using environmentally friendly methods and materials, and adopting circular business models (SMEUnited, 2021[85]). To ensure that SMEs are well equipped to embrace the opportunities of the circular transition, tailoring support to their specific needs is essential.

In recent years, the productivity of Hungarian micro, small and medium-sized enterprises (MSMEs) has improved significantly, exceeding the growth rate of large companies in the country. However, the SME sector still lags behind the EU average both in terms of its growth and the production of greener products and services (OECD, 2018[15]). Governmental support therefore needs to be stepped up to accelerate the innovation potential of the circular transformation of SMEs.[42] This support should focus on providing more financial incentives, for instance, grants to help domestic material producers to modernise technologies and production processes in order to manufacture construction materials using recyclates, enabling market mechanisms and tools to facilitate SMEs operations. The government also needs to ensure that any regulatory obstacles preventing SMEs in adopting new circular business models are removed.

Examples of SME specific measures include the Circular Economy Business Support Service, launched in Scotland, and the Circular Business Challenge established in the Netherlands. These help companies discover more circular ways of doing business through practical workshops and financial support. The EC has developed a voluntary reporting framework to help SMEs from the built environment to assess and monitor the sustainability performance of buildings (see Annex Box 6.A.17). Although not limited to SMEs, the Dutch Environmental Investment Allowance (MIA) and the Random Depreciation of Environmental Investments (VAMIL) schemes allow entrepreneurs to deduct part of their investment costs on top of their

regular investment tax deductions for environmentally friendly investments in a number of areas, including construction (Netherlands Enterprise Agency, n.d.[86]).

6.5. Concluding reflections on the key policy recommendations

The previous section presented the gaps in Hungary's transition towards a more circular building construction sector. To align with the objectives and targets of EU policies and to achieve Hungary's national ambitions, the country needs to address the following gaps:

- The absence of economic and regulatory incentives to shift construction materials from primary to secondary composition.
- Inadequate guidance to steer designers and constructors to prioritise design and construction in line with circular economy principles.
- Weak incentives to extend a building's life and the introduction of more intensive and flexible uses.
- Inadequate measures to incentivise the shift from landfilling to CDW recycling and reuse.
- The absence of horizontal tools to support greater circularity in the construction industry.

To close the identified policy gaps, this report presents a set of policy recommendations for implementation by the Hungarian government. The proposed instruments include a mix of economic and regulatory measures for each life cycle phase of construction, as well as a number of enabling horizontal tools targeting better coordination, education, information, digitalisation and business support to SMEs. To facilitate the transition to a circular construction industry, Hungary will need to strengthen existing policy instruments, including increasing the landfill tax rate and enforcing the waste regulation, as well as extending renovation support schemes and tailoring them better to promote the circular economy. However, to fully unleash the potential of circular building construction, new policy instruments are required. In the upstream, to support the uptake of the secondary materials market, policy instruments could include: i) developing quality standards for secondary materials; ii) introducing a tax on selected virgin construction aggregates; and iii) integrating minimum recycled content requirements into GPP criteria. To incentivise CDW recycling and reuse, the downstream measures will need to focus on: i) introducing EoW criteria for additional construction waste streams; ii) establishing a mandatory selective demolition system; and iii) consider developing an EPR scheme for construction products. Table 6.1 provides a list of key policy recommendations.

Table 6.1. Gap analysis and key policy recommendations for a transition towards a circular building construction sector

Life cycle stage	Gaps	Policy recommendations
Production	Absence of economic and regulatory incentives to shift construction materials from primary to secondary composition	Develop a secondary raw materials policy
		Develop a new quality standard and a quality label for secondary construction materials
		Simplify the procedure permitting the incorporation of secondary raw materials into construction projects
		Consider introducing a tax on selected virgin construction aggregates
Design and construction	Inadequate guidance to steer designers and constructors to prioritise design and construction in line with circular economy principles	Revise the current legislation on design and materials choices in buildings to include minimum recycled content requirements and the development of performance-based criteria for construction materials and components
		Develop circular design guidelines for buildings
		Adapt urban planning strategies to support the development of smart, sustainable and circular cities
		Revise the National Sustainable Construction Industry Strategy to include circular economy aspects
		Extend the use of GPP criteria for construction works and consider integrating minimum recycled content requirements into GPP

Life cycle stage	Gaps	Policy recommendations
Use	Weak incentives to extend a building's lifetime and the introduction of more intensive and flexible uses	Extend existing renovation support schemes and tailor them to promote circular economy principles
		Reduce value added tax on renovation works
		Promote shared and mixed-use concepts in public buildings by developing space-sharing strategies and revising zoning codes
End-of-life	Inadequate measures to incentivise the shift from landfilling to CDW recycling and reuse	Increase landfill tax rate and strengthen enforcement of waste regulation
		Introduce end-of-waste criteria for additional construction waste streams
		Develop a national construction and demolition strategy
		Establish a mandatory selective demolition scheme
		Consider developing an extended producer responsibility (EPR) scheme for construction products
Horizontal	Absence of horizontal tools to support a greater circularity in the construction industry	Enhance coordination and facilitate collaboration between stakeholders
		Improve capacity building, knowledge transfer and education
		Improve monitoring of construction materials uses and CDW generation
		Promote digitalisation of the industry
		Tailor government support for the circular transformation of SMEs

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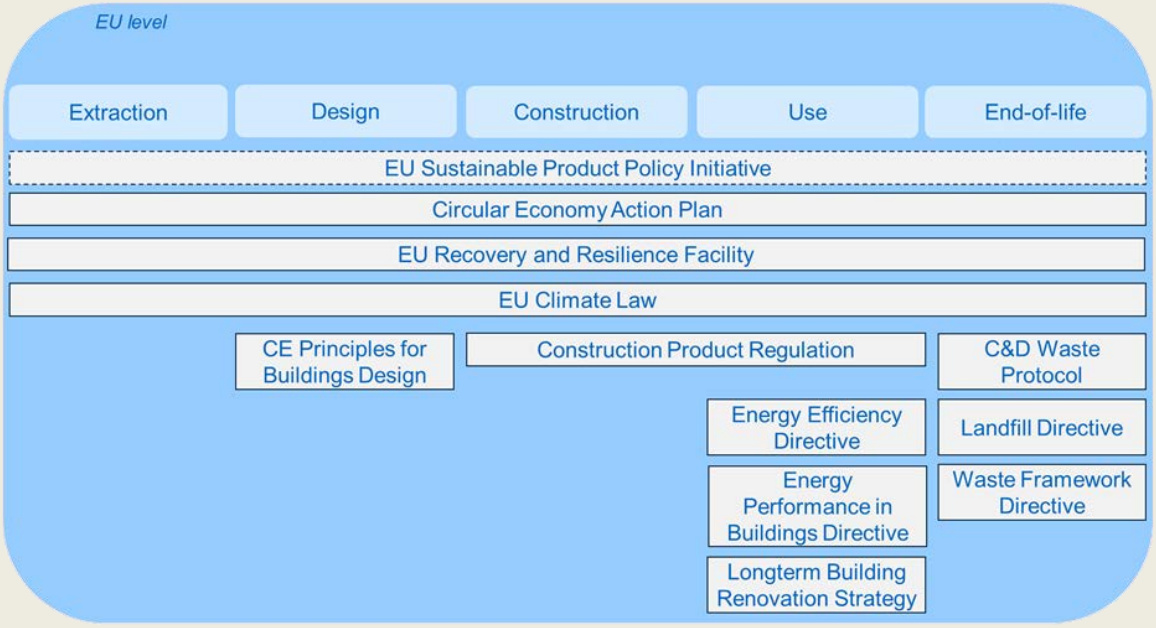
Annex 6.A. Supplementary information

Annex Box 6.A.1. EU policy framework for a circular construction sector

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

Annex Figure 6.A.1. Circular economy related policy landscape in the EU



Cross-cutting policies

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

- The circular economy is one of the focus areas of the European Green Deal and its New Circular Economy Action Plan (European Commission, 2020[87]), which foresees a Strategy for a Sustainable Built Environment (currently under development) (European Parliament, 2021[88]). Specific EU plans and policies cover various parts of the construction value chain in the buildings sector.
- At the design phase, the current EU circular economy approach for the construction sector is to enhance circular design, focusing on durability and adaptability, as well as waste reduction and high-quality waste management.
- Under the EU Recovery and Resilience Facility (European Commission, 2021[89]), loans and grants have been made available to support reforms and investments undertaken by Member States to mitigate the economic and social impacts of the COVID-19 pandemic while contributing to Europe's sustainable development. Flagship areas for investments and reforms include energy efficiency through renovation in buildings or re-/upskilling the local labour force.

- The first European Climate Law (European Commission, 2021[90]) proposes a legally binding target of net zero GHG emissions by 2050. This is supposed to be achieved by cutting emissions, investing in green technologies and protecting the natural environment. As emphasised in the European Green Deal, the circular economy has an essential role to play in reaching carbon neutrality, given that a significant share of GHG emissions in the construction sector is attributed to materials management activities (IRP, 2020[5]).

Policies targeting specific life cycle stages

The following policies are relevant for individual life cycle stages of construction at the EU level.

Design

The European Commission has introduced the circular economy initiative "Principles for Buildings Design" (European Commission, 2020[35]) in order to enhance resource efficiency. Another European initiative relevant to the design of buildings, their components and materials is the Sustainable Products Initiative (SPI). This includes a revision and extension of the Ecodesign Directive, which also affects the construction sector, as construction products are covered by this initiative. On 30 March 2022, the EC published a proposal for Ecodesign for Sustainable Products Regulation (ESPR) extending eco-design requirements to non-energy related products and to circular economy-related requirements (European Commission, 2022[91]). The proposal also suggests the introduction of digital product passports (DPPs).

Construction

The Construction Products Regulation (CPR) aims to achieve the proper functioning of the internal market for construction products by means of introducing harmonised technical specifications of their performance in the phases of construction or use. On 30 March 2022, the EC published a proposal for the revision of the CPR, which introduces recycled content requirements for construction products as well as DPPs, and empowers the EC to establish mandatory GPP criteria for public construction works (European Commission, 2022[34]).

Use

Policies relevant to the use phase of buildings only target energy consumption, and policies directly related to the circular economy in the use phase are largely absent. At the same time, the circular economy has been recognised as one of the tools to achieve carbon neutrality in national energy policies, such as national energy and climate plans (NECPs).

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

End-of-life

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

- The Waste Framework Directive (WFD) is the EU's legal framework for treating and managing waste. Construction and demolition waste (CDW) is one of the most important waste streams. The directive sets out a 70% target for non-hazardous CDW to be recycled by 2020, including backfilling (with exemptions for a few EU Member States).

- The EU Landfill Directive sets out operational requirements for landfill sites. It introduces a restriction on landfilling of materials that are suitable for recycling.

Annex Box 6.A.2. Strategic objectives and policy actions for CDW in Hungary

National Waste Management Plan 2021-2027 (NWMP 2021-2027)

The strategic objectives for CDW laid out in the National Waste Management Plan of 2021-2027 include:

- Increasing the rate of preparation for reuse and recycling.
- Promoting selective demolition and on-site recovery.
- Reducing the amount of landfilled waste.
- Increasing the number of drop-off locations for citizens.
- Improving control, monitoring and quality control.

The plan includes a proposal for two indicators to measure progress towards the objectives: the rate of preparation for reuse and recycling of CDW (with a target set to 70%), and the percentage of CDW landfilled (without a set quantitative target). To support a more sustainable management of CDW, the plan proposes a set of concrete measures, including:

- Strengthening the selective sorting of materials, removal of hazardous materials and safe handling.
- Establishing a selective sorting system for wood, minerals, metal, glass, plastics and gypsum.
- Encouraging efficient sorting on site and in inert processing plants.
- Promoting investment in on-site recovery.
- Establishing regional recovery centres.
- Setting up monitoring and control systems (such as a camera system, bridge scales, an online monitoring system, the designation of accredited laboratories).
- Establishing waste collection yards.
- Promoting the use of secondary raw materials, and the revision of technical road standards.
- Enforcing strict legal penalties for the illegal dumping of CDW.
- Introducing legislation on the end-of-waste status.
- Increasing the use of demolition waste for energy purposes.

National Waste Prevention Programme

The National Waste Prevention Programme has been drafted as part of the National Waste Management Plan 2021-2027. The CDW-related strategic objectives include:

- Avoiding the demolition of buildings by possibly repurposing buildings.
- Reducing primary raw materials use in production, construction, maintenance, conservation and in the demolition of construction products and structures.
- Increasing the life cycle of construction products.
- Dramatically reducing the amount of CDW going to landfill.

To achieve these objectives, the programme recommends a number of specific actions:

- Promoting alternative uses for obsolete buildings and structures.
- Setting up a coordination body to bring together the actors of the construction sector to find synergies and prompt common actions.
- Separate dismantling.
- Restructuring the building materials certification system.
- Establishing a waste transfer system.
- Establishing a mandatory minimum percentage of construction waste to green construction procurement in order to increase the reuse and recovery potential of CDW.
- Establishing sectoral legislation on CDW.

Source: Ministry for Innovation and Technology (2021[21]).

Annex Box 6.A.3. Strategies for the sustainable management of raw materials

Secondary raw materials policy of the Czech Republic

The secondary raw materials policy was developed in collaboration with experts from both academia and industry, and approved by the Czech government in 2014 (Ministry of Industry and Trade of the Czech Republic, 2016[92]). It is the first document establishing a national strategic framework for the use of secondary raw materials, defining 5 strategic objectives and 16 measures, with specific tasks developed in a separate action plan. The strategy identifies 10 commodities and sources of secondary raw materials, including CDW, that are of particular value for the country's production and export. The list of priority materials remains open to updates as business needs and the economy change. The overall objective of the national strategy is to promote self-sufficiency in raw materials by increasing the use of secondary raw materials.

Strategy for raw materials management in the Southern region of Denmark

The Region of Southern Denmark (Syddanmark) is preparing a new raw materials strategy, which will provide an opportunity to rethink raw materials management in line with the UN Sustainable Development Goals. The consultancy firm Metabolic has helped prepare inputs into this strategy, providing a conceptual framework for the sustainable management of raw materials in the region (Metabolic, 2020[93]). It has also analysed the current supply and consumption trends in the region, examined materials and activities in the value chain with the largest environmental impacts, and identified measures to successfully manage raw materials sustainably.

Annex Box 6.A.4. Quality standards and selective demolition for secondary raw materials

Austrian quality standards for recycled building materials

Published in 2015 and revised in 2016, the Austrian Recycling Building Materials Ordinance has as its main objectives the standardisation of recycling materials from CDW and their improved marketability. The ordinance sets out the procedures for construction and demolition, including conducting an audit of the on-site conditions prior to demolition. The audit should cover the presence of reusable components and pollutants or contaminants. The evaluation also has to follow the Austrian standard ÖNORM B 3151, which provides the specific dismantling procedure and the required documentation (European Commission, 2022[94]). The ordinance also establishes quality standards for the different recycling materials, defining the permitted input materials and the areas of application (the highest quality being classified as 'U-A' materials, which are no longer regarded as waste but as ready-to-use products). One major contribution of the ordinance in promoting a circular construction sector is the establishment of legal certainty and improved confidence in the quality of recycled building materials (Austrian Construction Materials Recycling Association, 2017[95]).

Moreover, the Austrian Construction Materials Recycling Association (BRV), an association of recycling companies formed in 1990 and member of the European Quality Association for Recycling (EQAR), offers recycling enterprises that join the Austrian Recycled Construction Materials Quality Insurance Association (ÖGSV) a quality label for recycled construction materials. The quality label, recognised as a quality assurance scheme under national law, is conferred on the basis of regular external and internal controls, which certify the meeting of quality standards according to guidelines by the ÖGSV. The BRV thus links public and private stakeholders, advising on the use of recycled construction materials and on adhering to national waste legislation (Austrian Construction Materials Recycling Association, 2017[95]).

Quality scheme for recycling CDW in the Netherlands

The recycling of CDW in the Netherlands started in the 1980s with the development of a national waste plan, implemented through landfill bans and recycling targets. The country's recycling industry was assigned the task to develop a quality assurance scheme for recycled materials, which started with the relatively simple crushing of inert CDW into aggregates. The quality of recycled aggregates, which improved over the years due to advances in production processes and quality controls, is assured through certification schemes covering mandatory requirements from the Soil Quality Decree. Asphalt and wood recycling have also become widespread, although a main alternative outlet for waste wood remains biomass for energy recovery. The recycling of other materials, such as flat glass and PVC windows, has proven more difficult as these constitute smaller fractions of CDW (Fédération Internationale du Recyclage, n.d.[96]).

Quality standards for recycled wood in France

Waste wood in France is classified into three categories: Class A (clean products, with no additives), Class C (heavily admixed products, containing hazardous substances, such as heavy metals), and Class B (anything between Class A and C, i.e. lightly admixed products). Different end uses eventually determine the regulations and quality standards that apply to recycled wood (Besserer et al., 2021[97]), such as the 2003 Order on the "Serviceability of wood-based panels intended for construction" (RECORD, 2019[98]). The basic waste law in France, inscribed under the Environment Code (Ordinance No. 2000-914), aligns French classification codes for waste wood with European ones and sets a landfill ban on waste wood, unless it cannot be reused or recycled (Economic Commission for Europe and Food and Agriculture Organization, 2021[99]).

European Standards for Waste from Electrical and Electronic Equipment (WEEE)

Following the requirement of the WEEE Directive and its article 8(5), the European Commission requested European Standardization Organisations (ESOs) to develop European standards for the collection, logistics and treatment of WEEE, including its recovery, recycling and preparation for reuse. The process of formulating standards is transparent and consensus based. The European Standards (ENs) are reviewed every 5 years, and the Technical Specifications (TS) are reviewed every 3 years. These standards reflect the state-of-the-art technologies and market needs, and can be used to support legislation. They have a harmonizing effect and can remove trade barriers and enhance economic growth (CENELEC, 2017[100]).

The objectives of the standards are to:

- Assist treatment operators in fulfilling the requirements of the WEEE Directive without placing unnecessary administrative burdens on operators of any size, including SMEs.
- Give additional guidance to operators.
- Cover the treatment of waste from all products within the extended scope of the WEEE Directive.
- Cover the collection and logistics of WEEE to allow for proper treatment.

Source: Adapted from OECD (2022[101]) and from sources reported in the box.

Annex Box 6.A.5. Economic instruments to disincentivise the use of virgin construction materials

Aggregates levy on sand, gravel and rock in the United Kingdom

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

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

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

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

- Revenues raised from the aggregates levy are redistributed to business through a 0.1% cut in the employer's National Insurance contributions. With this measure, the UK Government intends to shift taxation from the "good" to the "bad" (Seely, 2011[102]).
- A 10% share of the revenues raised from the aggregates levy are redistributed through an Aggregates Levy Sustainability Fund (ALSF). This fund provides a source of funding to R&D projects that are designed to deliver local environmental benefits to areas subject to the

environmental costs of aggregates extraction. The first objective of the fund is to reduce the demand of primary aggregates by promoting a greater use of recycled and secondary aggregates (Seely, 2011[102]; EEA, 2008[103]).

The introduction of the levy has contributed to an increase in the use of secondary aggregates. In 2020, the total UK sales amounted to 29%, which is the highest share of secondary aggregates in Europe (Highways, 2020[104]).

Lessons learned from Sweden

An interesting feature of Sweden's gravel tax has been the decision to incrementally increase the gravel tax over time. This appears to have been effective in sending a price signal to producers and consumers, reinforcing the need to shift away from natural gravel use. The Ministry of Environment predicted that companies would view the tax as an instrument that was likely to increase over time and so they changed their investment decisions. Such a "signal effect" would have strongly influenced companies to adapt their production plans. The gradual tax increases have also helped to facilitate an incremental restructuring across the aggregate industry.

Another lesson learnt from Sweden is the way in which competition issues were considered before the gravel tax was introduced. Although the tax intended to maintain natural gravel deposits in the southern part of Sweden (where natural gravel is scarce), it inadvertently imposed costs in northern Sweden (where natural gravel is abundant). This may have given the impression that the decision to introduce the gravel tax was not a cost-effective option for the North and had in fact distorted the market. A solution may have been to compensate the communities in the North that were most affected by using some of the revenue raised by the gravel tax for equity and social purposes. Instead, all the revenue from the tax was incorporated into the central budget and used to finance general government spending programmes.

Charges on minerals extraction in the Czech Republic

Instead of a tax, levy or duty, 11 other EU Member States, including the Czech Republic, increased charges on mining and extraction. In the early 1990s the Czech Republic introduced charges that were applied to the volume and area of extracted minerals. This system was originally designed to focus predominantly on strategic raw materials, such as coal, metals and high-quality mineral ores. In 2002 the scope of the charges was extended to include aggregate materials. The area charge is equivalent to EUR 3.6-36 (or CZK 100-1 000) per km^2 per year in accordance with local conditions and the impact to the environment, which is negligible compared to the total costs of a mining company. The beneficiaries of this charge are municipalities on whose territories the mining activities take place (EEA, 2008[103]).

Source: Adapted from OECD (2022[101]) and from the sources reported in the box.

Annex Box 6.A.6. Guidelines for a circular construction sector

EU Circular Economy Principles for Buildings Design

The EU's Circular Economy Principles for Buildings Design, developed within the framework of the Construction 2020 initiative and its multi-stakeholder Thematic Group 3 on "Sustainable use of natural resources", focuses on a set of sustainable design principles with the aim of reducing CDW generation and facilitating the reuse and recycling of construction materials. The guidelines target various groups, including building users, facility managers and owners, design teams, contractors and builders, investors, and government or local authorities, among others. General principles for circular buildings design are presented in addition to principles relevant for specific target groups (European Commission, 2020[35]).

Ellen MacArthur Foundation Circular Buildings Toolkit

Launched jointly by Arup and the Ellen MacArthur Foundation, the toolkit is intended to help designers and planners mainstream the circular economy principles into the design and operation of buildings. The main objective of the toolkit is to translate the principles of the circular economy into concrete strategies and actions for construction projects. Alongside circular building guidelines, the platform showcases exemplary case studies of projects where circular economy principles have already been successfully applied. The toolkit, which is regularly updated with new resources, is free to use and has open access (ARUP and Ellen MacArthur Foundation, n.d.[105]).

Building As Material Banks (BAMB)

The BAMB project, funded under EU Horizon 2020, represented an initiative to promote circular design in buildings through the use of instruments, such as materials passports and reversible building design. The project, which started in 2015 and lasted for three and a half years, brought together 15 partners from 7 European countries in a collaborative effort. Outputs included the development of tools, such as best practices and guidelines, which received inputs from lessons learned during pilot projects (BAMB, n.d.[106]).

New York City's Zero Waste Design Guidelines

New York City's Zero Waste Design Guidelines are an example of the application of circular economy principles in construction at the local level. These guidelines are the result of collaboration of architects, planners, developers, city officials and other stakeholders working towards the city's ambitious goal of sending zero waste to landfill by 2030. Improving the design of the built environment plays a critical role in achieving such a target, with the guidelines meant as a resource to help building designers, operators and planners reduce waste and improve the circularity of material flows (Zero Waste Design, n.d.[107]).

Annex Box 6.A.7. Circular planning in urban design

A "master" urban plan in Vienna

Aspern Seestadt is one of Europe's largest urban development projects, offering workplaces and housing to more than 20 000 people as well as spaces for education, culture, shopping and leisure in Vienna's 22nd municipal district. Its design was conceived from an underlying "master plan" that is flexible and robust enough to respond to change. Seestadt was designed as a city of short distances, giving priority to pedestrians and cyclists, while a well-developed network of public transport and innovative mobility options ensure city-wide connectivity. At the centre of the urban project is the 50 000 m^2 lake and surrounding park, while a circular boulevard interlinks the various city quarters. The plan for Seestadt was developed with the intention of serving as a basis for a future-proof smart city, detailed yet flexible in its planning. The Vienna City Council has approved the plan to serve as an urban development concept and the basis for all subsequent planning measures (Die Seestadt Wiens, n.d.[108]).

Copenhagen's Nordhavn

Copenhagen's new district of Nordhavn, a former industrial shipyard, is setting the benchmark for sustainable urban planning. Urban development in the area has been ongoing for a decade and is planned to end in 2050, providing housing and workspaces for about 80 000 people. Current development plans have put the municipality on track to receive the German Sustainable Building Council's platinum award certification. The area is being designed as a "five-minute city", meaning it will be possible to reach any destination or public transport within a five minute walk from any given point in the district. Everything from energy-efficient heating pumps, electric transportation and energy storage systems have been engineered by local companies, utility providers and government entities within the "smart city's energy lab". A city-wide energy data system collects real-time information on clean energy production, weather, energy costs and consumption levels at any given moment, allowing authorities to efficiently manage district-wide energy usage. Residents of the Harbour Park residential development regularly give up control of their personal heat supply systems, while a supermarket has technology in place to capture surplus heat from cooling systems and transfer it to a district heating network (Mary Holland, 2021[109]).

Annex Box 6.A.8. Green public procurement (GPP) criteria

EU's GPP criteria

The European Commission developed model GPP criteria for certain applications or groups of products (European Commission, 2008[110]). The Office Building Design, Construction and Management criteria cover the following aspects and measures, among others:

- Include selection criteria for project managers, architects and engineers with experience in sustainable building design, and for contractors in implementing improved designs and specifications.
- When specifying materials, include criteria to reduce their associated environmental impacts and resource use.
- Give preference to designs that incorporate high efficiency or renewable energy systems.
- Install physical and electronic systems to support the ongoing minimisation of energy use, water use and waste by facility managers and occupiers.
- Within the contract, give contractors responsibility to train the users of the building on sustainable energy use and, where they have ongoing responsibilities, for monitoring and managing energy performance for several years after construction.

GPP in the Netherlands

The Department of Public Works of the Ministry of Infrastructure and the Environment [Rijkswaterstaat, RWS] developed a methodology for infrastructure projects whereby the functional specification of the tender, together with the quality input from the client, ensure an innovative and high-quality solution. The bidder is also asked to respond to specific quality criteria. The RWS uses the "most economically advantageous tender" (MEAT) methodology, including specific sustainability criteria (OECD, 2016[111]).

The RWS decided to focus on two criteria when assessing the sustainability attributes of offers, work processes and associated products: CO_2 emissions and environmental impact. Two instruments were therefore developed: the CO_2 performance ladder (for CO_2 emissions) and "DuboCalc" (for environmental impact). The CO_2 performance ladder is a certification system with which a bidder can show the measures in place to limit CO_2 emissions within the company and its projects, as well as elsewhere in the supply chain. DuboCalc is a life cycle assessment (LCA) based tool that calculates the sustainability value of a specific design based on the materials to be used. Bidders use DuboCalc to compare different design options for their submissions. The DuboCalc score of the preferred design is submitted with the tender price.

Source: Adapted from OECD (2022[101]) and from the sources reported in the box.

Annex Box 6.A.9. Shared and mixed-use concepts in public buildings

Schools as shared use facilities in Western Australia

In Western Australia, public buildings, such as schools, are regarded as an opportunity for local communities to access a range of high-quality services, resources and facilities outside of school hours, providing a greater return on a public investment. Several individual arrangements between schools, local governments and communities already exist. However, a guide has been prepared by the Department of Sport and Recreation in collaboration with the Department of Education to provide a standardised approach to developing shared use facilities. The guide is intended for stakeholders considering the shared use of community and school facilities, and informs on their planning, development and management. Besides the several benefits to both schools and local communities, shared use facilities provide advantages in terms of minimising the duplication of resources by maximising public access (Government of Western Australia, n.d.[112])

Social purpose mixed-use development in Toronto

The Infrastructure Institute of the University of Toronto's School of Cities partnered with the real estate agency that manages the City of Toronto's real estate portfolio to promote the mixed-use model, blending residential, commercial and other uses, for the creation of more affordable housing. Examples of mixed-use include the co-location of schools, libraries, recreation centres and childcare into community hubs, or affordable housing built on top of fire stations and paramedic centres. The institute also launched a series of free training models, and will provide an accelerator programme for organisations undertaking social purpose real estate projects (University of Toronto, 2022[113]).

Annex Box 6.A.10. Landfill taxes

Denmark has an overall CDW recycling rate of 87% (measured in 2014 and 2015), which is the result of a long-standing policy effort, including the introduction of a weight-based landfill tax in 1987. The average gate fee for landfilling is EUR 44 per tonne, while the actual landfill tax stands at EUR 63 per tonne. Since its introduction, the tax has been incrementally increased (up from DKK 40 per tonne - around EUR 5 per tonne - in 1987) and differentiated, which gives operators clear incentives to change their waste management practices. The landfill tax, accompanied by subsidies for cleaner technology and recycling projects, local government sorting schemes, virgin material taxes, regulations on the use of waste material in construction, and rules on selective demolition for bricks and concrete, has led to a remarkable increase in the recycling of CDW (COVEC, 2012[114]). Moreover, in order to decrease the administrative burden related to CDW, Denmark grants the possibility to recycle CDW without a specific permit, provided that the waste is sorted, unpolluted and processed (European Commission, 2019[81]).

Annex Box 6.A.11. Construction and demolition waste strategy

The CDW in Malta historically consisted of extensive backfilling and land reclamation activities. According to the latest data available, Malta has reached a very high recovery rate of CDW and has already met the WFD target for its preparation for reuse, recycling and recovery. The new Waste Management Plan for the Maltese Islands includes specific provisions for the reuse and recycling of CDW in Malta, recognising the need to move away from backfilling to recovery operations higher in the waste hierarchy. Furthermore, it stresses the significance of reusing traditional Maltese building materials (e.g. Maltese stone), and CDW prevention by promoting the refurbishment of old buildings instead of demolition.

In this context, the Construction and Demolition Waste Strategy for Malta (2020-2025) aims to address current issues in the country's CDW management and identify possible short and long-term measures to shift CDW treatment from backfilling towards reuse and recycling (ERA, 2021[66]). It recognises the need to raise both the quantity and quality of secondary raw materials, while also safeguarding human health and environmental standards. The strategy identifies four priority areas: i) planning and design, ii) waste management, iii) quality management, and iv) the policy and regulatory framework. For each of these areas, a set of target measures, which are key to successfully managing CDW, has been identified. These include improving building design in order to ensure its recycling and recovery, innovating and incentivising the recycling industry, instilling a behavioural change for stakeholder within the construction and demolition sector, and better regulating CDW, to name a few. Moreover, the strategy outlines an implementation plan to achieve the proposed measures.

Annex Box 6.A.12. EPR scheme for construction and demolition waste

In France, as of 1 January 2022, all producers, importers and retailers of construction products and materials must ensure the free recovery and treatment of the resulting CDW. They need to do so through one or more eco-organisations and in collaboration with local authorities. Article 1 of Decree no. 2021-1941 (Journal Officiel de la République Française, 2021[115]) defines the scope and coverage of the EPR scheme (applying to all products and materials intended to be permanently incorporated in a building, excluding those used only for the duration of construction works, such as excavated earth, industrial tools and technical equipment). Article 1 further sets the criteria for waste sorting and collection, as well as the obligations of eco-organisations in terms of organisation and geographic coverage. Additionally, France is intending to install new professional waste collection centres for the free collection of sorted materials.

As a result of this law, Valobat was established by 37 leading companies in the manufacture of building and construction products and materials, whose aim is to improve the recycling of building waste (Valobat, 2022[116]). The construction materials to be collected separately are defined across 16 categories, as shown in Annex Table 6.A.1.

Annex Table 6.A.1. Construction materials categories

Category	Materials
Partitions and ceilings	Plates and partitions, partitioning and ceiling accessories (supports, fasteners, dowels, angles, hooks, uprights, rails, cleats, inspection hatches)
Coverage and sealing	Adhesives, sealing strips, felts, films, fittings, bands, ridges, plates, tiles, green roof devices, roofing and sealing accessories (steel, closures / flashings, collars, hooks, leaf guards, anti-pigeon spikes)
Heating equipment	Wood heating (wood fireplaces, wood/gas stoves and inserts), hot water/gas radiators, hot water towel dryers
Electronic equipment and medium voltage electrical equipment	Lifting and moving equipment, medium voltage transformers and switchgear
Sanitary equipment, shower room and bench	Baths and shower trays, washbasins, basins, sinks, walls and bath screens, taps, waste and evacuation, WCs, other sanitary equipment (handrails, complete shower cabins, inspection hatches)
Façade	Curtain walls, façade frames, cladding/cladding products and structures (concrete, bricks, joint covers, gratings, trellises, expansion joints, mouldings, canvas)
Big work	Reinforcement steels, prefabricated elements, masonry, frameworks, floors, foundations, frames, braces, building structures (basting, concrete, gratings, cement, joists, beams, etc.)
Insulators	Hemp, bulk cotton/textile fibre, bulk wood fibres, bulk cellulose fibres, cellulose wadding, insulation panels and rolls, complex products of insulation etc.
Joinery	Railings, handrails, balcony separator, protective grilles and curtains, interior joinery, garage doors, sun and pest protection, hardware and accessories, verandas and canopies (framework), glazing, shutters and closures, other joinery (stairs)
Mortars, coatings, paints, varnishes, resins, preparation and implementation products	Glues, sealants and foams, mortars and coatings, paints, stains and varnishes, other products (adhesives, resin)
Other networks (sanitation, water and gas supply)	Inert materials, concrete, plastics, PVC, metals
Heating and sanitary networks	Measurement and metering accessories (water meters, thermometers), network protection accessories (water hammer arrestors, anti-pollution valves, filters, balancing valves), smoke pipes, insulation and sealing, heating/sanitary fittings, tubes, hoses and fittings, other accessories (mortar, fixing plates for fitting)
Drainage and sewerage networks	On-site sanitation, pipes, tanks and reservoirs, gutters, downspouts and accessories, drainage systems
Electrical and communication networks	Cables, mouldings, trunking, plinths, cable trays and accessories, tubes, fittings and accessories, connection accessories (cable storage box, flush-mounting boxes, grommet, cover gasket, etc.)
Coatings and exterior fittings	Shelters, garages and carports, watering and water recovery, fences and gates, fixed furniture, paving, paving and coverings, swimming pool universe and accessories, other outdoor equipment (hydrant and fire hydrant, gratings, etc.)
Floor, wall and ceiling coverings	Ceiling coverings (stretch ceiling, etc.), floor coverings (floor tiles, slabs and strips, stone, wooden floors, resin, etc.), wall coverings (wall tiles, panelling, wallpaper, etc.), other covering equipment (skirting, nosing steps, mouldings, etc.)

Source: Valobat (2022[116]).

Annex Box 6.A.13. Inter-sectoral collaborations and partnerships

Green Deals for innovation in circular activities in the Netherlands

Green Deals in the Netherlands offer a best practice example of collaboration between government, private companies and other stakeholders in addressing cross-cutting issues. Such deals consist of mutual agreements defining specific initiatives, actions and quantitative targets for all involved stakeholders. The government then commits to the removal of regulatory obstacles to support sustainable projects. Several of these deals included projects related to innovation and the circular economy, but mostly involve recycling (Green Deal, n.d.[117]).

Public-private digital discussion platform for a circular construction sector in the Netherlands

Rijkswaterstaat, in collaboration with the National Real Estate company and the National Standardisation body, sought to achieve a consensus on the concept of a "circular building sector" through the establishment of a public-private discussion platform. Discussions with several stakeholders covered issues such as how to measure circularity, with which type of tools, and the information required. As a result, guidelines were drawn up from the discussions, including the "Core method for measuring circularity in the construction sector" or "Passports for the construction sector". More recently, the focus of discussion has shifted to information and data exchange (PLATFORM CB'23, 2020[118]; DigiDealGO, 2020[119]).

Source: Adapted from OECD (2022[101]) and from sources reported in the box.

Annex Box 6.A.14. Capacity building and knowledge transfer

Circular Economy Training Programme

With the support of nine Slovenian ministries, EIT Climate-KIC has developed a Circularity Thinking course for stakeholders and practitioners of the Slovenia Deep Demonstration project (Climate-KIC, 2022[120]). Based on research and a feasibility study, the programme aims to implement change by developing an understanding of how circular economy tools and approaches can be used in developing strategies, policies and plans. It is specifically designed for individuals working in municipalities and governments, as well as business associations working at the national level, to understand how to support the transition to a circular society. It considers the complexities of systems and how the perspectives of different stakeholders need to be taken into account.

Holland Circular Hotspot

Holland Circular Hotspot is a private-public platform composed of the HCH foundation, (local) government authorities, knowledge institutes and companies (Holland Circular Hotspot, n.d.[121]). It serves as a network where key stakeholders collaborate and exchange knowledge with the aim of stimulating entrepreneurship in the field of circular economy. The founding of HCH emerged from one of the actions of the Dutch government programme "Nederland Circulair 2050".

The activities of Holland Circular Hotspot are to:

- Offer insights in and access to the network of Dutch circularity pioneers.
- Develop and exchange knowledge on international market opportunities for a circular economy.
- Create circular opportunities internationally by matching offer and demand.
- Support companies and organizations that want to contribute to the internationalization of a circular economy.
- Stimulate cooperation between the private sector, knowledge institutions, governments and other relevant parties.
- Provide international visibility of Dutch CE innovations/best practices.
- Facilitate access to Dutch and international (financing) instruments and programmes.

MSc programme Circular Design in the Built Environment – TU Eindhoven, Netherlands

This programme, at one of the main technical universities in the Netherlands, is designed to provide students with theoretical knowledge and practical (real world) assignments, who want to understand energy, waste and material flows, and the associated emissions that come with building in the construction sector (Eindhoven University of Technology, n.d.[122]). Mainstreaming the circular economy curricula into courses on traditional urban planning, architecture and design helps to prepare the next generation of decision makers, designers and home-owners to follow ecological principles when thinking and building the homes and facilities of the future.

Annex Box 6.A.15. Central database for construction materials

France's National Buildings Database

The National Buildings Database [Base de données nationale des bâtiments] in France is an open-data project cross-sourcing geospatial information from about 20 different datasets in the public domain, representing a unified identity map of more than 21.4 million buildings on French (metropolitan) territory (DATA.GOUV.FR, 2022[123]). The data relate to the morphology of buildings, the type of uses, embedded materials and technical equipment, energy consumption and performance, as well as administrative and economic data. This unified database allows users to navigate information on the national built environment, bypassing the limitations of individual datasets. Relevant applications include the fields of energy transition (such as the Bat-ID project on monitoring buildings' energy renovation), circular economy, social housing, infrastructure networks, and others. Since April 2022, publicly available data can be downloaded directly from the government's website.

Data-driven CDW management in the Netherlands

Rijkswaterstaat, part of the Dutch Ministry of Infrastructure and Water Management, is responsible for the design, construction, management and maintenance of the main infrastructure in the Netherlands. The maintenance of over 6 000 assets, including bridges, sluices, viaducts and aqueducts, and over 3 000 kilometres of national road infrastructure, would not be possible without access to detailed information. Notably, information on assets' performance, their materials and components, as well as the repair and maintenance undertaken over their lifetime, is crucial for the potential future reuse of embedded materials. Compared to previous years, in which this informational aspect was largely overlooked, Rijkswaterstaat is now explicitly seeking to become a data-driven organisation (Rijkswaterstaat, 2019[124]).

Some of Rijkswaterstaat's data-driven initiatives include discussions on digitalising the construction sector, for example, through the piloting of Dutch start-ups, such as Excess Materials Exchange, which aims to develop a cross-sectoral "dating site for secondary materials" based on blockchain technology (Excess Materials Exchange, 2019[125]), and Madaster, an online materials library, aiming to become the central register of construction materials use and to facilitate their reuse (Madaster Foundation, 2020[126]).

Source: Adapted from OECD (2022[101]) and from the sources reported in the box.

Annex Box 6.A.16. Digitalisation strategies for the construction sector

Bulgaria's digital transformation strategy

Adopted in July 2020, the Digital Transformation of Bulgaria strategy for 2020-2030 outlines the vision, goals and general policy framework for the digitalisation of the country's key public and economic sectors. The strategy takes into account the UN 2030 Agenda for Sustainable Development and the role of digital tools to achieve the SDGs, as well as the EU guidelines and commitments to achieve the digital transition. In line with the European Green Deal, the strategy envisions specific measures targeted at the digitalisation of the construction sector, which should ensure the application of circular economy principles. More specifically, the digitalisation of the construction sector is intended to cover the entire life cycle of buildings using digital databases, 3D models and electronic passports for the improved design and management of construction, repair, renovation and demolition works (Bulgarian Government, 2020[127]).

Estonia's digital construction cluster

In 2015, the e-difice Digital Construction Cluster was launched to bring together private and public stakeholders to initiate the digital transformation of the Estonian construction sector. In 2019, this was superseded by the Estonian Digital Construction Cluster, the main purpose of which is to develop an innovative digital construction environment that encompasses the entire construction life cycle and value chain (European Commission, 2020[128]).

Source: Adapted from OECD (2022[101]) and from the sources reported in the box.

Annex Box 6.A.17. Tools to accelerate the circular transition of SMEs

Circular Economy Business Support Service in Scotland

Scotland's Circular Economy Business Support Service is a one-to-one service supported by the European Regional Development Fund, providing consultancy to SMEs across all sectors. The service is intended to help companies discover more circular ways of doing business, including adopting principles of sharing resources, modular design, reuse and repair, remanufacturing and reprocessing. Once the service is completed, businesses may be eligible for funding for prototyping, lab testing or field testing activities via the Circular Economy Development Grant. The Circular Economy Investment Fund is available for projects nearing commercialisation (Zero Waste Scotland, 2020[129]).

Circular Business Challenge in the Netherlands

Another exemplary support programme for SMEs is the Circular Business Challenge (previously Circular Economy Challenge) provided by Rabobank since 2014. This is a regional initiative to help entrepreneurs develop circular-inspired businesses in the Netherlands. Companies and entrepreneurs are offered practical workshops and other forms of support, including financial support, to develop innovative business models. Over 50 companies have participated in the challenge, acting as a source of inspiration and serving as role models for circular entrepreneurship in the country (Rabobank, n.d.[130]).

European Framework for Sustainable Buildings

Developed specifically for SMEs in the construction and demolition sector by the European Commission, Level(s) is a voluntary reporting framework to help professionals working in the built environment to assess and monitor the sustainability performance of buildings. From developers and investors to architects, engineers, contractors and building occupants, this open-source tool helps complement existing assessments and certification schemes to encourage more consistency and a common language between projects and countries. Project partners are Green Building Councils throughout Europe (European Commission, n.d.[131]).

Notes

[1] By 2020, CO_2 emissions in construction had fallen by an estimated 10%, driven by reduced energy demand during the COVID-19 pandemic and the decarbonisation of the power sector (UNEP, 2021[4]).

[2] According to estimates for the EU 27 and the United Kingdom, applying selected circular economy strategies in the buildings sector can lead to reductions of almost two-thirds of materials-related GHG emissions across a building's life cycle (by 2050 compared to the 2015 baseline) (EEA, 2020[133]).

[3] Including buildings and civil engineering works, renovations, repairs, maintenance and demolition, in line with the definition of the Hungarian Central Statistical Office.

[4] With the exception of 2020, when construction output was down by 10% due to the COVID-19 pandemic (Hungarian Central Statistical Office, 2022[134]).

[5] Using an average conversion rate of 351 HUF to EUR 1 in 2020 and 275 HUF to EUR 1 in 2010 as reported by the Hungarian National Bank.

[6] Note that based on data reported in the Unified Waste Management Information System (EHIR), the share of CDW in total waste generation was 40% in 2018 and 44% in 2020 (EHIR, 2020[135]).

[7] Note that based on data reported in the EHIR, the increase already occurred in 2017 with a rate of 47% (EHIR, 2020[135]).

[8] Note that the figure is based on data using European Waste Catalogue (EWC) codes and shows a decrease in landfilling of CDW to 15% and an increase in materials recovery of CDW to 85% in 2018 (compared to 30% and 70%, respectively, in 2010) (EHIR, 2020[135]).

[9] The rules and calculation methods set out in Article 11(2) of the WFD are used to determine whether the EU target regarding the rate of preparation for reuse and recycling of CDW has been reached. All CDW from category 17 of the EWC (except hazardous waste and naturally occurring materials under code 17 05 04) are included in the target calculation (Ministry for Innovation and Technology, 2021[21]).

[10] In accordance with the Act CLXXXV of 2012 on Waste, backfilling is a recovery or disposal operation involving the replacement of non-waste materials by waste suitable for a specific purpose in the course of the restoration of an extractive site or landscape. There is no recent data available on the rate of backfilling in Hungary. However, in 2013 almost 63% of recovered CDW was backfilled (Deloitte, 2015[63]).

[11] The decarbonisation planning process does not set its own waste management targets and instruments but supports the waste prevention, disposal and recycling efforts of the National Environment Programme, the National Environmental Technology Innovation Strategy and the National Waste Management Plan. The National Energy Strategy aims to increase the energy-efficient recovery of demolition waste from building demolition as one of the short-term actions that define the detailed tasks for the decarbonisation of the building stock.

[12] All other targets spelled out in various Hungarian policies and regulations provide only an indirect support to circular economy uptake in the building construction sector. These include the annual renovation targets for residential buildings (3%) and public buildings (5%) by 2030. The underlying rational is to reduce total energy consumption by about 20% and CO_2 emissions by about 18% (Ministry for Innovation and Technology, 2021[19]). Other more general targets relate to energy efficiency (European Commission, 2021[137]), energy consumption, the integration of renewable energy sources, and decarbonisation (European Commission, 2019[136]).

[13] Given that no new target has been set after 2020, the 70% target will be maintained for the remaining years (pending EC's decision by 2024).

[14] The Action Plan for the Exploitation of Energy Mineral Resources and Stockpile Management covers only energy-related mineral resources, including coal, hydrocarbons, domestic uranium ore deposits and geothermal energy.

[15] To boost prevention and management of CDW, work to prepare a new government decree began in 2018. Its aim is to introduce mandatory waste prevention plans for construction activities, promote selective demolition and the reuse of recovered materials (Ministry for Innovation and Technology, 2021[21]).

[16] Hungary is also missing a national raw materials policy for primary materials. Ideally, the secondary and primary raw materials policies would jointly improve raw materials self-sufficiency and security by increasing the use of recyclates and turning waste into resources. The policies would also facilitate and more effectively plan the sourcing and transport of virgin materials that cannot be entirely substituted.

[17] Hungary has a mining royalty fee that applies to the extraction of virgin construction materials. However, the fee is not conceived as an economic instrument for environmental purposes (OECD, 2018[15]).

[18] The construction sector is currently affected by a sharp increase in prices and a shortage of several raw materials. Imposing taxes on primary materials in the short term might further undermine the functioning of the construction market, especially for SMEs. Before implementing the tax, it is recommended that Hungary carries out an assessment of how the tax will correct the market failure and how it will impact on environmental quality and economic efficiency. This should be compared with impacts resulting from the use of other regulatory approaches (Söderholm, 2011[31]). To avoid a steep increase in the cost of building materials and construction products, Hungary may consider incremental tax increases over several years. This approach could send positive price signals and influence companies to gradually adapt their production plans.

[19] The main source of law is the Hungarian Civil Code (Act V of 2013), which contains the general provisions regulating contracts for the design and conduct of building works. However, parties are free to deviate from the rules.

[20] 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 – may become mandatory.

[21] The Civil Code (Act V of 2013) and the Construction Act (Act LXXVIII of 1997) form the main legislative basis for the construction phase. Yet, neither of them refers to circular economy principles.

[22] The Dutch Circular Construction Economy Transition Agenda can be taken as a source of information (Circulaire Bouweconomie, 2018[138]).

[23] The Sustainable Hungary Programme, established by the Public Procurement Authority, aims to provide public institutions with a platform for cooperation in public procurement in the areas of environmental protection, climate protection and strengthening economic sustainability. The Sustainability Working Group brings together the Public Procurement Authority and the largest Hungarian contracting authorities and representatives of organisations cooperating with the Authority in the field of sustainability.

[24] The Green Code sets out detailed regulations for the conduct of public procurement procedures, which also cover the planning and implementation of the procedures and the fulfilment of contracts.

[25] Recycled content requirements is a regulatory requirement for producers to use a minimum percentage of recycled materials in their production, which creates incentives to use recycled materials instead of virgin or non-recyclable materials. It not only makes recycled aggregates more competitive, it also helps to

decrease the use of virgin materials and divert CDW from landfills. Such a requirement has been implemented within public procurement policies in Japan and in Scotland. For instance, 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[139]). The EC proposes to introduce mandatory recycled content requirements for construction products and materials within the context of the revision of the CPR (European Commission, 2022[34]).

[26] In Hungary, buildings represent the largest share of energy consumption, with around 27% of total final energy used in residential buildings and another 6% in public buildings (Balázs Zay, 2021[146]).

[27] According to the Hungarian National Asset Management Inc. survey on the technical condition of condominiums, 34-36% of prefabricated housing built after 1960 is in need of renovation (Társasházi Háztartás, 2022[147]).

[28] There are two perspectives of achieving sustainability in the buildings use phase: i) improving energy efficiency; and ii) keeping materials for longer. The policy recommendations in this chapter focus on the material perspective.

[29] The Housing Subsidy for Families (CSOK) scheme offers non-refundable state subsidies for purchasing or constructing residential buildings. The amount of subsidy is linked to the number of existing or planned children. For households with two or more children, subsidies for new homes are substantially higher than subsidies for the renovation of existing structures (OTP Bank, 2022[149]).

[30] A recent study showed that there is public interest in the renovation of at least 1.4 million flats over the next 5 years. This demand could be even higher if accompanied by non-repayable grants supporting 30-40% of the investment cost, coupled with repayable grants. Even if only half of them were to happen in the next five years, Hungary could save nearly 420 000 tonnes of CO_2 and create around 100 000 new jobs (Magyar Energiahatékonysági Intézet, 2021[148]).

[31] Civil engineering, especially road infrastructure in Hungary, has a great potential for absorbing secondary raw materials in road construction. However, current legislative barriers (such as technical limits and absent quality standards) significantly impede the actual reuse of these materials in the construction of new surfaces.

[32] Reducing legal uncertainties regarding waste treatment contributes to increasing the safe use of secondary raw materials. The EoW criteria sets out rules on when waste ceases to be waste and obtains a status of secondary raw material or a by-product (European Commission, n.d.[140]). The revised WFD recommends implementation of EoW criteria to promote a level playing field for secondary raw materials (European Parliament, 2018[68]).

[33] A specific case study on mineral CDW used as building material under EoW status has been analysed in a recent report (European Commission, 2020[132]). An earlier report by the Joint Research Centre 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[141]).

[34] The economic viability and environmental sustainability of selective demolition largely depends on the characteristics of the buildings to be demolished as well as on the local markets for specific recycled materials. Additional energy requirements for the selective demolition also need to be taken into consideration (Pantini and Rigamonti, 2020[150]).

[35] Recovered asphalt is classified as waste under the current EWC. It therefore ends up deposited in one of the many sites designated by the State where it becomes worthless over time. According to the interviewed stakeholders, it would make more environmental and economic sense to reuse the reclaimed asphalt directly on site. This is, however, hindered by the technical limits for incorporating reclaimed asphalt into new asphalt layers. The qualification of reclaimed asphalt for reuse therefore requires the introduction

of a specific quality standard. The Hungarian Road and Railway Society is currently developing such a qualification specification.

[36] As noted by the interviewed stakeholders, in addition to introducing mandatory selective demolition, Hungary also needs to reduce the administrative burden for constructors to collect and later reuse residual building materials from construction sites and for waste operators dealing with the recycling of waste on site. The recovery of materials is currently hindered by the fact that dismantled material is first classified as waste and must later be re-certified for its reusability by an operator with a waste management licence. Should Hungary decide to revise the existing regulations, it is recommended to consult relevant stakeholders for specific materials and waste streams.

[37] According to the interviewed stakeholders, the recent study on carbon footprint reduction in the construction industry by the National Council for Sustainable Development is the only assessment of construction waste from a circular perspective in Hungary thus far. The National Environmental Information System (OKIR) (Ministry of Agriculture, n.d.[145]) contains data on waste composition based on the EWC codes, however, its coverage and level of detail are not sufficient to identify the availability and quality of recyclable materials for subsequent reuse.

[38] Industrial symbiosis is a process through which waste streams or by-products of an industry or industrial processes become the raw materials for another. In Hungary, such a business model has not yet been applied. However, according to the interviewed stakeholders, a potential for regional industrial symbiosis between mines and CDW operators has already been identified. This could contribute to mitigating the fluctuating demand of construction materials (30-40% annually) during peak times, while triggering a shift towards a higher utilisation rate of secondary raw materials in the long term.

[39] Feedback from the industry and public sector indicates that digital twins could be particularly beneficial for promoting the digitalisation of the construction industry in Hungary. However, public sector actors will also need to build their BIM-related capacities, find a balance between price and quality, and make sure that companies of all sizes will be able to leverage these opportunities to digitalise. Hungary already has a national BIM standard/guidance in place, but could further benefit from establishing a dedicated BIM national working group.

[40] The only well-established initiative in the construction sector is Madaster (n.d.[142]), a digital registry and archive of the materials applied in buildings and construction structures. Until the EC develops a harmonised approach for DPPs, Hungary could encourage construction stakeholders to use this registry, possibly linking the information gathered to the new database for CDW (discussed in the section “Better monitoring of uses of construction materials and CDW generation will accelerate the uptake of more circular practices across the industry“).

[41] This tool can be used on a local and regional level by initiating (co-creation) workshops with residents and other relevant stakeholders, such as construction companies, architects and municipalities.

[42] Hungary has already introduced a number of measures targeting SMEs. Specific measures targeting the digitalisation of SMEs have been developed within the Modern Enterprises Programme (Hungarian Chamber of Commerce and Industry, n.d.[143]). The Green National Champions programme provides financial support in the form of repayable grants to MSMEs with high growth potential related to the green economy and industry. In the construction industry, this programme targets the development of new recycling technologies to produce viable construction materials from CDW (Holland Circular Hotspot, n.d.[144]). A substantial part of funding – tied to Hungary’s Partnership Agreement for 2021-2027 – is targeted to support improvements among MSMEs, specifically in the areas of digitalisation, R&D&I, market entry, circular economy, waste recycling, strengthening the secondary raw material market, new technologies, building energy and renewable energy investments, as well as the modernisation of energy production processes (Government of Hungary, n.d.[151]).

7 Transition to a circular life cycle for plastics

This chapter develops policy recommendations for the transition to a more circular plastics life cycle in Hungary, with focus on the most frequently used polymers in packaging, construction, and single-use plastics beyond packaging. It provides an overview of the current situation and policy landscape, identifies areas for improvement and proposes a set of concrete policy recommendations. The recommendations are supported by international good practices.

7.1. Closing the plastics loop is key to the transition to a global circular economy

Plastics are highly versatile, light and affordable. They are found in numerous applications, such as in packaging, construction, transportation and electronics. However, the proliferation of plastics has also led to significant environmental concerns along the entire life cycle of the material (OECD, 2022[1]). The circular economy can help minimise these environmental impacts.

7.1.1. The current plastics life cycle is far from circular

In 1950, global plastics production stood at 2 million tonnes (Mt). Since then, plastics production has increased 230-fold, reaching 460 Mt in 2019 (OECD, 2022[1]). The majority of plastics in use today are virgin (primary) plastics, mostly made from crude oil or gas. Recycled (secondary) plastics are quickly gaining ground, but they only make up 6% of the market share.

Consequently, plastic waste has also increased substantially, doubling since the turn of the century and reaching 353 Mt in 2019 (OECD, 2022[1]). A significant share (almost two-thirds) of plastics applications (such as packaging, consumer products and textiles) has short lifetimes, becoming waste within five years. The vast majority of plastic waste is landfilled (50%) or incinerated (19%). Only 9% of all plastic waste is recycled. The plastics life cycle is, therefore, significantly linear. In addition, a large share (22%) of plastic waste is mismanaged, that is, disposed of in uncontrolled dumpsites or burned in the open.

Mismanaged plastic waste can leak into the environment where it causes significant harm to ecosystems and communities. About 22 Mt of plastics leaked into terrestrial or aquatic environments in 2019 (OECD, 2022[1]). The vast majority of leaked plastics are macroplastics (88%), i.e. they are recognisable items such as littered bottles, which are more than 5 mm in diameter. The remaining plastic leakages can be attributed to microplastics (12%), i.e. solid synthetic polymers less than 5 mm in diameter. Microplastics have been found in food and beverages such as tap water, bottled water and beer. Road transport is also an important source of aerial microplastic pollution from the wear and tear of tyres and brake pads.

The plastics life cycle is also a significant source of global GHG, contributing 1.8 gigatonnes (Gt) of GHG emissions in 2019 (OECD, 2022[1]). The production and conversion of fossil-based primary plastics is the main source of emissions, but end-of-life treatment, such as incineration, is also an important contributor. Beyond leakage to the environment and GHG emissions, plastics have other environmental and human health impacts. They contribute to ozone formation, eutrophication and ecotoxicity in aquatic environments, as well as human carcinogenic and non-carcinogenic toxicity.

In the absence of new and more ambitious policies to curb plastics use along their entire life cycle, the volumes of plastic, waste and leakage to the environment are projected to increase substantially in the future (OECD, 2022[2]). Closing the plastics loop, therefore, remains an important policy objective.

7.1.2. Plastics have a wide variety of features and uses

Plastic materials are polymers, that is, they are made of very large molecules that chemically bind a large number of simpler molecules called monomers. There are many different polymers with diverse features and characteristics, making plastics a highly heterogeneous material. The most commonly used polymers include: i) high density polyethylene (HDPE); ii) low density polyethylene (LDPE); iii) linear low-density polyethylene (LLDPE); iv) polyethylene terephthalate (PET); v) polypropylene (PP); vi) polystyrene (PS); vii) polyurethane (PUR); viii) polyvinyl chloride (PVC); ix) acrylonitrile butadiene styrene (ABS); x) acrylonitrile styrene acrylate (ASA); and xi) styrene acrylonitrile (SAN) (OECD, 2022[2]).

Polymers are often mixed or compounded with a wide range of additives, which can customise and improve the performance of plastics. Additives can prevent ageing, colour the plastic, and make rigid material

flexible, among other uses. However, mixing certain polymers and additives used in manufacturing can inhibit the recyclability of plastic waste (OECD, 2022[2]).

Plastic materials can be categorised into monomaterials and composite, multilayer/multimaterials. Monomaterials are made of a single polymer. Plastics materials assemble into multilayered materials can have additional technical features, e.g. resistance to mechanical stress, compatibility with food contact, and opacity. However, multilayer/multimaterial products may prove challenging to reuse and recycle if their component parts are difficult to separate.

There are two main plastics recycling technologies: mechanical and chemical. Mechanical recycling is the traditional method whereby sorted plastic waste items are typically shredded, small pollutants are removed and cleaned, and a homogenous mass of polymer is obtained to be molten again and shaped into a new plastic piece. Chemical recycling is an emerging technology and can also be separated into two sub-categories: plastic-to-plastic and plastic-to-fuel (OECD, 2022[1]). Plastic-to-plastic means transforming the plastics back into feedstock ("feedstock recycling"), which can then be used to manufacture monomers. In the latter case, the plastic is transformed into fuel, which is a form of energy recovery.

7.1.3. The majority of plastics have short lifetimes, but they can be persistent pollutants once in the environment

Plastics are found in a wide range of applications such as food packaging, clothing, construction, transport, and electrical and electronic goods. The application for which a plastic item is used typically determines its lifetime. Plastics found in packaging, consumer products and clothing applications tend to have short average lifetimes (less than 5 years), after which they are discarded (Geyer, Jambeck and Law, 2017[3]; OECD, 2022[1]). However, plastics found in transport and construction applications have longer lifetimes (20 years for transport and 35 years for construction), remaining in use for longer. Plastics in use in any one year will therefore differ from the plastics that become waste.

Plastic items can break and deteriorate relatively easily and the majority of plastics in use have short lifetimes. However, once leaked into the environment, they can also persist for a long time. For example, single-use plastic products (SUPs) like LDPE plastic bags and HDPE milk bottles could have an estimated half-life (the time it takes for the material to lose 50% of its original mass) of 5-250 years on land and 3-58 years in marine environments (Chamas et al., 2020[4]). However, HDPE pipes may need thousands of years to completely degrade, with an estimated half-life of 1 200 years (Chamas et al., 2020[4]).

7.1.4. Biobased and biodegradable plastics only represent a minute share of plastics use

Biobased plastics (often referred to as bioplastics) are derived from biomass such as corn, sugarcane, wheat or residues from other processes. Bioplastics only make up about 2% of global plastics and are projected to retain a small market share in the future (OECD, 2022[1]). Their environmental impact in terms of GHG emissions, however, remains ambiguous. There are important concerns regarding the indirect environmental impacts arising from the monoculture production of corn, sugarcane and wheat used as the feedstock for biobased plastics, especially as it relates to land use. This could place additional pressure on agricultural land and lead to a loss of forests, natural environments and biodiversity, as well as one-off carbon emissions. Sustainably sourcing biobased plastics is therefore an important objective.

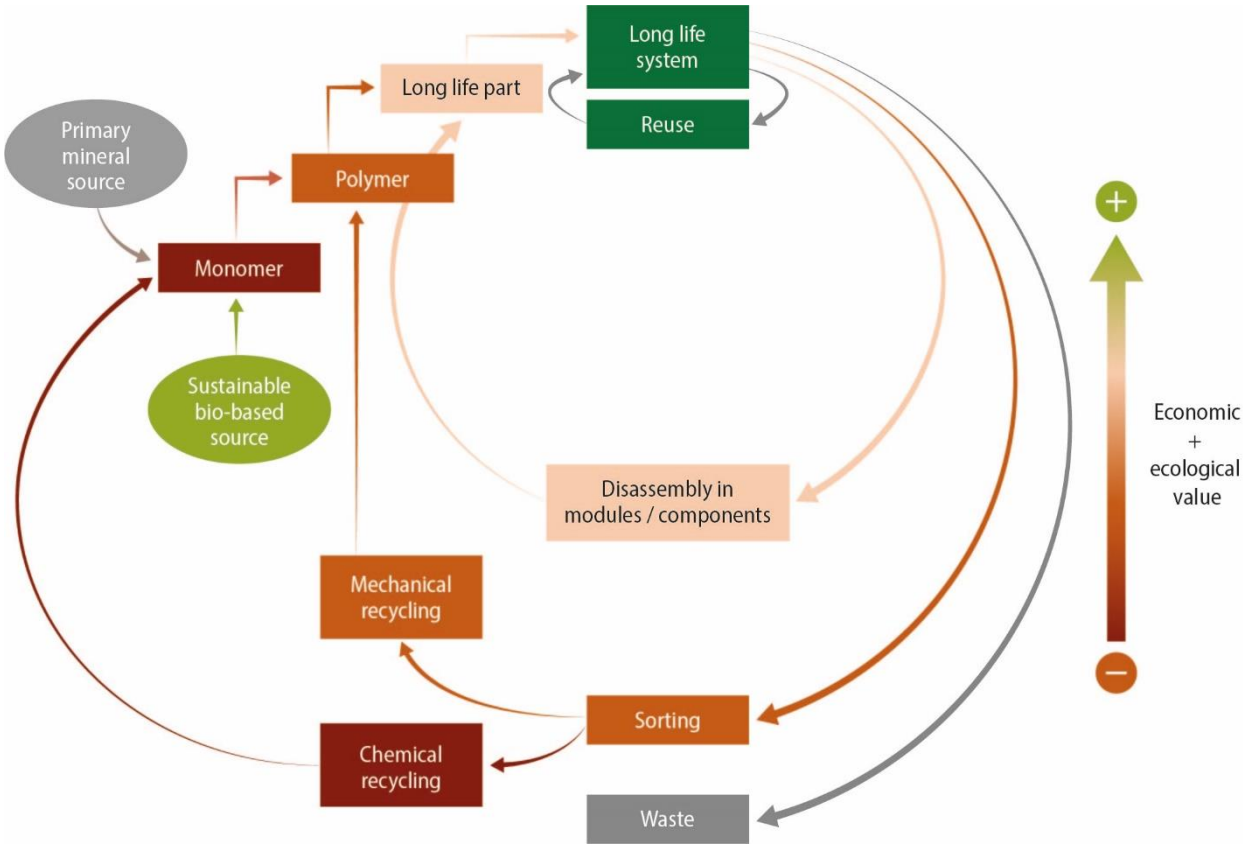
Biobased plastics should not be confused with biodegradable plastics. Biodegradable plastics "degrade" in the natural environment, releasing carbon dioxide, water and biomass. However, there are some concerns regarding biodegradability. Some polymers do not biodegrade within a reasonable time under normal circumstances and would therefore persist in the environment (OECD, 2022[1]).

7.1.5. A circular life cycle for plastics can substantially reduce environmental impacts

The circular economy provides many opportunities to decrease the environmental damage associated with plastics. But what does the circular economy mean for plastics? especially considering the diversity of plastics and their use in a variety of applications. A circular plastic product is one which is designed to be used and reused over a long period of time. It is manufactured from secondary plastics, whenever possible, and is recycled when discarded. The application of circular economy principles in the plastics industry means guiding decision making to ensure a more circular life cycle, which considers design, production, use and reuse, and end-of-life stages (see Figure 7.1).

- **Design.** Circular plastic products are designed in such a way that they remain in the materials loop for as long as possible, and once they become waste, they can be seamlessly recycled. The application of circular design principles ensures that the product can be repaired and reused so that it does not become obsolete once defective, thereby maximising the longevity of the product. If the product is to be discarded then its circular design facilitates sorting and enables separate processing without cross-contamination, allowing for greater recyclability.
- **Production.** Circular plastics are manufactured to the greatest extent possible from secondary feedstock for as long as the technical features and requirements of the product allow. Secondary feedstock comes from local supply chains whenever this is economically and logistically viable. If primary feedstock is used for manufacturing, for instance, when the performance of secondary plastics is insufficient to meet technical requirements, the harmful chemicals and additives that hamper recyclability are avoided.
- **Use and reuse.** A more circular use of plastics ensures that plastic products stay in use for as long as possible. Products that have long lifetimes and high reusability are therefore favoured over SUPs with short lifetimes. Products that can be disassembled, and whose parts are reused, repaired and replaced, in case they become obsolete or non-functional, are also treated preferentially.
- **End-of-life.** A circular end-of-life treatment of plastics means ensuring that a large percentage of plastics is recycled once a product is discarded. This means a higher rate of separate collection, a higher purity of sorted plastic waste, and thus a higher quality of secondary plastic. Plastic waste that cannot be recycled is treated in the formal waste management system and leakage to the environment is thus avoided.

Figure 7.1. The circular plastics life cycle keeps materials in a closed loop



The introduction of circular economy principles in the production of plastics significantly interacts in the life cycle stages of the product. For example, a plastic product designed for durability will be more circular in its use, while better recycling can produce higher quality secondary feedstock for manufacturing. Well-aligned strategies will therefore encourage the adoption of circular economy principles. One such strategy is to design for circularity, which can be an important tool in improving the longevity of plastic products, while bolstering higher recycling rates. Another strategy to lessen the demand for plastics is to cut back on the plastics-intensity of intermediary products, and therefore the amount of plastics found in final products, thereby reducing the excessive quantities of plastics in circulation. Promoting recycling also remains a central strategy in closing the plastics loop (OECD, 2022[1]).

7.2. Plastics and the economy: context and developments in Hungary

This section reviews the main trends in the plastics industry in Hungary and provides key information to help understand the role plastics play throughout their entire life cycle, from production to use and their end-of-life stage.

7.2.1. Plastics are a staple of the Hungarian economy

The plastics industry is strategically important to the Hungarian economy. In 2019, the gross value added (GVA) of manufactured rubber and plastic products represented almost 10% of manufacturing GVA in 2019 (OECD, 2020[5]). The economic importance of plastics mainly lies in them being a key input to several sectors, such as: i) the transport equipment sector; ii) the computer, electrical and electronic products

sector; iii) the food products, beverages and tobacco sector; iv) the pharmaceuticals sector; v) the construction sector; and vi) the services sector. The manufacture of rubber and plastic products produces intermediary products (e.g. packaging, components, pipes, cables and flooring), which are then used in the assembly and manufacturing of other products, for example, in buildings, and also in the wholesale and retail trade (Pogány, 2020[6]).

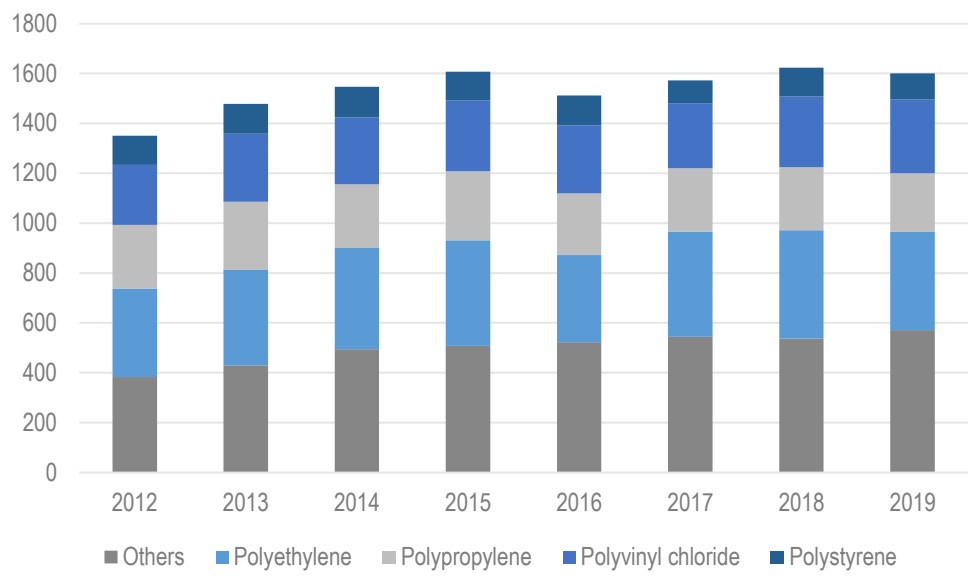
7.2.2. Four main polymers dominate domestic production in Hungary

In Hungary, plastics production reached 1.6 Mt in 2019 (Pogány, 2020[6]). In the same year, polyethylene (PE) production represented around 25% of all plastics produced, polyvinyl chloride (PVC) represented the second largest polymer production at 18.5%, polypropylene (PP) production made up 15% of domestic production, and polystyrene (PS) represented around 6.5% (see Figure 7.2). The rest was made up of a mixture of different polymers, which tend to have specific applications, such as for Acrylonitrile butadiene styrene (ABS), Styrene acrylonitrile (SAN), among others.

Hungary's demand for plastics in manufacturing is not completely met by domestic production. This means that trade in plastics is also important for the economy, not least because Hungary is a very open economy, that is, it is deeply embedded in international markets. Export volumes of plastics reached 1.67 Mt while imported volumes reached 1.06 Mt in 2019 (Pogány, 2020[6]).

Figure 7.2. Four main polymers make up two-thirds of all plastic production in Hungary

Plastics production in thousand tonnes



Source: Pogány (2020[6])

7.2.3. Despite a highly concentrated plastics industry, SMEs play an important role

The plastics industry is characterised by some large industrial players, but SMEs also play an important role. In the manufacture of polymers, additives and other plastics-related products, a number of large players dominate the industry, such as MOL Petrochemicals and Borsodchem. These two firms have more than 1 000 employees and a sizeable revenue, approximately EUR 1 billion. For the conversion of plastics to products, the concentration of the domestic industry is also high, i.e. the 25 biggest firms converting

plastics manufactured about 0.5 Mt of plastic products in 2019 (Pogány, 2020[6]). However, more than 300 firms produced an equal amount (0.5 Mt) in terms of weight of plastic products in the same year, showing that SMEs, when taken together, can have the same economic importance as the biggest players.[1]

7.2.4. In Hungary, the share of plastic packaging use is higher than the global average

The main applications of plastics in Hungary are comparable to those at the global level. The most important application is packaging (40% of total plastics use in Hungary, 31% globally), followed by construction (15% in Hungary, 17% globally), transportation (11% in Hungary, 12% globally), electrical and electronic products (9% in Hungary, 4% globally), and other miscellaneous uses (Pogány, 2020[6]; OECD, 2022[1]). The main polymers used for packaging are PE and PP, covering almost 90% of packaging. In the construction sector, PVC (at 45%) and PS (at 25%) are the most frequently used polymers (Pogány, 2020[6]). In the transport sector, the main polymer used is PP, representing 38% of the total uses.

Plastic packaging makes up 25% of total packaging used in Hungary (Eurostat, 2022[7]). With living conditions improving and household disposable income increasing, there has been a boost in demand for goods and services, leading to the consumption of products that often contain plastics. Plastic packaging is one such component. The strong demand for packaging products is exemplified by the rise in consumption of bottled water, which has grown almost five-fold within two decades, from 28 litre/capita in 1999 to 131 litre/capita in 2019 (Pogány, 2020[6]; Hungarian Mineral Water, Juice and Soda Association, 2022[8]). Other emerging trends, such as the uptake of e-commerce and take-away foods, especially in the wake of the pandemic, have led to an even greater demand for plastic packaging (Ministry for Innovation and Technology, 2021[9]).

7.2.5. Plastic packaging waste has grown significantly in recent years

Plastics are an important part of waste streams in Hungary. Given its vast number of uses, data on plastic waste is surprisingly incomplete. Nevertheless, the existing information provides a partial picture of the challenges faced by Hungary in its end-of-life management of plastic waste.

Plastic waste can be found both in industrial waste and municipal waste. Industrial plastic waste is often pure and homogenous, and can be collected and recycled more readily, although in some cases this may not be feasible owing to health and food restrictions. These “residues” are therefore discarded, i.e. they are either incinerated or landfilled. In 2018, industrial plastic waste from the plastics industry amounted to about 67 000 tonnes (Ministry for Innovation and Technology, 2021[9]). Trends for industrial waste, in general, have shown that despite an increase in industrial activity, waste generation has not increased significantly, pointing to the possible adoption of more efficient technologies and better internalisation of the value of waste.

Municipal plastic waste is typically composed of plastic packaging, SUPs, sanitary waste, consumer durables, household products and business-to-business packaging. In line with the trend for more packaging applications, plastic packaging waste generation increased by more than 60% in Hungary between 2010 and 2019 compared to the EU average of 25% (Eurostat, 2022[7]). However, there appears to be some convergence with plastic packaging waste now at 35 kg per capita in Hungary, which is similar to the EU average of 34 kg per capita (Eurostat, 2022[7]).

7.2.6. Landfilling of waste continues to dominate

More than half of all municipal plastic waste in Hungary is landfilled, which is higher than the global average. However, less than one-quarter of plastic waste is recycled in Hungary, which is among the lowest in Europe (Plastics Europe, 2020[10]). In addition, the share of recycled plastic waste is less than the average recycling rate of municipal waste (at 34%), as separately collected municipal plastic waste has a high-level of impurities, showing that it is a particularly problematic waste stream.

Despite the majority of municipal plastic waste comprising disposable packaging, only about one-third of all plastic packaging waste was recycled in 2019, which is below the EU average of 41% (Eurostat, 2022[7]). Recycling capacities in Hungary reached 242 000 tonnes per year, of which less than half was utilised (Ministry for Innovation and Technology, 2021[9]). This means that there is a significant idle (unused) recycling capacity, although some import of plastic waste is present. Nevertheless, total plastic packaging waste amounted to approximately 350 000 tonnes in the 2018-2020 period (Ministry for Innovation and Technology, 2021[9]). There would therefore be insufficient capacity if more than 70% of plastic packaging waste were to be recycled, potentially creating bottlenecks for domestic recycling. In addition, separate collection is not uniformly accessible throughout the country and the geographic distribution of sorting plants is also uneven, further hampering recycling efforts.

7.3. Hungarian policy landscape and legal context of plastics

This section provides an overview of Hungary's policy landscape covering plastics. There are already policies and legislation in place in Hungary to tackle the challenge of plastics, often with the aim to align Hungarian policies with EU measures. The plastics policy landscape has been dynamic at the EU and international levels. Several EU policy documents have been put in place to help transition towards a circular economy and a circular use of plastics. A number of policies affect how plastics are produced, used and disposed of in Europe, including the European Strategy for Plastics in a Circular Economy (European Union, 2018[11]) and – in line with its vision – the Single-Use Plastics Directive (SUPD) (European Union, 2019[12]), the "Plastics own resource" measure (European Union, 2020[13]), and the Sustainable Products Initiative, which is yet to be adopted (European Union, 2022[14]) (see Annex Box 7.A.1).

Although Hungarian legislation stipulates the need to prevent and minimise waste, as well as favouring higher steps of the waste hierarchy, it has not yet led to the development of a more circular life cycle for plastics. Plastics-specific legislation was only recently introduced in Hungary, and policy alignment with the EU is often faithfully complied without aiming at supplementary measures. In addition, with Hungary unable to tackle the root causes of a linear plastics life cycle, the country is unlikely to meet the ambitious targets set out by the EU.

7.3.1. Upstream, policy focuses on regulation and niche applications

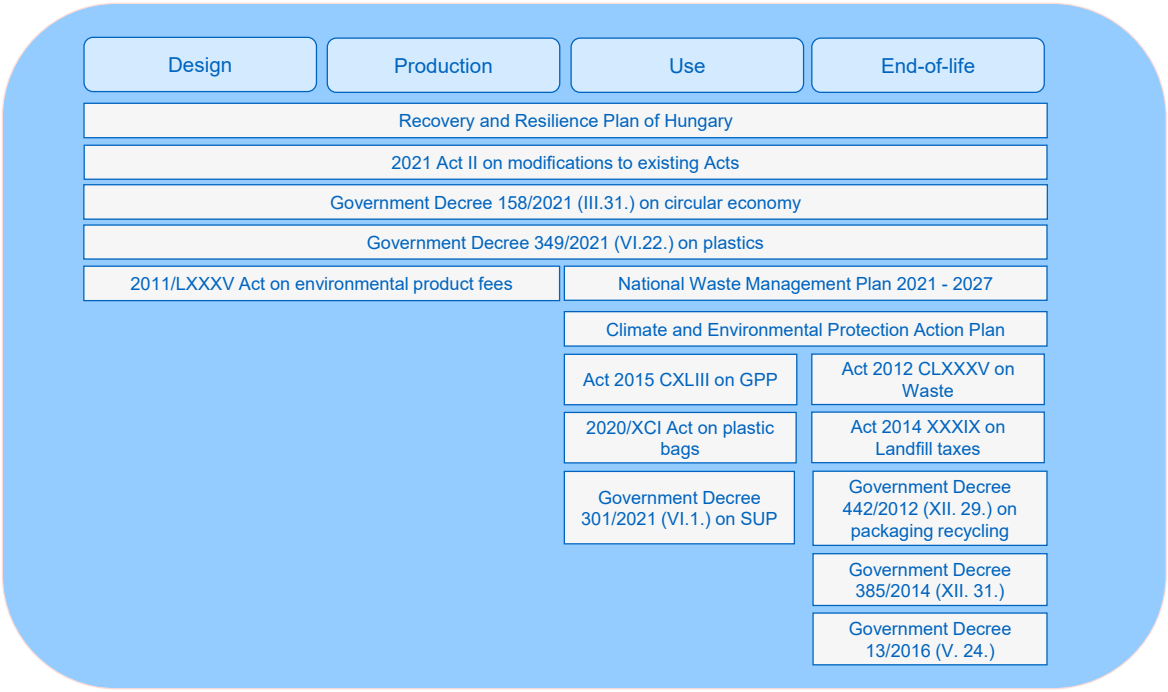
Only a few policy instruments have been implemented that intervene at the upstream production or design stage of the life cycle, of which the most prominent instrument is the environmental product fees for plastic packaging that was recently updated in Act 2020 XCI (Parliament of Hungary, 2020[15]), which modifies Act 2011 LXXXV (Parliament of Hungary, 2011[16]) (see Figure 7.3). As such, current Hungarian legislation remains focused on regulatory instruments targeting the use stage for niche applications, such as carrier bags and SUP items. Hungary has aligned its policy with recent EU policy documents, such as the SUPD (European Union, 2019[12]) through Act 2020 XCI (Parliament of Hungary, 2020[15]) and Government Decree 301/2021 (VI. 1.) (Government of Hungary, 2021[17]). However, this narrow focus on certain plastic items needs to be broadened. The SUPs tend to be small volume items that only make up a fraction of plastic waste. In the absence of policy that goes beyond niche applications, the impact on critical applications and polymers will remain limited.

7.3.2. Downstream, policy lacks coherence and clout to bring about change

Several policy documents identify downstream activities as crucial issues, such as the low rate of separate collection and recycling. The NWMP 2021-27 (Ministry for Innovation and Technology, 2021[9]) discusses in detail the plastic waste data and the low rates of separate collection and recycling, which will not reach the mandated EU targets if current trends continue. The Recovery and Resilience Plan for Hungary

(Government of Hungary, 2021[18]) also highlights the difficulties faced with regard to the recycling of plastic waste. In order to reach EU waste targets and to align with the SUPD, the Government Decree 158/2021 (III. 31.) (Government of Hungary, 2021[19]) mandates minimum recycling targets for plastic packaging waste, with similar recycling targets already present in other legislation, for example, Government Decree 442/2012 (XII. 29.) (Government of Hungary, 2012[20]). In addition, the Government Decree 349/2021 (VI. 22.) (Government of Hungary, 2021[21]) mandates an increase in separate collection rates for beverage bottles in line with the SUPD. However, mandates alone may not be enough to reach these targets. Further policy intervention may be necessary, not least because Hungary's low performance on this front is due to a lack of policy coherence and insufficient incentives. Without such coherence, and in the absence of incentivisation, achieving the ambitious EU targets will remain difficult.

Figure 7.3. Overview of Hungary's plastics policy landscape



7.4. Life cycle gap analysis and policy recommendations towards more circular plastics

The previous sections provided an overview of the current state of play in Hungary, including the most recent trends in plastics production, use and waste generation. It also mapped the plastics policy landscape in order to understand the developments at the EU level and in Hungary. Plastics are used throughout the Hungarian economy: from production to general use and waste generation. Packaging and construction represent over half of all plastics used in Hungary, and the three most common polymers (PE, PP, PS) and PVC together represent two-thirds of the polymers produced. The consumption of plastic products, especially packaging and SUPs, has also increased in recent years, not least because of improving living standards and other trends, which gathered pace during the COVID-19 pandemic.

Meanwhile, the plastics policy landscape is recent and is aligned with EU developments. Upstream, regulation focuses on narrow applications, while downstream, low separate collection and recycling rates remain hard to overcome without a mixture of coherent policies. These main polymers and applications

should therefore form part of the scope of Hungary's plastics strategy, while the issues identified upstream and downstream point to the specific challenges faced by the country.

What policies should Hungary implement along the plastics life cycle to overcome the acute challenges it faces? This section provides policy recommendations to help bridge the existing gaps, intervening at the most appropriate life cycle stage to ensure the greatest impact. Gaps represent the difference between the current state of play in Hungary compared to both the existing targets and goals at the EU level as well as Hungary's own ambitions. Policy best practices in other countries are then drawn upon to understand how such policies can work in practice. As meaningful policy should aim to target applications and polymers which are most common, these aspects are taken into consideration throughout the analysis. Finally, policy alignment throughout the entire life cycle of plastics remains important in order to ensure that the effectiveness and impact of policies are maximised and that they support the closing of the plastics loop to the greatest extent possible. Detailed policy recommendations that respond to the specific gaps identified are presented in the next section.

7.4.1. To curb plastics use, policy action should first target design and production

Plastics production stood at 1.6 Mt in Hungary in 2019 (Pogány, 2020[6]). Plastics are a key input to a number of sectors, and contribute to almost 10% of manufacturing GVA (OECD, 2020[5]). Early decisions taken at the design and manufacturing stage can already put plastics on a circular trajectory from the outset. When businesses are faced with a choice between maintaining the status quo or choosing circular options, the odds are often stacked against the circular economy. Policy making can help level the playing field and make the circular option more attractive. However, in Hungary, there is an absence of instruments currently in place to steer producers towards favouring plastics that are recycled or are easier to recycle. A mix of economic and regulatory policy instruments can ensure that circular solutions are already favoured at the design and production stage. These instruments include minimum recycled content requirements, information on designing for recyclability, the eco-modulation of environmental product fees, and taxes on primary plastics.

Minimum recycled content requirements encourage the use of secondary materials

Design requirements are the non-negotiable conditions (i.e. needs) to be met by the designed product and the negotiable conditions (i.e. wants) that are deemed desirable (OECD, 2021[22]). Sourcing is relevant for all types of products and include the selection of a base polymer (secondary or primary). Favouring secondary feedstock (i.e. secondary plastics from recycled plastic waste) is a prime requirement for a more circular life cycle. However, the use of secondary plastics is not without challenges. Primary plastics are usually engineered with specific features in mind, but secondary plastics may not meet these requirements. This is the case, for instance, for food contact grade packaging, which is only available from recycled PET beverage bottles. There are also issues relating to the quality of secondary feedstock, which can often vary significantly, as well as issues of quantity owing to relatively low recycling rates. Other issues may also emerge, including the limited selection of colours and colour variations, as well as possible low olfactory performance (PolyCE, 2021[23]).

Minimum recycled content requirements are one of the core elements of the EU SUPD. More eco-design requirements can be expected in the Ecodesign Directive (European Parliament and Council, 2009[24]) and in the Sustainable Products Initiative (SPI) legislative package. Hungary will therefore have to implement these measures in its national legislation and develop the necessary policy instruments.

A concrete example of targets with minimum recycled content is well underway in the United States. Under California's 2020 Assembly Bill 793, beverage bottles must contain at least 15% of recycled plastic (PET and HDPE bottles) by 2022, increasing to 25% by 2025 and 50% by 2030 (CalRecycle, 2022[25]). Non-compliant companies face penalties of USD 0.20 per pound (lb) of shortfall from the minimum requirement. However, only the largest companies were able to meet these requirements, with many smaller

manufacturers unable to even report enough data. With Hungarian SMEs playing a pivotal role in the plastics industry, similar bottlenecks should already be expected. Guidelines for designing products with recycled content, including for verification schemes, will therefore be essential. A variety of such guidelines from a number of organisations and businesses in different countries is already available to help companies make this transition (see Annex Box 7.A.2).

Designing for recyclability can contribute to higher quality and quantity of secondary plastics

The other side of the coin is to design products that are easier to recycle. This is an important circular plastics strategy. Many products are designed with certain features and technical performance targets in mind and, in order to achieve these goals, manufacturers make design choices that hamper recyclability. For instance, composite and multi-material designs or the use of hazardous chemicals and additives (e.g. fibreglass) could make an otherwise homogenous waste stream highly differentiated and therefore more difficult to recycle. As such, design considerations should include: i) polymer selection so that waste is minimised; ii) a simplification of design, to include as few polymers as possible; and iii) a choice of recyclable materials, which can be recycled at the highest quality possible (OECD, 2021[22]). Other considerations may include the choice of polymer that matches secondary market demand, as well as ensuring transparency in terms of information on the chemical composition of products (e.g. materials passports at the chemical level).

With the presence of a few large players and an important number of SMEs in the plastics industry in Hungary, it is important to ensure that the proliferation of design choices can be harmonised, to the extent possible, to ensure that plastic products are recyclable and that their design contributes to recyclability. Legislation stipulating the need to produce packaging that is easier to recycle exists (see Government Decree 442/2012 (XII. 29.)) (Government of Hungary, 2012[20]). Nevertheless, in the absence of guiding principles, manufacturers are more likely to make design choices that satisfy business needs but do not take into consideration needs further along the plastics life cycle, particularly at the end-of-life stage. There are several guidelines that can support businesses with gaining the know-how and understanding the logic of design for recyclability (see Annex Box 7.A.3) (PolyCE, 2021[23]). It has been shown that since knowledge spillovers and productivity is lowest among SMEs in general in Hungary, they face barriers in catching up with large multinational companies (OECD, 2019[26]; OECD, 2019[27]). Information instruments of this nature, if targeting manufacturers, can contribute to knowledge spillovers and capacity building at the level of SMEs.

Eco-modulated extended producer responsibility fees can incorporate waste management costs at an early stage of the plastics life cycle

Extended producer responsibility (EPR) is a policy approach by which producers bear the costs of the product's end-of-life stage (OECD, 2016[28]). The EPR schemes consist of several policy instruments to steer producers towards take-back requirements, advance disposal fees and deposit-refund schemes. The effectiveness of an EPR scheme in achieving circular economy goals is determined by its design, which includes correctly setting up the producer's fees and requirements to fully cover the costs of waste management. A nuanced EPR scheme is especially important for plastics because of their variety, their different waste treatment costs and their recycling properties.

In order to capture the true end-of-life costs of a product under an EPR scheme, it is important to determine the producer's fees based on a product's environmental criteria. These can be based, for example, on recyclability, durability, biodegradability or the availability of recycling facilities (Watkins et al., 2017[29]). Fees can be modulated based on recyclability criteria, the use of secondary raw materials or eco-modulation, which can bring about changes that reduce the end-of-life costs of a product.

In Hungary, environmental product fees on packaging already provide a basis for incentivising a shift away from plastic packaging materials, however, they are insufficiently differentiated.[2] Although the current

environmental product fee for plastic packaging is three-times higher than for other materials, such as paper packaging (19 HUF/kg), it is steady at 57 HUF/kg. This means that there is no distinction made in the environmental product fee levied on packaging made from different types of plastics (e.g. based on polymer, use of additives, etc.). This does not therefore allow the difference in relative prices to incentivise the shift towards using more recyclable plastics packaging or packaging made from secondary feedstock. The eco-modulation of the forthcoming EPR fees for plastics packaging is therefore recommended, especially given the policy of environmental product fees currently in place.

This practice is already seen in other EU Member States. For instance, producer fees in Belgium for plastic packaging range from EUR 0.1 per kg for easy-to-recycle transparent colourless PET bottles to more than EUR 1 per kg for plastics which tend to be harder to recycle (see Annex Box 7.A.4). Such an advanced eco-modulation of fees provides a clear financial incentive for producers to use more sustainable and recyclable materials. Beyond implementing the eco-modulation of fees, it also remains important to harmonise modulation criteria with those used in other European Member States to ensure that the measure has the greatest possible impact.

A tax on primary plastics can reduce demand for the most challenging applications of plastics

Market-based instruments, such as taxes or subsidies, are commonly used to stimulate the transition to a circular economy (OECD, 2020[30]). Taxes on plastic materials, certain types of polymers or certain uses of plastics (e.g. single-use packaging) can help reduce the quantities consumed and drive demand away from such items through substitution. Well-designed taxes should lead to the use of more durable and more sustainable alternatives and level the playing field between primary plastics and secondary plastics. To improve markets for secondary plastics, which remain vulnerable to trends in the primary plastics markets and to oil prices, an increase in taxes on primary materials is recommended (OECD, 2018[31]).

There is no tax on primary plastics currently in place in Hungary.[3] The absence of such a tax is a barrier to reducing the share of primary plastics in production and using more secondary plastics and alternative materials instead. Hungary should therefore plan to implement a tax on problematic primary plastics applications such as packaging.

The recently introduced plastic packaging tax in the United Kingdom provides an example of an international best practice that Hungary can adapt to its own circumstances. This tax (at GBP 0.20/kg) applies to all plastic packaging with recycled content of less than 30% in weight of chargeable plastic packaging components. The aim of the tax is to provide a clear economic incentive for businesses manufacturing plastic packaging to use recycled plastic in their products (see Annex Box 7.A.5).

7.4.2. To turn the tables on the use and reuse of plastics, restrict and shift demand from primary plastics to alternatives

As of July 2021, Hungary's Government Decree 301/2021 (VI. 1.) bans plastic in balloon sticks, earbuds, cutlery, plates, straws, stirrers, and polystyrene food containers and plastic bags with a wall thickness of above 15 microns (except those made of biodegradable plastics) (Government of Hungary, 2021[17]). However, these measures are mainly regulatory in nature and target narrow applications. This limits the scope of the policy, making it inflexible to evolving market developments and consumer demands. Hungary should therefore consider using economic instruments to boost the efficacy of its regulatory efforts.

Economic instruments can diminish the use of primary plastics and shift demand towards secondary plastics or substitutes made from sustainable alternative materials. However, Hungary has few such instruments in place. The most prominent economic instrument is Act 2020 XCI, which substantially increases levies on plastic bags with a wall thickness of under 50 microns, from HUF 57 kg to HUF 1 900/kg for plastic carrier bags, and HUF 500 /kg for biodegradable plastic carrier bags (Parliament

of Hungary, 2020[15]). As such, there is a greater need for economic instruments at this life cycle stage and the broadening of applications beyond SUPs. Green public procurement is one such instrument.

Green public procurement can shift demand away from primary plastics and promote the use of sustainable alternatives

GPP sets sustainability standards for suppliers and products purchased by the public sector. In EU countries, where public procurement accounts on average for 18% of GDP annually, GPP has the potential to improve markets for greener products (Ellen MacArthur Foundation, 2016[32]). GPP can also introduce further criteria relevant to the circular economy, such as product lifespan. The demand for sustainable plastic products can be improved by introducing mandatory criteria (e.g. recycled content) on plastic products. These criteria can include the use of secondary materials, recycled content or reusability and recyclability of the plastic product, among others.

Hungary's contracting authorities used environmental aspects in only 9% of their procedures (European Commission, 2019[33]). This is because although Act 2015 CXLIII (Parliament of Hungary, 2015[34]) on public procurement allows public authorities to take environmental aspects into account during their public procurement procedures, it does not make it mandatory. Hungary should consider expanding the GPP criteria and introducing mandatory GPP as these measures create demand, especially for products and applications where markets have not yet emerged in Hungary.

There are a few international best practice examples on GPP criteria for plastics that could guide Hungary. The municipality of Lolland in Denmark, for example, has introduced recycling and recyclability criteria for packaging in their tender for cleaning services. In Sweden, GPP criteria related to plastics are applied in the procurement of office IT equipment. In Germany and Belgium, bans on certain single-use products were introduced. Japan also uses GPP criteria on plastic products, where the higher the recycled content share in an evaluated good, the higher the evaluation score for that good. For instance, stationary products should contain at least 40% recycled plastics in terms of weight (see Annex Box 7.A.6).

Labelling schemes can help consumers in their purchasing decisions

Consumer-oriented information and labelling schemes can help shift demand towards more circular plastics products (Laubinger and Börkey, 2021[35]). They can empower consumers by helping them distinguish products based on their environmental impact. In the absence of such information, consumers are more likely to make uninformed purchase decisions, leading to worsened unintended environmental impact.

In Hungary, there are already policy changes underway on this front. A key legislation on the labelling of SUPs is Government Decree 349/2021 (VI. 22) (Government of Hungary, 2021[21]). According to this decree, producers would be required to clearly label plastic products (sanitary pads, wet tissues, cigarette butts and cups) to inform consumers of their plastic content and on their correct disposal. The decree mandates an additional type of labelling so as to raise awareness on the environmental impacts of littering these products as well as food containers, flexible packaging, beverage bottles (up to three litres), consumer balloons and light carrier bags.

7.4.3. Policies at the end-of-life phase can make or break the plastics loop

As explained above, Hungary is facing the challenge of meeting the EU's waste targets, which is to increase separate collection and recycle plastic packaging waste, and divert waste from landfills. More than half of all municipal plastic waste is landfilled and less than one-third is recycled. In terms of plastic packaging waste, the consumption of which has increased faster than the EU average, only about one-third was collected for recycling in 2019, which is well below EU targets. While policy changes are pointing

towards a more favourable policy landscape, given Hungary's low performance on this front, policy stringency and coherence needs to be strongest for the end-of-life stage of the plastics life cycle.

The Hungarian waste management system is currently being reformed under a new concessionary system, which is an opportunity to rationalise waste management and also to better incorporate economic instruments that can steer behaviour. For instance, a Deposit Refund System (DRS) for plastic beverage bottles (as well as glass bottles and metal cans) is being developed and is expected to be in place in Hungary by 1 January 2024 (OECD, 2022[36]). This instrument will be an important first step towards ensuring higher recycling rates. However, a DRS alone can only go so far. Other instruments, such as improved landfill taxes, enhanced "pay-as-you-throw" schemes and door-to-door collections, as well as the separate collection of plastic CDW, should also be considered to bolster Hungary's performance and to ensure that it can meet ambitious EU targets.

Increasing landfill taxes will boost recycling

Economic instruments, such as a landfill tax, have proven to be good policy practices. Studies suggest a strong correlation between landfill tax levels and the percentage of waste sent to landfill (BIO Intelligence Service and European Commission, 2013[37]). Indeed, without the right level of incentives to divert plastic waste away from landfills, many other policies that aim to increase plastics recycling could be less effective than intended. It is also essential to ensure that there are other flanking measures in place, such as an incineration tax, to ensure that waste originally destined for landfills does not end up being incinerated.

In Hungary, separate collection and recycling are not well incentivised, not even as part of government policy to keep consumer costs low. Hungary's Act 2012 CLXXXV (annex 5, via Act 2014 XXXIX) regulates landfill taxes (Parliament of Hungary, 2012[38]), which would have seen linear increases in taxes from HUF 3 000 per tonne to HUF 12 000 per tonne. However, landfill taxes have been frozen at EUR 15 per tonne (HUF 6 000)[4], which is lower than in most EU Member States. In addition, without adjustments to inflation, the tax becomes less effective at discouraging landfilling. As such, this could explain the observed high landfill rates for municipal waste, including plastic waste and low separate collection and recycling rates. With the introduction of the "plastics own resource" contribution, which requires EU Member States to contribute based on the amount of non-recycled plastic packaging, there are even more reasons to act in this space. Hungary should therefore consider increasing its landfill taxes and putting in place other supportive measures, such as an incineration tax, to ensure stronger enforcement.

Landfill taxes are widely used in EU Member States, but they range from no tax (Malta) to more than EUR 100/tonne (Belgium) (Cewep, 2021[39]). The tax is typically charged on the weight or volume of waste delivered to landfill sites. In addition, landfill taxes do need not to be at a flat rate and can be modulated based on sorting rate to further incentivise the reduction of mixed waste. This is especially important in the case of plastic waste, which tends to be an important part of municipal solid waste streams. Hungary's neighbour, Slovak Republic, has already introduced modulated landfill taxes. Incineration taxes, such as those in place in France, the Netherlands and Sweden, can also be used to further lessen the incentive to avoid waste recycling (see Annex Box 7.A.7).

Beyond landfill taxes, enforcement is also an important aspect to consider as the illegal dumping of waste remains an issue in Hungary. Hungary's Climate and Environmental Protection Action Plan envisions a more systematic curbing of illegal dumping, which includes the pollution of transboundary rivers (Government of Hungary, 2020[40]). The *Tisztítsuk meg az Országot!* [Clean up the country] initiative and *HulladékRadar* [Waste radar] application have been implemented under the auspices of the action plan. Similarly, the initiative *TeSzedd! Önkéntesen a tiszta Magyarországért* [Voluntary clean up action for a clean Hungary] has been initiated and continues to rein in littering and illegal dumping. These measures target the identification of illegal landfills and clean-up. The next step, however, will require enforcement so that discarded waste ends up in the formal waste management system, the foundations of which can already be found in Act 2021 II (Parliament of Hungary, 2021[41]).

A PAYT scheme and door-to-door collection can boost the separate collection of plastic waste

The PAYT waste collection scheme can steer behaviour towards waste reduction and better separate collection. The PAYT is a principle whereby waste producers are charged based on the actual amount of waste generated. Countries with recycling rates above 45% have a certain PAYT scheme in place. Meanwhile, countries with recycling rates below 20% tend not to have a PAYT scheme in place (European Environmental Agency, 2016[42]). The effective operation of PAYT schemes requires a well-developed infrastructure for separate waste collection, including door-to-door collection.

At present, consumers do not fully understand the true costs of waste generation in Hungary, not least due to the government policy on "reducing consumer costs for utilities". There is thus a strong need to ensure that consumers are sufficiently incentivised to increase the amount of sorted waste, thereby reducing their mixed waste generation. Although there is door-to-door collection in Hungary since 2015 (OECD, 2018[43]), and waste disposal fees have volume and frequency-based components, they have not led to the desired performance in separate collection. Indeed, purely volume and frequency-based PAYT schemes, which are subscription based, often do not allow consumers to appreciate the cost of waste generation. This is especially true in densely populated urban areas where fees are split among several households. Indeed, the Hungarian Central Bank has advocated for enhanced PAYT schemes that differentiate rates based on average per capita waste generation and not just volume. This would mean that households generating above average amounts of waste would pay a premium (Hungarian Central Bank, 2022[44]). At the same time, low performance in this area has a regional component, that is, in smaller or less developed municipalities, separate collection is particularly low because of the differences in the provision of services, which also highlights the uneven distribution of waste management services across the country.

Conversely, there might be concerns that an enhanced PAYT scheme in Hungary would increase illegal dumping and littering, for which there is evidence elsewhere (Bucciol, Montinari and Piovesan, 2011[45]). However, a well thought out PAYT scheme, one which is rolled out at different speeds across the country and takes into account of Hungarian sensitivities and concerns, could be an important turning point. Hungary should therefore consider enhancing its PAYT scheme and door-to-door collection to improve its separate collection of plastic waste.

Hungary could be inspired by success stories seen in other countries. In Belgium, in particular, there is a widespread use of a unit-based system using special bags for waste. In this system, the bag for mixed municipal waste is the most expensive (up to EUR 2 per bag). The price of bags for the sorting of plastics, however, is typically much lower. This provides a clear financial incentive for households to separate their waste (see Annex Box 7.A.8). Such a system could also help overcome some of the difficulties with separate collection in densely populated urban areas. In addition, door-to-door collection is organised for recyclables, including for plastic packaging. In the Brussels region, where there is door-to-door collection of various recyclable waste streams, including plastics, recycling rates have increased significantly from 25% in 2005 to 43% in 2017 as a result of separate collection (OECD, 2021[46]).

The separate collection of plastics in CDW can improve the recycling of problematic polymers such as PVC

Plastic waste from construction applications should be treated separately to allow for more efficient recycling. An extension of the EPR scheme that includes construction products and materials can provide a solution to setting up a separate collection of plastics in CDW. The construction sector represents the second largest share of plastics in total use. Construction plastics, in particular, tend to have long lifetimes (35 years on average), which likely means that they will be part of the waste stream for decades to come.

With the recent expansion in construction in Hungary, as well as the possible modernisation of the building stock, in line with the country's ambition to reach climate goals, it is important that there are mechanisms

in place that ensure that hard to recycle, problematic plastics in CDW, including PVC, can be treated. Hungary could include plastics in CDW as a separately collected waste stream under its EPR system, which is currently under reform.

The recently introduced EPR platform (Valobat) in France provides an example of such a scheme. This EPR scheme lists categories of CDW that can be recycled, including pipes, insulators, window frames, floors, water and gas supply, and all forms of plastics. Such a system can ensure that hard-to-recycle and problematic plastic waste, often made of PVC, are treated as plastic waste, as opposed to treated as CDW only, which allows for synergies across circular economy priority areas (see chapter 6).

7.4.4. Flanking horizontal tools can support the transition to a more circular use of plastics

Efforts could be ineffective if flanking measures are not in place to put the country on the trajectory of closing the plastics loop. It is therefore essential to use horizontal tools that can support the more targeted policies along the life cycle of plastics. At present, Hungary is not sufficiently exploiting the opportunities that exist in this area. Horizontal tools include soft instruments such as education and information campaigns, research and development grants, as well as data collection and monitoring. Horizontal tools also have the benefit of potentially having positive spillovers. As such, they not only form an integral part of a circular plastics strategy but they can also pave the way towards long-term improvements.

Well-informed consumers are more likely to properly dispose of and sort plastic waste

Soft instruments, such as education (capacity building), remain important tools in the transition to a circular economy and can be employed to affect material flows at all stages of a product's life cycle. Knowledge and capacity building includes a better understanding of the environmental implication of waste generation, the benefits of re-using products, and favouring repair over buying new products, among others. Consumers are more likely to comply with waste management regulation and respond to incentives if they have the necessary information on how to properly sort waste and have a better understanding of how sorted waste is used for recycling. Expenditure on recycling education is also considered to be a cost-effective measure to increase recycling rates (Sidique, Joshi and Lupi, 2010[47]).

The fact that the share of impurities can be as much as 40% in separately collected plastic packaging waste possibly points to issues related to the lack of awareness in Hungary (Ministry for Innovation and Technology, 2021[9]). Even if all the right economic incentives and regulations are in place, consumer compliance must be underpinned by education and information campaigns. Hungary should ensure that adequate capacity-building resources are available, and that a targeted communication and information campaign is conducted in conjunction with policy efforts. Although resources such as the website Szelektalok.hu (Szelektalok, 2022[48]) are available, the knowledge and information they contain have not been adequately mainstreamed and dispersed among the population. Most efforts and resources are targeted mainly at students through the incorporation of separate collection concepts in the National Curriculum [*Nemzeti Alaptanterv*], and through programmes such as Eco-schools [*Ökoiskola*] (Oktatási Hivatal, 2012[49]). However, these topics tend to be marginalised, highlighting the need to strengthen their role in education.

Information campaigns play an important role in ensuring the proper disposal of plastic waste, particularly because of the variety of polymers. Waste management policies, such as an enhanced PAYT scheme, should therefore be appropriately accompanied by awareness-raising campaigns and programmes. Communication campaigns conducted in the city of Treviso and in the region of Apulia (Italy) have shown that PAYT schemes can help push recycling rates to above 80% when such communication efforts are present (see Annex Box 7.A.9).

Research and development efforts should target innovation in recycling technologies

Research and development (R&D) can be promoted at every stage of the plastics life cycle, from the introduction of new materials in the production phase to new technologies for waste sorting or recycling. However, given the "public good" nature of innovation, it is imperative to have strong intellectual property rights and adequate framework conditions to ensure that the optimal level of innovation occurs. Direct government support to R&D activities, via grants and loans, can further enable the emergence of technologies with a strong public good component.

Given the acute need for improved recycling and separate collection in Hungary, funding for innovation in recycling technologies remains crucial. The high level of contamination of separately collected waste in the country often impedes efficient recycling. For instance, polylactic acid (PLA), one of the most common biodegradable plastics used in packaging, is considered a severe contaminant, but conditions for the separate collection and further treatment of biodegradable plastics, such as PLA, are not yet available in Hungary. Recycling facilities in Hungary tend to have 10-15 year-old technology, which is often not sufficiently sophisticated to allow for efficient sorting of contaminated waste (Government of Hungary, 2021[18]). Investments are foreseen to increase Hungary's chemical recycling capacity under Hungary's RRP. Research on this emerging technology would therefore also be an important complement. Hungary could provide research grants to groups and SMEs that are close to promising technological breakthroughs that can help overcome issues relating to the contamination of waste streams. There are already strong precedents for this through the various R&D programmes, such as the "KKV start innováció" programme for SMEs, which has awarded grants for innovation on plastics, although the programme does not specifically target plastics. More targeted R&D grants on plastics can thus help and also encourage the emergence of circular business models, which can further help close the material loops (OECD, 2019[50]).

Hungary could try to look for good practices at the international level and use these as a starting point for enhancing its R&D efforts on plastics. For example, the United States Department of Energy has been funding research into various plastics technologies to combat plastic waste. The most recent project announced USD 14.5 million in funding, specifically targeting SUPs. Seven innovative recycling technology projects, including on chemical recycling, were awarded with funding averaging USD 2 million (see Annex Box 7.A.10).

Data collection, monitoring and digitalisation could be an important tool for tracking developments in plastics trends

Plastics and plastic waste, in particular, are especially difficult to track given their ubiquity and how they are embedded in other products. In addition, the most problematic waste streams, such as mismanaged waste and littering, are often the most challenging to track as they constitute the fraction that falls through the cracks. Nevertheless, efforts to gather better data and monitor the evolution of materials and waste flows are at the core of the circular plastics life cycle.

As stated previously, although existing data provides a partial picture of the challenges that Hungary faces with regard to plastics throughout their life cycle, data is still incomplete. However, there are systems in place to gather data on the management of various waste streams (e.g. OKIR, EHIR), although this system would need to be broadened to provide sufficient granularity on plastics material flows throughout their life cycle (Ministry for Innovation and Technology, 2021[9]). For instance, currently, there is detailed disaggregation at the regional and sectoral level for plastic waste and well-detailed disaggregation of industrial plastic waste, however, municipal plastic waste data is less detailed. Given the wide variety of plastics, more granularity would allow for more targeted interventions, especially for problematic waste streams such as mixed waste. Some elements, however, that move towards an updated data monitoring and collection system can be observed in the Hungarian EPR system from Act 2021 II as well as from Government Decree 349/2021 (VI. 22.) (Parliament of Hungary, 2021[41]; Government of Hungary, 2021[21]). For instance, the decree foresees that producers would have to be registered in a national system

and would be required to collect data on the weight and quantities of SUP products produced as well as their origin, recycled content and generated waste. Such data collection requirements will enable better monitoring of waste from SUP products. However, a narrow focus on SUPs might not make data collection and monitoring efforts sufficiently impactful as these items only make up a small share of total plastics material streams. Conversely, broadening data collection and monitoring will require the modernisation of such a system. Digitalisation of data collection and monitoring, through the entire life cycle of plastics, can be an important enabler in this effort.

Hungary could look at international practices for inspiration. In Antwerp (Belgium), waste data collection was improved by creating a data warehouse for all types of data (e.g. sensor data, static, historical, geographical) in order to increase insight into the waste management of the city and to disclose waste management data to different stakeholders, thus also increasing transparency (see Annex Box 7.A.11).

7.5. Concluding reflections on the key policy recommendations

The gaps that Hungary has to overcome in order to reach EU targets and to achieve its own ambitions have been presented. The main gaps identified are as follows:

- There are no instruments in place to steer producers to favour recycled and easier to recycle plastics.
- Measures to reduce the use of plastics lack an economic dimension. Current and upcoming measures are primarily regulatory in nature.
- Separate collection and recycling rates are low and there are not enough economic incentives in place to motivate economy-wide behavioural change.
- There is a need for flanking instruments that can support the transition of plastics to a more circular life cycle.

For each of these gaps, the analysis provided policy recommendations, building on the detailed logic of intervention and the possibilities that exist in Hungary, while also drawing examples from international best practices (Table 7.1). It identified a mix of instruments, ranging from economic, regulatory to information instruments that could be deployed to make the plastics life cycle more circular. The recommendations target the most frequently used polymers, often used in the most problematic applications, such as packaging, SUPs and construction. It also takes into consideration the role of SMEs in the Hungarian context, and the possibilities that lie in education and awareness raising, as well as research and development efforts. Finally, as the policy recommendations target the entire life cycle of plastics, their alignment can ensure that they synergise in order to make the plastics life cycle more circular. As such, these recommendations should not be treated as piecemeal actions but rather deployed together so that they can reinforce one another.

Table 7.1. Gap analysis and policy recommendations

Life cycle stage	Gaps	Policy recommendations
Design and Production	There are no instruments in place to steer producers to favour recycled and easier to recycle plastics	Implement minimum recycled content requirements for plastic beverage bottles
		Promote design for recyclability among businesses
		Eco-modulate EPR fees on plastic packaging
		Introduce a tax on primary plastics packaging
Use	Measures towards reducing the use of plastics lack an economic dimension. Current and upcoming measures are primarily regulatory in nature	Expand GPP criteria and introduce mandatory GPP to reduce the use of primary plastics and promote the use of secondary plastics and sustainable alternatives
End-of-Life	Separate collection and recycling rates are low and there are not enough economic incentives in place to motivate economy-wide behavioural change	Increase landfilling taxes and strengthen enforcement of waste regulation
		Enhance PAYT schemes and door-to-door collection
		Expand EPR to ensure the separate collection of plastics in CDW
Horizontal	There is a need for flanking instruments that can support the transition of plastics to a more circular life cycle	Educate and inform consumers on proper disposal and sorting of plastic waste
		Provide grants and loans for innovative plastics technologies, especially recycling technologies
		Support detailed downstream data collection, monitoring and its digitalisation

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Annex 7.A. Supplementary information

Annex Box 7.A.1. The EU legislation remains the backbone of Hungary's plastics policy landscape

Several EU policy documents have as their goal to enable and support the transition towards the circular economy. These include the Circular Economy Action Plan of 2020, the Waste Framework Directive of 2008, the Landfill Directive of 1999, the Construction and Demolition Waste Protocol of 2015, among others (European Commission, 2015[51]; European Commission, 2020[52]; European Parliament, 2008[53]; European Commission, 2016[54]; Council of the European Union, 1999[55]). These policy documents provide an overarching framework for the transition to a circular economy, including making the plastics life cycle more circular, and setting targets to steer Member States towards this goal.

Recognizing the need for more specific and targeted legislation on plastics, the EU has launched its European Strategy for Plastics in a Circular Economy in 2018 and, in line with its vision, has introduced measures specifically aimed at tackling plastics (European Union, 2018[11]). The Single-Use Plastics Directive (SUPD), which entered into force in 2019, is an example of such a plastics-specific policy document (European Union, 2019[12]). The SUPD has as its goal to reduce the consumption of the 10 most littered SUP products (for instance, cotton bud sticks, cutlery, cups and food containers, plastic bags and packaging). For products where alternative, more sustainable and affordable options are available, the directive requires that the presence of SUP products on the market be restricted. For products without readily available alternatives, other measures that lead to a sustained reduction in their consumption should be put in place. Plastic beverage bottles will have to contain at least 25% recycled plastic from 2025 and 30% from 2030, while their separate collection would have to increase to 77% by 2025 and then to 90% by 2029. Finally, the "plastics own resource" measure incentivises EU Member States to reduce plastic packaging waste and increase recycling rates . Member States will be required to provide a national contribution based on non-recycled plastic packaging waste, at a call rate of EUR 0.80/kg.

The international plastics policy landscape evolves into new directions

With increasing public interest, the plastics policy landscape is becoming a dynamic space, and further legislative changes are expected in the near future. One such example is the forthcoming EU Sustainable Product Policy Initiative, which will revise the Ecodesign Directive and propose additional measures that will affect the design of products, including their durability and recyclability (European Union, 2022[14]). Another policy document that will likely shape the European plastics policy landscape is the EU policy framework for bio-based, bio-degradable and compostable plastics. This framework has as its goal to rethink the sourcing, labelling and use of bio-based plastics as well as biodegradable and compostable plastics.

Beyond the EU, the international plastics policy landscape is also evolving into new directions. For instance, the recent UNEA Resolution 5/14 adopted by the United Nations Environment Assembly (UNEA-5) entitled "End plastic pollution: Towards an international legally binding instrument" has kick-started intergovernmental negotiations to develop an international legally binding instrument to tackle plastic pollution (UNEP, 2022[56]). The outcomes of these negotiations could provide the framework for further global policy action.

Annex Box 7.A.2. Designing products with recycled plastic content

Minimum recycled content in California

Minimum recycled content requirements are already in place in California (United States). After passing Assembly Bill 793 in 2020, recycled content standards were established for plastic beverage containers. The requirement of the law is that these beverage bottles have a post-consumer plastic recycled content of at least 15% by early 2022, 25% by 2025 and 50% by 2030. Non-compliant companies face penalties, calculated at the rate of USD 0.20 per pound (lb) based on the shortfall of recycled content used compared to the minimum content requirement. Penalties are to be paid in quarterly instalments, and manufacturers that fall behind are to submit a corrective action plan where they detail how they are to meet the requirements of the law (CalRecycle, 2022[25]).

Design guidelines for minimum content requirement

A number of different organisations have developed guidelines on recycling-related aspects of plastic products, including recyclability and recycled content. The majority of these guidelines are for packaging products, as those represent the largest share of plastics in use. Generally, these guidelines detail both some of the technical challenges that manufacturers may face as well as the opportunities that exist in using more recycled plastics.

Annex Table 7.A.1. Selected guidelines and information on use of recycled plastics

Organisation	Country	Sector
KIDV	Netherlands	Packaging
PolyCE	Germany	WEEE
Recoup	UK	Packaging
British Plastic Federation (BPF)	UK	Packaging
FH Campus Wien	Austria	Packaging
CEFLEX	Europe	Packaging
RecyClass	Europe	Packaging
EPBP	Europe	Packaging (PET bottles)
EFBW and UNESDA	Europe	Packaging
APR	US	Packaging
Borealis	Global	Packaging

Source: PolyCE (2021[23]).

Another important step in an effective rollout of minimum content requirements is the use of verification systems. Such a system is necessary to ensure that manufacturers comply with minimum recycled content requirements. Verification can be done via material audits, which could be at the product level. Certification schemes are also available, which can ensure compliance and build trust not just between regulators and businesses but also between businesses and consumers (RECOUP and BPF, 2021[57]).

Annex Box 7.A.3. Designing for recyclability

Designing for recyclability is an important circular economy strategy and one that can contribute to a higher quality and a larger quantity of secondary plastics stream at the end-of-life stage of the material. Businesses that are making design choices can ensure that they take into consideration a number of design principles (OECD, 2021[22]), such as those below:

- Minimise the amount of waste at end-of-use through polymer selection.
- Simplify designs to include as few polymers as possible.
- Maximise the production of high-quality recycled materials as output of the recycling process.
- Minimise the amount of and exposure to chemical hazard at end-of-use through chemical selection.
- Match the polymer selection to the waste management operations in the intended market.
- Consider ways to mitigate the risk of littering.
- Ensure transparency of chemical composition.

Annex Table 7.A.2. Design guidelines for recyclability

Organisation	Country	Sector
CITEO	France	Packaging
COTREP	France	Packaging
Ecosystem	France	EEE
Danish Plastics Federation	Denmark	Packaging
Der Grüne Punkt (DSD)	Germany	Packaging
Cyclos-HTP	Germany	Packaging
IK (Industrievereinigung Kunststoffverpackungen e.V)	Germany	Packaging
Zentrale Stelle	Germany	Packaging
KIDV	Netherlands	Packaging
Recoup	UK	Packaging
WRAP	UK	Packaging
OPRL	UK	Packaging
FH Campus Wien	Austria	Packaging
Circular Analytics TH GmbH	Austria	Packaging
CEFLEX	Europe	Packaging
RecyClass	Europe	Packaging
PETCORE Europe	Europe	Packaging (PET)
EXPRA	Europe	Packaging
EPBP	Europe	Packaging (PET bottles)
EFBW and UNESDA	Europe	Packaging
APR	US	Packaging
Suez.circpack®	Global	Packaging
Borealis	Global	Packaging

Source: PolyCE (2021[23]).

Annex Box 7.A.4. Product fees for packaging in Belgium

Advanced eco-modulation of fees provides a financial incentive for producers to enhance product design towards more sustainable and recyclable materials. Fostplus, a packaging producer responsibility organisation in Belgium, applies a high level of differentiation of product fees for various packaging (Fostplus, 2022[58]). The product fees changed gradually. In 2020, there were only three different tariffs for plastic packaging, ranging from EUR 246 to EUR 711 per tonne, but in 2022 nine different tariffs apply for plastic packaging. In 2022, the lowest fees apply for glass and aluminium packaging, around EUR 40 to 50/tonne, which are easily recyclable. These are followed by paper packaging, corresponding to EUR 100/tonne.

In case of plastic packaging, nine different tariffs apply. The lowest fee applies to transparent colourless PET bottles, which dropped significantly from EUR 246/tonne in 2020 to EUR 104/tonne in 2022. Conversely, the highest fees of more than EUR 1 000/tonne apply to PE films and other plastic. Furthermore, for valorised (but not recycled) packaging, the fee represents EUR 1 734/tonne, and for non-valorised packaging it is more than EUR 2 000/tonne.

Annex Box 7.A.5. Tax on primary plastics

Chapter 26 of the Finance Act 2021 of the United Kingdom, adopted on 10 June 2021, introduces in Part 2 a “plastic packaging tax”, which amounts to GBP 200 per metric tonne of chargeable plastic packaging components (§45) (Parliament of the United Kingdom, 2021[59]). This tax entered into force on 1 April 2022 and applies to all plastic packaging in which “recycled plastic in the component, when measured by weight, is less than 30% of the total amount of plastic in the component” (§ 47(1)a). The aim of the tax is to provide a clear economic incentive for producers manufacturing plastic packaging to use secondary plastics in their products. Producers using secondary plastics had been placed in a disadvantageous competitive position compared to competitors exempt of the tax. As such, this tax is expected to create greater demand for recycled plastics. In turn, this will stimulate increased levels of recycling and the collection of plastic waste, diverting it away from landfill or incineration.

Annex Box 7.A.6. GPP criteria on plastics

In the municipality of Lolland (Denmark), recycling and recyclability criteria for packaging have been included in tenders for cleaning services: 75% of materials used for bags must be recycled or biodegradable; non-reusable packaging must be easy to separate into single material types; mono-materials are to be used if possible; only recyclable materials must be used; and the use of dark colours must be avoided (Jones, Kinch Sohn and Lysemose Bendsen, 2017[60]). In 2010, Stockholm applied GPP when purchasing new computers, using its own set of criteria (European Commission, 2012[61]). With regard to plastics, new computes were required to be free of PVC and contain at least 10% recycled plastics. In 2016, the City of Hamburg (Germany) introduced rules that ban the use of several plastic items, including plastic coffee capsules, single-use bottles, utensils and plates in government buildings (Plastic Smart Cities, 2022[62]). Reusable cups were introduced in several public institutions, including cafeterias of public administrations and the police academy. This measure lead to the prevention of up to 675 000 single-use cups per year. Finally, the Government of Japan has included GPP criteria on recycled content in its Act on Promoting Green Procurement and its related Basic Policy on Green Procurement (Ministry of the Environment of Government of Japan, 2020[63]). According to these criteria, the higher a product's recycled content share, the higher its evaluation score. For some goods, there are specific minimum content requirements, for instance, a minimum of 40% recycled content for stationary products. The GPP criteria is mandatory for government agencies across a large number of product categories.

Annex Box 7.A.7. Landfill taxes

Landfill taxes remain an important instrument to divert waste away from landfills and to ensure that a higher share of waste is sorted and then recycled. While there are important heterogeneities in terms of landfill taxes across countries, there is a strong correlation between a higher landfill tax rate and lower landfilling of waste. In order to decrease the landfilling of plastics waste, it is therefore important that consumers are sufficiently incentivised to sort their waste and recycle. Landfill taxes on their own may not be enough to ensure the circularity of the plastics life cycle, as incineration could be seen as a low cost waste management option. In order to ensure that plastic waste is not simply incinerated instead of being landfilled, it is important to ensure that some form of incineration tax is in place, which then makes sorting and recycling plastic waste the most economically attractive option. Several countries have incineration taxes in place (e.g. Austria, France, the Netherlands, Sweden and the United Kingdom). These taxes are either higher than the landfill tax or lower. For example, incineration taxes are more than double the landfill tax in the Netherlands, and 1.5 times higher in France, while it is only one-third of the landfill tax in Sweden (ADEME, 2017[64]). A relatively lower tax makes incineration a second-best option while ensuring economic incentives towards recycling waste are greatest.

Annex Table 7.A.3. Examples of landfill tax rates in selected EU Member States

Country	Landfill tax in EUR/tonne of waste
Malta	No tax
Greece	EUR 10/tonne
Hungary	EUR 19.35/tonne
Slovak Republic	Based on level of municipal waste separation (2021 levels): = 10% EUR 33/tonne 10-20% EUR 30/tonne 20-30% EUR 27/tonne 30-40% EUR 22/tonne 40-50% EUR 18/tonne 50-60% EUR 15/tonne <60% EUR 11/tonne
Poland	EUR 46/tonne
Sweden	EUR 51/tonne
Finland	EUR 70/tonne
Ireland	EUR 75/tonne
Belgium	Flanders EUR 107.87/tonne for combustible waste landfilled in inorganic industrial waste landfill EUR 59.33/tonne for non-combustible waste in 2020 Average landfill rate (pre-tax) in 2018: EUR 49/t for household and similar waste EUR 40/t for industrial waste Wallonia EUR 120.52/t for general waste EUR 66.89/t for non-combustible waste EUR 267.55/t mix of hazardous and non-hazardous waste

Source: CEWEP (2021[39]).

Annex Box 7.A.8. Pay-as-you-throw schemes

Pay-as-you-throw (PAYT) schemes aim to charge based on the amount of waste generated. The schemes can be volume based, sack based, weight based or frequency based (Dri et al., 2018[65]). The main driver of behavioural change is the unit rate, that is, the factor that pushes consumers to reduce their waste and opt for waste sorting, thus avoiding the higher prices associated with the generation of large quantities of mixed waste.

Belgium, in particular, recovers, recycles and composts nearly all its municipal waste, with landfilling of municipal waste amounting to less than 1% (OECD, 2021[46]). This is partly achieved by using PAYT schemes for municipal waste. The Flanders and Wallonia regions both use specially designated bags, where a higher price for residual waste bags (or "brown bags"), up to EUR 2 , encourages waste sorting (OECD, 2021[46]). For recyclable waste, including for plastic waste, the specially designated "blue bags" are lower priced. In Flanders, separate collection covers almost 70% of municipal waste, and almost all is recycled or composted.

In addition to the bag-based system, weight-based systems are also used to great effect. In Aschaffenburg (Germany), a weight-based system was introduced in 1997, which led to an increase in recycling of up to 86% and a reduction in mixed municipal waste to 55 kg per capita per year (Morlok et al., 2017[66]). This example shows that a PAYT scheme need not be a more expensive option in the long run (Dri et al., 2018[65]): fees in Aschaffenburg have decreased over time by 23% between 2002 and 2013.

Annex Box 7.A.9. Information campaigns

When adopting a PAYT scheme, municipalities in Treviso also prepared a well-developed and targeted communication campaign for residents (Bucciol, Montinari and Piovesan, 2011[45]). The communication campaign included emotive and engaging posters displayed in public spaces and shops, technical and specific leaflets and booklets for households explaining in detail the new waste collection system, and public events and meetings with residents in order to respond to questions and concerns. In the city of Altamura, a survey was designed to evaluate the effectiveness of the PAYT scheme from the citizen's point of view (Laurieri et al., 2020[67]). The results of the study showed that citizens are more motivated to adequately collect separate waste fractions when they receive information about subsequent environmental benefits and the outcomes of the fractions collected, and when there are greater controls on the quality of the sorted waste fractions.

Annex Box 7.A.10. R&D funding towards plastics technologies

The United States Department of Energy announced investments up to USD 14.5 million for R&D in technology to reduce waste and to increase the efficiency of recycling, specifically targeting SUPs (United States Department of Energy, 2022[68]). The award criteria for this funding includes: i) technical merit, innovation and impact (45%), which looks at the extent of innovation of the technology and can demonstrate convincingly that it would move towards state-of-the-art technology and provide sufficient technical detail, and could reduce the externalities of plastics waste and use; ii) project research and market transformation plan (30%), a description of the research approach, the identification of technical risks, and an identification of target market and competitors; iii) team and resources (20%), on the sufficiency of facilities and capacities within the team to carry out the research; and iv) diversity, equity and inclusion (10%). Researchers and businesses were required to submit concept papers, followed by more detailed complete applications (United States Department of Energy, 2021[69]). Some of the projects selected and their funding are shown below.

- University of Massachusetts Lowell (Lowell, MA) to integrate delamination and carbonization processes for the upcycling of single-use, multi-layer plastic films (Award amount: USD 1 600 276).
- Braskem (Pittsburgh, PA) to develop infinitely recyclable single-polymer chemistry bio-based multilayer films (Award amount: USD 2 000 000).
- Iowa State University of Science and Technology (Ames, IA) to develop a closed loop upcycling of SUP films to biodegradable polymers (Award amount: USD 2 500 000).
- Michigan State University (East Lansing, MI) to create a redesign for inherently recyclable plastics (Award amount: USD 1 705 811).
- North Carolina Agricultural and Technical State University (Greensboro, NC) to formulate the catalytic deconstruction of plasma treated SUPs to value-added chemicals and novel materials (Award amount: USD 2 499 994).
- TDA Research Inc. (Wheat Ridge, CO) to develop infinitely recyclable and biodegradable films for improved food packaging (Award amount: USD 1 609 056).

West Virginia University Research Corporation (Morgantown, WV) to develop process intensified modular upcycling of plastic films to monomers by microwave catalysis (Award amount: USD 1 500 001).

Annex Box 7.A.11. Waste Management Data Warehouse in Belgium

The Waste Department of the City of Antwerp collected data in the past in an old fashioned way (handwritten notes, insufficient use of Excel, among other practices) (Interreg Europe, 2020[70]). Data was managed in an unstructured, non-standardized way and therefore, often, it was non-transparent. Introducing a data warehouse thus responded to this fragmented internal data landscape, the limited access to waste data, and the limited data sharing between systems. Datasets were not linked and reporting was separate for each data set. The objective of the data warehouse is to increase insight into the waste management of the city. Another aim is to disclose waste management data to different stakeholders (local policy makers and administrations, waste processing companies, citizens and researchers) so as to increase transparency. To achieve these objectives, the Waste Department had to collect all types of data (real-time data, e.g. sensor data, static, historical, geographical). Approximately EUR 100 000 was spent to consult expert analysts and obtain licenses for software. The software, in particular, consists of a business intelligence tool (Cognos) and a dashboard creator (Cumul.io) (Interreg Europe, 2022[71]). A dedicated team of six data experts were involved in this task. As a result of the implementation of the data warehouse, data from different sources is now uploaded in an automated way. Through this process, Antwerp is able to get more insight into the operations of its data suppliers and to allocate costs more accurately. The waste data warehouse also delivers added value to Antwerp's various stakeholders. It has also increased transparency, and introduced time and cost efficiencies, and is now a reliable source for researchers.

Notes

[1] The data is based on the 2019 Hungarian Plastics Association's survey, which gathered responses from 371 companies of various sizes (Pogány, 2020[6]). Therefore, it covers only part of domestic production and conversion.

[2] The Hungarian state-led EPR system is currently under reform. At present, EPR fees are collected via environmental product fees (Interreg Danube Transnational Programme MOVECO, 2017[73]). These fees combine an environmental tax and a licence fee. With the transposition of Article 8a of the WFD on the general minimum requirements for the establishment of EPR schemes, these two functions will be separated. Starting from July 2023, Hungary's waste management system will transform into a concession system with a private company (MOL). MOL will manage waste management (for municipal solid waste along with non-municipal waste streams covered by EPR systems or deposit-refund schemes) on behalf of the State (About Hungary, 2022[72]), with producers paying fees to the concession company to manage their product waste streams. At the same time, the environmental product fee will be transformed into an environmental tax, intended to shift consumer behaviour towards using less plastics (Government of Hungary, 2022[74]).

[3] Although the environmental product fee will change to an environmental tax starting in 2023 (see footnote above), it will not specifically target primary plastics.

[4] Using a conversion rate of HUF 399 to EUR 1 in September 2022 reported by the Hungarian National Bank.

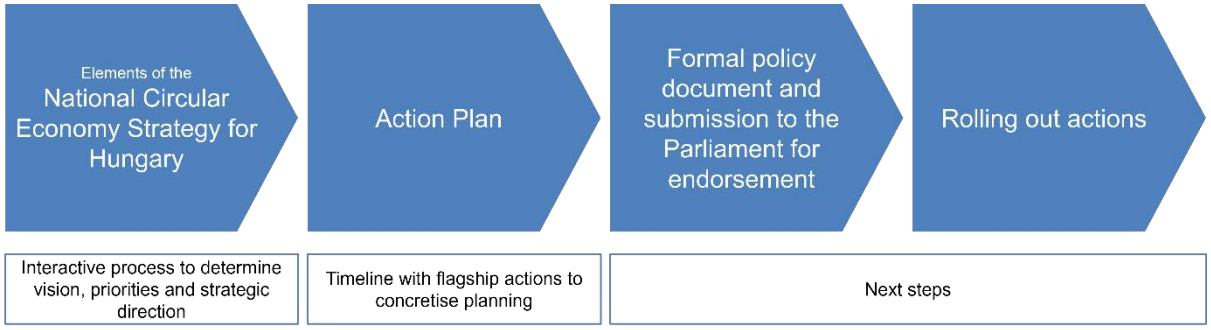
8 Proposed action plan and monitoring framework of the National Circular Economy Strategy

This chapter puts forward an action plan with specific actions to help implement the future strategy. It also outlines a monitoring framework to measure the progress towards specific strategic objectives and quantitative targets in Hungary's circular economy transition.

8.1. Implementing a circular economy strategy requires several steps

The proposed action plan and monitoring framework of the National Circular Economy Strategy (NCES) fully builds on the preceding chapters of this report and aims to make the policy recommendations more concrete by proposing flagship actions and developing a timeline for their implementation. In a following step, the documents would need to be endorsed by the Hungarian Parliament in order to roll out the proposed actions (Figure 8.1).

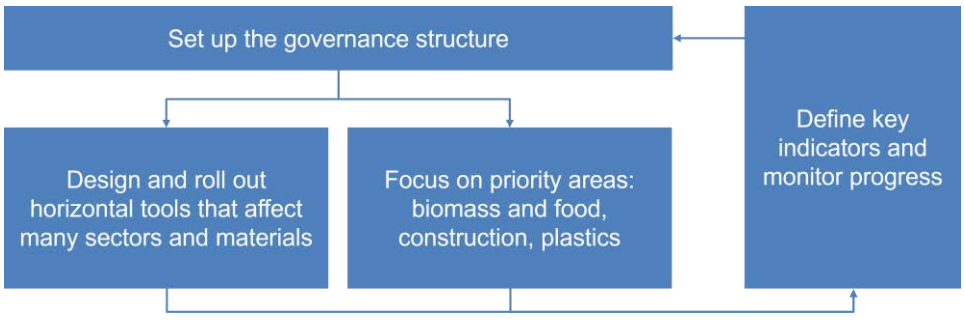
Figure 8.1. Developing and rolling out a circular economy strategy requires several steps



The transition to a circular economy is a long-term process that will require efforts and a long-term commitment of many stakeholders. Monitoring progress and steering the concerted efforts in the right direction requires a well-designed governance structure. Actions to set up the governance structure are thus essential and urgent. With the right governance structure, actions can be taken that deal with horizontal aspects or target priority areas with potentially high circular economy impacts. Setting up indicators helps to monitor progress and steer the process towards impactful changes and structural reforms. These elements are outlined in Figure 8.2.

To achieve the vision and strategic objectives of the NCES by 2040, the proposed action plan suggests implementation actions for 45 policy recommendations across the three priority areas, as well as for governance structure and horizontal tools. It also proposes their implementation across three time horizons: short-term actions (to be fully effective by 2024), medium-term actions (to be fully effective by 2028), and long-term actions (to be fully effective by 2040). In order to ensure the timely transition to a circular economy, the actions need to be implemented well ahead of the 2024, 2028 and 2040 milestones. The actions put forward should not be interpreted as a menu from which measures can be cherry-picked. They form a coherent set of measures that have to be implemented together in a policy mix in order to achieve the greatest impact and transform Hungary as it moves towards a circular economy.

Figure 8.2. Proposed elements of the action plan for the implementation of the NCES



8.2. Set up the governance structure

The transition to a circular economy is a shared responsibility of a range of stakeholders. The successful implementation of the NCES requires the timely setting up of a structure for inclusive and effective governance. Proposed actions to improve governance are outlined in Table 8.1.

Table 8.1. Flagship actions to improve governance of the circular economy transition in Hungary

Effective by 2024	Recommendations	Implementation actions	Responsibility
X	Prepare NCES for adoption	Convert the proposed elements of the NCES into a legal document and submit it to Parliament for formal endorsement	Ministry of Energy
X	Establish a coordination mechanism	Set up an inter-ministerial committee to leverage synergies, implement actions and monitor progress: nominate a high-level chair that has the political mandate and is linked to the ministry that will take the lead in the circular economy transition; ensure that each ministry involved in the implementation of the NCES has nominated a fixed representative; set up a timetable to have meetings every six months	Ministry of Energy, Ministry of Agriculture, Ministry of Construction and Investment, Ministry of Culture and Innovation, Ministry of Finance, Ministry of Economic Development, Ministry of Regional Development, Ministry of Interior, Prime Minister's Office
X	Strengthen cross-sectoral, inter-ministerial and multi-stakeholder collaboration[1]	Set up a stakeholder sounding board that provides expertise and can make recommendations to the inter-ministerial committee: meetings to be held every six months in preparation for the inter-ministerial committee. The meeting format and selected participants can be flexible depending on the focus of horizontal actions or sector-specific discussions. Organization and facilitation of the meetings to be carried out by the ministry that will take the lead in the circular economy transition, and supported by the ministries that are relevant to the focus area	Ministry of Energy, public and private sector stakeholders, academia, NGOs
X	Develop an indicator dashboard[2]	Develop an indicator dashboard to monitor progress towards the long-term strategic targets every 6 months, define data collection processes and allocate responsibilities to solve data gaps	Ministry of Energy, Ministry of Agriculture, Ministry of the Interior, Hungarian Central Statistical Office, inter-ministerial committee

1. Hungary has recently established the Circular Economy Technology Platform (see Box 2.2), which could play an instrumental role in strengthening stakeholder collaboration for circular transition in Hungary.
2. Guidance for developing such a dashboard is provided in the final section of this chapter (" Define key indicators and monitor progress").

8.3. Design and roll out horizontal tools

Horizontal tools cut across product and materials life cycles and go beyond individual sectors. As these tools help implement specific recommendations of priority areas and can contribute to the economy-wide circular transition, their development and implementation should already be initiated in the short term and continue throughout the implementation of the NCES. The suggested horizontal flagship actions will strengthen education, capacity building and knowledge transfer, provide more financial support for eco-innovation and technological development, better tailor government support for the circular transformation of SMEs, and improve existing data collection and monitoring systems (see Table 8.2).

Table 8.2. Flagship actions to drive Hungary's economy-wide circular transition

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
X	X	X	Strengthen education, capacity building and knowledge transfer	Educate and inform consumers by designing education and information campaigns to improve the understanding of circular economy concepts and to promote more circular behaviour (including sustainable consumption patterns, waste prevention practices and proper disposal and sorting of different waste streams); promote more circular thinking and the necessary skills by mainstreaming circular economy into curricula of higher education programmes; raise awareness among consumers, public entities and companies by showcasing successful pilot projects, international good practices and initiatives, and by implementing interactive events to motivate changes in behaviour, attitudes and practices; increase capacity building by developing a national training programme targeting industry stakeholders and local and national policy makers; improve knowledge transfer by developing dedicated private-public platforms, bringing together relevant stakeholders	Ministry of Energy, Ministry of Agriculture, Ministry of Construction and Investments, Ministry of Culture and Innovation, Ministry of Interior
X	X	X	Provide more financial support for eco-innovation and technological development	Support projects via direct government funding for R&D on innovative products, processes and technologies; introduce circularity indicators in calls for funding; ensure that financing schemes include circularity principles; consider introducing a dedicated tax instrument to allow deductions of investment costs (beyond regular investment tax deductions) for environmentally friendly investments; encourage banks, investors and multinational companies to provide capital for innovative products	Ministry of Energy, Ministry of Agriculture, Ministry of Ministry of Construction and Investments, Ministry of Economic Development, Ministry of Finance
X	X	X	Tailor government support for the circular transformation of SMEs	Strengthen incentive subsidies for SMEs; facilitate access to information about external financing opportunities beyond conventional R&D grants; support dissemination of examples of profitable business cases and innovative business models; support development of decision-making tools and business plans to facilitate more circular ways of doing business; support the establishment of public-private collaboration platforms and partnerships, and encourage actors to share good practices; remove regulatory obstacles that prevent SMEs from adopting new circular business models	Ministry of Energy, Ministry of Agriculture, Ministry of Construction and Investments, Ministry of Culture and Innovation, Ministry of Finance, Ministry of Economic Development, Hungarian Chamber of Commerce and Industry, industry clusters and associations, Circular Economy Technology Platform
X	X	X	Improve current data collection and monitoring systems	Consider reforming the national database or develop a new inventory to capture more reliable and granular data; broaden and digitalise data collection and monitoring of waste streams and their quality specifications to provide sufficient information on material flows throughout their life cycle and across industries; improve reporting of data on EWC codes, lifetimes, prices and (re)usability of different waste streams; consider creating a waste catalogue containing multiple criteria, including waste compositional data, environmental impact and other sustainability indicators; specify laboratory tests to determine the quality of secondary raw materials recovered from waste streams	Ministry of Energy, Ministry of Agriculture, Ministry of Interior, Hungarian Central Statistical Office

8.4. Focus on biomass and food

The action plan for the circular transition for biomass and food proposed 18 implementation actions (see Table 8.3). Two actions are soon to be implemented. The development and implementation of the 11 medium-term actions should already be initiated in the short term so that they become fully effective by 2028, at the latest. Similarly, the five long-term actions need to be implemented well ahead of the 2040 milestone (i.e. by 2035) so that they become effective in achieving the vision and goals of the NCES.

Table 8.3. Flagship actions to support the transition to a circular bioeconomy in the biomass and food sector in Hungary

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
X			Provide additional incentives for the separate collection of municipal bio-waste through improving the waste collection infrastructure	Ensure that adequate infrastructure for the separate collection of municipal bio-waste is in place: provide properly sized kitchen caddies or bags for households; establish regular collections; ensure appropriate distance to the containers (in case of kerbside collection) or a door-to-door collection	Ministry of Energy, Ministry of Agriculture, municipalities, Prime Minister's Office
X			Promote GPP of food and catering services by developing a catalogue of good practices and a guidance on GPP methodology or training materials for public authorities	Develop a catalogue of good practices for suppliers of food and catering services	Ministry of Energy, Ministry of Agriculture, Ministry of Regional Development, Hungarian Public Procurement Authority
	X			Develop a guidance manual on GPP methodology for public authorities (consider the EU guidance and EU GPP criteria for food, catering services and vending machines)	
	X		Develop a regulatory framework supporting the use of products from bio-waste (compost and digestate) in agriculture, with a focus on the quality assurance system for compost and digestate	Conduct an assessment to examine the required legislative changes to provide stronger incentives for greater use of compost and digestate on agricultural land (including the quality assurance system, a compost classification system and stricter quality standards for impurities, a list of suitable input materials for composts as well as product control requirements for compost and digestate quality)	Ministry of Energy, Ministry of Agriculture
				Amend legislation regulating the management of bio-waste and specifying the technical requirements for composting to introduce elements of an improved quality assurance system for compost and digestate	
	X		Develop a dedicated bioeconomy research and innovation programme with associated funding and technical support to support the development of industrial biotechnology and biorefineries	Introduce business research and an innovation support scheme (through Operational Programmes [OPs] co-funded through EU funds or a dedicated bioeconomy funding programme) directed at strengthening the research and innovation environment, multi-stakeholder cooperation, and scaling up and commercialising innovative bio-based products and materials	Ministry of Energy, Ministry of Agriculture, Ministry of Finance, Ministry of Regional Development
	X		Provide additional incentives for the separate collection of municipal bio-waste by supporting PAYT schemes and by increasing landfill taxes	Amend the relevant legislation to gradually increase landfill taxes; consider redistributing proceeds from landfill taxes to incentivise municipalities to introduce separate collection and recycling of bio-waste	Ministry of Energy, Ministry of Agriculture, Ministry of Finance, Ministry of Regional Development, municipalities, Prime Minister's Office
				Consider providing subsidies for municipalities to adopt PAYT schemes	
				Strengthen monitoring and enforcement to deter illegal landfilling (including fines)	
	X		Strengthen financial support for bio-waste processing and recycling facilities to ensure adequate investments into	Consider strengthening the existing financial support for bio-waste processing and recycling facilities (through OPs co-funded by EU funds) and extend the eligibility for such funds to additional actors (if available funds are	Ministry of Energy, Ministry of Agriculture, Ministry of Finance, Ministry of Regional

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
			recycling capacities	not being fully disbursed)	Development
				Consider promoting home composting through economic incentives and providing infrastructure (including free composter bins)	
	X		Investigate the potential to enhance the use of sewage sludges on agricultural land	Conduct a preparatory study to determine the potential of enhancing the use of sewage sludges on agricultural land (including for phosphorus recovery), and develop requirements for safety measures (preventing possible leakage of contaminants) as well as a monitoring system for the composition and characteristics of sludges	Ministry of Energy, Ministry of Agriculture
		X		If a decision is made to extend the safe application of sludges on agricultural land, amend the relevant legislation (considering the potential revision of the EU Council Directive on sewage sludge)	
	X		Consider allowing food donations after food's "best before" date for food under specific conditions that is safe for consumers but cannot be sold, and consider introducing additional tax incentives	Consider amending the relevant legislation to extend the right to donate food that is past the "best before" date instead of making food donations mandatory under certain circumstances	Ministry of Energy, Ministry of Agriculture, Ministry of Finance
		X		Consider amending the relevant legislation to introduce tax credits or additional tax deductions	
		X	Consider policy support for alternative initiatives in the field of innovative protein production	Consider developing a national policy with long-term targets and objectives in support of innovative protein production (including crops other than soy and single cell microalgae, and potentially the use of insects as a protein source for feed, as well as the extraction of protein products from agricultural and industrial food by-products)	Ministry of Energy, Ministry of Agriculture, Prime Minister's Office
		X	Consider implementing a form of mandatory use of GPP criteria in contracts	Conduct an assessment to examine the feasibility of introducing a form of mandatory GPP criteria and, if needed, amend or develop the relevant legislation	Ministry of Energy, Ministry of Agriculture, Ministry of Regional Development, Hungarian Public Procurement Authority
		X	Redefine the policy approach for bioenergy production to ensure the transition to a circular bioeconomy	Define an integrated policy approach, including a decision-making process, for the use of biomass to help reconcile the conflicting goals of bioenergy and bioeconomy (to align it with the EU CEAP and the European Bioeconomy Strategy)	Ministry of Energy, Ministry of Agriculture, Prime Minister's Office, inter-ministerial committee

8.5. Focus on construction

The action plan for the transition to a circular construction proposes 27 implementation actions (see Table 8.4). Two actions are to be implemented promptly. The development and implementation of the 12 medium-term actions should already be initiated in the short term so that they become fully effective by 2028, at the latest. Similarly, the 13 long-term actions need to be implemented well ahead of the 2040 milestone (i.e. by 2035) so that they become effective in achieving the vision and goals of the NCES.

Table 8.4. Flagship actions for a circular building construction sector in Hungary

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
X			Develop circular design guidelines for buildings	Develop a guideline with circular economy principles in the design of buildings (including guidance and best practice examples on integration of recyclable materials, and design for modularity and durability of buildings, as well as on the use of digital tools)	Ministry of Energy, Ministry of Construction and Investments
X			Simplify the procedure permitting the incorporation of secondary raw materials into construction projects	Identify challenges encountered by contractors in incorporating secondary raw materials into construction projects	Ministry of Energy, Ministry of Construction and Investments
	X			Amend the relevant legislation to simplify the authorisation procedure	
	X		Consider introducing a tax on selected virgin construction aggregates	Conduct an impact assessment study on the possible introduction of a tax on selected construction aggregates (including impacts of the tax on environmental quality and economic efficiency, and their comparison with potential impacts from other regulatory approaches)	Ministry of Energy, Ministry of Construction and Investments, Ministry of Finance
				If a decision is made to introduce a tax on construction aggregates, amend the relevant legislation	
	X		Revise the National Sustainable Construction Industry Strategy to include circular economy aspects	Adapt the National Sustainable Construction Industry Strategy to include concrete implementation measures and targets for circular economy transition and to reflect the revision of the European CPR	Ministry of Energy, Ministry of Construction and Investments, Prime Minister's Office
	X		Extend existing renovation support schemes and tailor them to promote circular economy principles	Amend existing renovation support schemes to extend their coverage (to better target growing public interest in renovations) and to include circular economy principles (beyond energy efficiency) for both buildings and products	Ministry of Energy, Ministry of Construction and Investments, Ministry of Finance
	X		Promote shared and mixed-use concepts in public buildings by developing space-sharing strategies and revising zoning codes	Conduct a feasibility study to examine the applicability of different space-sharing strategies in public buildings in Hungary (including multi-use and mixed-use concepts) as well as the benefits of revising zoning codes in certain districts and cities (including requirements for the inclusion of affordable housing and measures promoting the repurposing of the existing buildings for new types of uses)	Ministry of Energy, Ministry of Construction and Investments, Ministry of Regional Development, municipalities, Prime Minister's Office
	X		Increase landfill tax rate and strengthen enforcement of waste regulation	Amend the relevant legislation to gradually increase landfill taxes	Ministry of Energy, Ministry of Finance
				Strengthen monitoring and enforcement to deter illegal landfilling (including fines)	
	X		Introduce end-of-waste criteria for additional construction waste streams	Develop legislation to introduce additional end-of-waste (EoW) criteria	Ministry of Energy, Ministry of Construction and Investments
	X		Develop a national construction and demolition strategy	Consider developing a national strategy for a harmonised management and treatment of CDW, connecting national targets with specific measures and activities	Ministry of Energy, Ministry of Construction and Investments, Prime Minister's Office
	X		Establish a mandatory selective demolition scheme	Develop legislation to introduce mandatory selective demolition, including a system of inspection/audit before and after demolition	Ministry of Energy, Ministry of Construction and Investments
	X		Extend the use of GPP criteria for construction works and consider integrating minimum recycled content requirements into GPP	Conduct a pre-market study to understand the feasibility and associated costs of using GPP criteria for construction works and to define minimum recycled content requirements	Ministry of Energy, Ministry of Construction and Investments, Ministry of Regional Development, Hungarian Public Procurement Authority
		X		Consider introducing a form of mandatory GPP criteria for construction works by state level entities or even by all public entities	
		X	Develop a secondary raw	Consider developing a national policy with long-term targets	Ministry of Energy, Prime

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
			materials policy	and objectives for secondary raw materials, considering the regional perspective	Minister's Office
		X	Develop a new quality standard and a quality label for secondary construction materials	Conduct a feasibility and market study on the introduction of a quality standard for recycled construction materials	Ministry of Energy, Ministry of Construction and Investments
				Develop new legislation specifying quality standards for recycled construction materials (including metrics for performance measurements and testing and calculation procedures) and revise existing legislation on quality standards accordingly	
				Conduct a study to determine the potential of introducing a national quality label for secondary construction materials	
		X	Revise the current legislation on design and materials choices in buildings to include minimum recycled content requirements and the development of performance-based criteria for construction materials and components	Amend relevant legislation to align it with European regulations and principles and to introduce minimum recycled content requirements and performance-based criteria	Ministry of Energy, Ministry of Construction and Investments
		X	Adapt urban planning strategies to support the development of smart, sustainable and circular cities	Conduct an evaluation study to identify the shortcomings of the existing urban planning strategies	Ministry of Energy, Ministry of Construction and Investments, Ministry of Regional Development, municipalities, Prime Minister's Office
				Consider adapting urban planning strategies to reflect more integrated spatial planning prioritising sustainability and circularity	
		X	Reduce value added tax on renovation works	Conduct an impact assessment study of a possible introduction of VAT reductions (targeting specifically the use of secondary and renewable materials in renovation projects and possibly deep energy renovation projects)	Ministry of Energy, Ministry of Construction and Investments, Ministry of Finance
				Amend the relevant legislation to introduce VAT reductions for renovations works	
		X	Consider developing an EPR scheme for construction products	Conduct a cost-benefit analysis study to assess the potential of introducing an EPR for construction and renovation products and materials (including concrete and tile waste, plastics and insulation materials, doors and window glass)	Ministry of Energy, Ministry of Construction and Investments
				Consider amending relevant legislation to expand the current EPR scheme to include certain construction and renovation products and materials (possibly only voluntary in the first years, becoming mandatory later)	
		X	Promote digitalisation of the industry	Consider developing a digital strategy for the construction sector and promote the uptake of digital solutions (including BIM, digital twins and open-source software)	Ministry of Energy, Ministry of Construction and Investments, Prime Minister's Office

8.6. Focus on plastics

The action plan to promote the transition to a circular plastics life cycle suggests 17 implementation actions (see Table 8.5). Two actions are to be implemented immediately. The development and implementation of the 13 medium-term actions should already be initiated in the short term so that they become fully effective by 2028, at the latest. Similarly, the three long-term actions need to be implemented well ahead of the 2040 milestone (i.e. by 203 5) so that they become effective in achieving the vision and goals of the NCES.

Table 8.5. Flagship actions to promote a circular life cycle for plastics in Hungary

Effective by			Recommendations	Implementation actions	Responsibility
2024	2028	2040			
X			Eco-modulate EPR fees on plastic packaging[1]	Conduct a preparatory study to determine the most suitable eco-modulation of fees for different types of plastic packaging	Ministry of Energy
				Amend the relevant legislation on current environmental product fees to define and provide conditions for eco-modulation (consider the forthcoming EU guidance on EPR fee modulation)	
	X		Implement minimum recycled content requirements for plastic beverage bottles[2]	Develop guidelines for designing products with recycled content (including for verification schemes)	Ministry of Energy
				Develop legislation specifying minimum recycled content requirements	
	X		Promote design for recyclability among businesses	Develop guidelines for designing products with better (plastics) recyclability	Ministry of Energy, Ministry of Culture and Innovation
				Develop information instruments for knowledge and capacity building on better design for recyclability among manufacturers	
	X		Introduce a tax on primary plastic packaging[3]	Conduct an impact assessment study of a possible introduction of taxes on certain primary plastics applications	Ministry of Energy, Ministry of Finance
				Amend the relevant legislation to introduce taxes on primary plastics packaging	
	X		Enhance PAYT schemes and door-to-door collection	Provide subsidies for municipalities to adopt PAYT schemes	Ministry of Energy, Ministry of Regional Development, municipalities, Prime Minister's Office
				Strengthen monitoring and enforcement to deter illegal waste disposal (including fines)	
				Provide subsidies for municipalities to develop infrastructure for improving door-to-door collection for plastics	
	X		Increase landfill taxes and strengthen enforcement of waste regulation	Amend the relevant legislation to gradually increase landfill taxes	Ministry of Energy, Ministry of Finance
				Strengthen monitoring and enforcement to deter illegal landfilling (including fines)	
		X		Conduct a study assessing the potential impacts from the introduction of incineration taxes	
	X		Expand GPP criteria and introduce mandatory GPP to reduce the use of primary plastics and promote the use of secondary plastics and sustainable alternatives	Conduct a pre-market study to understand the feasibility and associated costs of introducing minimum recycled content and recyclability requirements of plastics into GPP criteria and make them mandatory for various product groups	Ministry of Energy, Ministry of Regional Development, Hungarian Public Procurement Authority
				Develop a guidance manual on GPP methodology for selected plastic product groups in the procurement by state level entities or even all public entities	
		X		Consider introducing a form of mandatory GPP criteria for selected plastic product groups	
		X	Expand EPR to ensure the separate collection of plastics in CDW[4]	Amend relevant legislation to expand the current EPR scheme to include plastics as a separately collected waste stream in CDW (especially hard-to-recycle plastics, such as PVC)	Ministry of Energy, Ministry of Construction and Investments

1. Hungary's extended producer responsibility (EPR) system is currently under reform, which will include the detailed rules of the requirements of the SUP Directive.
2. The EU Single-use Plastics Directive requires incorporating 25% of recycled plastic in PET beverage bottles from 2025, and 30% in all plastic beverage bottles from 2030 (see Box A A.2). The medium-term horizon for this action reflects the fact that an initial implementation is necessary by 2025 and that a more robust system should be put in place by 2030.
3. Starting from July 2023, the environmental product fee will be transformed into an environmental tax targeting plastic packaging, but not specifically primary plastics.
4. It is already reflected in the proposal for establishing an EPR scheme for construction products in Table 8.4.

8.7. Define key indicators and monitor progress

A monitoring framework for the circular economy transition is required for understanding and measuring the progress towards specific strategic objectives and quantitative targets set out within the strategy. A set of indicators that allow for the monitoring of key trends and patterns helps policy makers understand how the various elements of the circular economy have developed over time, assess whether sufficient action has been taken, and identify areas for further intervention (European Commission, 2018[1]). Monitoring also provides guidance for setting new long-term priorities, and delivers feedback to strategy and planning development for the different actors in the economy (Alaerts et al., 2019[2]).

As the concept of the circular economy cuts across a variety of sectors, material streams and horizontal tools it is impossible to capture the transition with a single indicator. Circular economy monitoring frameworks therefore comprise a larger set of relevant indicators. Such frameworks can be structured using a multi-tiered approach: from more general to more specific indicators. The indicators can be classified into three levels: i) the macro level (global, national, regional and city level related to resource flows, waste generation, recycling rates, recovery of specific waste streams, secondary materials use, but also jobs related to circular activities); ii) the meso level (penetration of new business models, consumer behaviour, but also industrial symbiosis and activities within eco-industrial parks); and iii) micro level (on company and product levels) (Alaerts et al., 2019[2]). The academic literature strongly suggests going beyond the commonly used macro-level indicators to include indicators that provide direct feedback to policy makers on specific products and services, and that address consumer and business behaviour, as well as societal needs, related to the circular economy (Alaerts et al., 2019[2]; Giljum et al., 2011[3]; Ekins et al., 2019[4]; Potting et al., 2018[5]). There is also a need for additional indicators to properly measure the effects and process of the transition itself, connecting the circular economy to environmental impacts and capturing possible rebound effects (Potting et al., 2018[5]; Alaerts et al., 2019[2]). An overview of circular economy monitoring frameworks for policy makers to support their circular economy strategies is reported in Annex Box 8.A.1.

8.7.1. Three sets of indicators are proposed for Hungary's monitoring framework

The proposed monitoring framework to support the implementation of the NCES rests on a three-tiered structure of indicators:

- First, a **set of three key indicators** to measure the attainment of strategic objectives formulated in the vision of the NCES. These include resource productivity, circular material use and number of circular jobs. The indicators are listed in Table 8.6.
- Second, a **specific list of indicators for the three vertical priority areas** to monitor the progress of the circular transition within biomass and food, construction and plastics. This set of indicators draws predominantly on indicators proposed within relevant Hungarian plans and strategies, for instance, the Fourth National Environmental Programme (4NEP), the NWMP 2021-2027, the Waste Management Public Services Plan (WMPSP), and the National Environmental Technology Innovation Strategy (NETIS). They also include some of the individual indicators from the EU Circular Economy Monitoring Framework, i.e. food waste, bio-waste recycling, recovery of CDW, and recycling of plastic packaging waste. Finally, the set is complemented by a proposal for a number of aspirational indicators, such as the monitoring of food waste avoided, GPP for construction, and use of non-recyclable plastics. These will require further development of the indicator or additional data collection, either through the waste management system or through ad hoc surveys. The indicators are listed in Table 8.7.
- Third, a **set of complementary indicators** is proposed to monitor the economy-wide circular transition in Hungary. These indicators are grouped into five cross-cutting themes: i) production and consumption; ii) waste management; iii) secondary raw materials; iv) competitiveness; and v)

horizontal tools. They build on the EU Circular Economy Monitoring Framework (Eurostat, 2019[6]), the Eco-Innovation Scoreboard (European Commission, 2021[7]), and the indicators listed in relevant Hungarian plans and strategies. Some of the indicators are related to EU targets, for instance, landfilling rate and the separate collection of certain waste streams. The set is complemented by suggested aspirational indicators to measure materials footprint, consumer behaviour and circular business models. The specific indicators are listed in Table 8.8.

Hungary may consider these three sets of indicators during the preparation of the monitoring framework for the implementation of the NCES. In case it is felt that a lower number of indicators is needed, the following criteria could offer guidance (adapted from OECD (2011[8])):

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

To promote the implementation of circular economy principles in practice, Hungary should also consider including the indicators within the calls for public funding (concrete funding opportunities for the circular economy transition are discussed in chapter 9). Tenders have so far included indicators related to capacity, sales revenue or an increase in number of employees. In the future, these could target indicators monitoring the intended increase in recycling rate or decrease in the generation of specific waste streams.

Table 8.6. Proposed indicators to measure the strategic objectives of the NCES vision

Name	Description	Justification	Source
Resource productivity	Gross domestic product divided by the total amount of materials directly used by the economy (EUR/kg)	Roadmap to a resource efficient Europe and target of the proposed NCES vision	Eurostat
Contribution of recycled materials to raw materials demand	Circular material use (CMU) rate (%)	EU CE Monitoring Framework and target of the proposed NCES vision	Eurostat
Circular jobs	Number of persons employed in circular activities as share of total employment (%)	EU CE Monitoring Framework, EU Eco-Innovation Scoreboard, NETIS[1] and target of the proposed NCES vision	Eurostat

1. NETIS focuses on a broader indicator: share of employment in the environment industry.
Source: Based on Eurostat (2019[6]), European Commission (2011[9]; 2021[7]) and Ministry of Rural Development (2011[10]).

Table 8.7. Proposed dashboard of specific indicators for three vertical priority areas

Name	Description	Justification	Source
Biomass and food			
Waste from agriculture, forestry and fishing	Waste generated in agriculture, forestry and fishing (kg/capita)	To monitor if the generation of waste from agriculture, forestry and fishing is decreasing	Eurostat
Food waste	Food waste generated in production, distribution and consumption of food (tonnes)	EU CE Monitoring Framework, NWMP 2021-2027	Data to be systematically collected
Food waste avoided	Food waste avoided through a circular consumption, i.e. donation (tonnes)	To monitor the contribution of circular consumption to food waste reduction	Indicator to be developed, data to be systematically collected (example Paris - France)

Name	Description	Justification	Source
Collection of biodegradable municipal waste	Separate collection of biodegradable waste (including food and green waste) (tonnes)	NWMP 2021-2027, EU target	Data to be systematically collected
Recycling of bio-waste	Ratio of composted/methanised municipal waste over the total population (kg / capita); ratio of composted/anaerobically digested bio-waste to total bio-waste (%)	EU CE Monitoring Framework to monitor if composting and AD of bio-waste is increasing	Eurostat
Use of compost in agriculture	Compost used in agriculture (tonnes)	NWMP 2021-2027	Data to be systematically collected
Use of sewage sludge in agriculture	Share of sewage sludge reused in agriculture (%)	To monitor if the share of sewage sludge reused in agriculture is increasing	Indicator to be developed, data to be systematically collected
Biodegradable municipal waste disposal	Biodegradable waste landfilled (tonnes)	4NEP, NWMP 2021-2027	Data to be systematically collected
GPP for food and catering services	Share of public procurement procedures in food and catering services that include environmental elements (%)	GPP included in the EU CE Monitoring Framework	Indicator to be developed (EU GPP criteria for food and catering services published in 2019), data to be systematically collected
Investments in the circular bioeconomy	Share of public and private funds raised to fund the circular bioeconomy (%)	To monitor if the total investment made in the circular bioeconomy is increasing	Indicator to be developed, data to be systematically collected
Construction			
Domestic extraction of construction minerals	Measures the amount of extracted non-metallic minerals	To monitor whether the domestic extraction of virgin non-metallic minerals is decreasing over time	Eurostat
Domestic material consumption of construction minerals	Measures the amount of non-metallic minerals directly used by the economy	To monitor whether the domestic material consumption of construction minerals is decreasing	Eurostat
Generation of CDW	Generation of minerals waste from construction and demolition (kg per capita)	To monitor if the CDW per capita is decreasing	Eurostat
Recycling of CDW	Ratio of CDW recycled divided by CDW generated (%)	To monitor whether the share of CDW recycled (excluding recovery through backfilling) is increasing	Indicator to be developed, data to be systematically collected (example Denmark)
Recovery of CDW	Ratio of CDW prepared for reuse, recycled or subject to materials recovery (including through backfilling operations) divided by CDW generated (%)	EU CE Monitoring Framework, 4NEP, NWMP 2021-2027, EU target	Eurostat
Landfilling of CDW	Share of CDW landfilled of total CDW (%)	NWMP 2021-2027	Eurostat
GPP in construction	Share of public procurement procedures in construction that include environmental elements (%)	GPP included in the EU CE Monitoring Framework and in the NWMP 2021-2027	Indicator to be developed (EU GPP criteria for office building design, construction and management developed in 2016, revision still under review), data to be systematically collected
Plastics			
Use of non-recyclable plastics	Use of non-recyclable plastics in the food sector (tonnes); use of non-recyclable plastics in the construction sector (tonnes)	To monitor whether the use of non-recyclable plastics is decreasing across the sectors	Indicator to be developed, data to be systematically collected (example Galicia - Spain)
Collection of plastic bottles	Share of separate collection of plastic bottles of all single-use bottles placed on the market (%)	EU target	Data to be systematically collected

Name	Description	Justification	Source
Recycled content of plastics	Share of recycled plastics in new bottles (%)	EU target	Data to be systematically collected
Generation of plastic packaging waste	Generation of plastic waste from packaging (kg/capita)	To monitor if the plastics packaging per capita is decreasing	Eurostat
Recycling of plastic packaging waste	Recycling rates of plastic packaging (%), consumption of disposable plastic cups and food containers (%)	EU CE Monitoring Framework, 4NEP, NETIS, WMPSP, NWMP 2021-2027, EU target	Eurostat
GPP in plastics	Share of public procurement procedures for plastic products that include environmental elements (%)	GPP included in the EU CE Monitoring Framework and in the NWMP 2021-2027	Indicator to be developed, data to be systematically collected

Source: Own elaboration based on Eurostat (2019[6]), Ministry of Rural Development (2011[10]), Ministry for Innovation and Technology (2021[11]), Nemzeti Hulladékgazdálkodási Koordináló és Vagyonkezelő (2020[12]), Government of Hungary (2015[13]) and OECD (2021[14]).

Table 8.8. Proposed dashboard of complementary indicators to monitor the economy-wide circular transition in Hungary

Name	Description	Justification	Source
Production and consumption			
Materials footprint	Raw materials consumption (including both direct and indirect material flows) per capita (tonnes)	To monitor the quantity of raw materials used to cover a country's end-use consumption (including materials contained in the products consumed, as well as those not contained in the products but necessary for their manufacture, whether domestic or imported)	Indicator to be developed, data to be systematically collected (examples Denmark, France, the Netherlands)
Waste generation	Generation of municipal waste (kg per capita); generation of waste excluding major mineral wastes (kg per GDP unit); generation of waste excluding major mineral wastes per domestic material consumption (%)	EU CE Monitoring Framework, NETIS, NWMP 2021-2027	Eurostat
Companies' environmental performance	Number of companies introducing and applying ISO 14001; number of companies introducing and applying the EU Eco-Management and Audit Scheme (EMAS); number of companies excelling in Corporate Social Responsibility (CSR); number of companies assessing sustainability	NWMP 2021-2027, EU Eco-Innovation Scoreboard	Data to be systematically collected
Certified reuse centres and used products deposited in them	Number of certified reuse centres (per size of population served); number of used products going to certified reuse centres; share of products deposited in and sold to certified reuse centres (%)	NWMP 2021-2027	Data to be systematically collected
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 to be developed, data to be systematically collected
GPP	Share of public procurement procedures above the EU thresholds that include environmental elements (%)	EU CE Monitoring Framework, NWMP 2021-2027	Data to be systematically collected
Waste management			
Separate collection	Share of municipal waste collected separately compared to all municipal waste generated (%); separate collection of paper, metal, plastic and glass	4NEP, NWMP 2021-2027	Hungarian Central Statistical Office
Recycling rates	Recycling rate of municipal waste (%), recycling rate of all waste excluding major mineral waste (%)	EU CE Monitoring Framework, WMPSP, NWMP 2021-2027, EU target	Eurostat
Collection, recycling, recovery for specific waste streams	Recycling rates of: overall packaging (%); plastic packaging (%); wood packaging (%); waste from Electrical and Electronic Equipment (WEEE) (%); recycled bio-waste (kg per capita), textile waste (%).	EU CE Monitoring Framework, 4NEP, WMPSP, NETIS, NWMP 2021-2027, EU target	Eurostat

Name	Description	Justification	Source
	Collection/recycling/recovery rates of: CDW (%); textile waste (tonnes); hazardous waste, including asbestos (tonnes); battery and accumulator waste (%); WEEE (%); end-of-life vehicles (%); pesticides (kg or litre); waste oils (%); pharmaceutical waste (tonnes); non-hazardous industrial and other waste (%)		
Landfilling rate	Municipal waste landfilled (%); non-hazardous industrial and other waste landfilled (tonnes)	4NEP, WMPSP, NWMP 2021-2027, EU target	Eurostat
Illegal landfills	Change in the number of illegal landfills, amount of illegally discarded municipal waste (m^3)	NWMP 2021-2027	Data to be systematically collected
Secondary raw materials			
Contribution of recycled materials to raw materials demand	End-of-life recycling input rate (EOL-RIR) (%)	EU CE Monitoring Framework	Eurostat
Trade in recyclable raw materials	Imports, exports and intra EU trade of selected waste categories and by-products	EU CE Monitoring Framework, EU Eco-Innovation Scoreboard, NETIS[1]	Eurostat
Competitiveness			
Private investments and gross value added	Gross investment in tangible goods (% of GDP), value added at factor costs (% of GDP) in the recycling sector, and repair and reuse sector	EU CE Monitoring Framework, EU Eco-Innovation Scoreboard	Eurostat
Horizontal tools			
Tax revenues or tax savings generated from circular economy-related fiscal instruments	Measures the use of economic instruments for the CE	To monitor whether the use of environmental taxes earmarked for circular economy is increasing	Indicator to be developed, data to be systematically collected
R&D expenditure	Environment-related R&D&I expenditure by state and business sectors (Gross expenditure on research and development [GERD] %)	NETIS	Hungarian Central Statistical Office
Patents	Number of patents related to recycling and secondary raw materials; environment-related patents and registered certifications	EU CE Monitoring Framework, EU Eco-Innovation Scoreboard NETIS[2]	Eurostat
Industrial innovation centres	Number of industrial innovation centres	NWMP 2021-2027	Data to be systematically collected
Eco-innovation index	Composite indicator measuring the progress made on eco-innovation	EU Eco-Innovation Scoreboard	EU Eco-Innovation Scoreboard
Circular business models	Share of circular business models (%); share of population active in the sharing economy (%); number of industrial symbiosis initiatives; household spending on product maintenance and repair	To monitor the uptake of circular business models	Indicator to be developed, data to be systematically collected (example Denmark, Peterborough [UK], France)
Awareness raising	Number of students educated on waste prevention; number of waste prevention events	NWMP 2021-2027	Data to be systematically collected

1. NETIS focuses specifically on consumption of packaging materials in trade, and export income from environmental industrial activities.
2. NETIS focuses on a broader indicator: environment-related patents and registered certifications.
Source: Own elaboration based on Eurostat (2019[6]), Ministry of Rural Development (2011[10]), Ministry for Innovation and Technology (2021[11]), Government of Hungary (Government of Hungary, 2015[13]), Ministry of Environment of Denmark (2021[15]), Netherlands Environmental Assessment Agency (2018[16]), OECD (OECD, 2021[14]) and Ministry of Ecological Transition (2021[17]).

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Annex 8.A. Supplementary information

Annex Box 8.A.1. Circular economy monitoring frameworks

Various circular economy monitoring frameworks have been developed for policy makers to support their circular economy strategies:

- The EU Circular Economy Monitoring Framework offers a set of headline indicators consisting of 10 macro-level indicators (in total 23 individual indicators) grouped into four stages and aspects of the circular economy: i) production and consumption; ii) waste management; iii) secondary raw materials; and iv) competitiveness and innovation for the circular economy (European Commission, 2018[1]).
- The EU Eco-innovation Scoreboard (Eco-IS) includes 16 indicators within its measurement framework to monitor five aspects of eco-innovation: i) inputs; ii) activities; iii) outputs; iv) socio-economic outcomes; and v) resource-efficiency outcomes. Relevant circular economy indicators include: i) implementation of resource efficiency actions; ii) implementation of sustainable products among SMEs; iii) number of ISO 14001 certificates; iv) material productivity; and v) employment and value added in environmental protection and resource management activities (European Commission, 2021[7]).
- At the level of Member States, monitoring frameworks include additional indicators capturing other circular economy aspects. For instance, the Dutch framework for monitoring the progress of the circular economy applies the national set of indicators to its five priority themes (biomass and food, plastics, construction, manufacturing, consumer goods) and also develops specific action indicators for them. Moreover, it proposes indicators for “consumption footprint” and “production footprint”. The Danish Action Plan for Circular Economy includes specific indicators for circular transition for its five focus areas (waste and resource use, recycling, biomass, built environment, plastics) (Ministry of Environment of Denmark, 2021[15]). By contrast, France’s monitoring framework incorporates indicators on “circular business models” (including the number of industrial symbiosis initiatives, and the number of companies and local authorities that have benefited from support mechanisms for circular business models such as product life extension and product as a service), and “consumer behaviour” (such as household spending on product maintenance and repair) (Ministry of Ecological Transition, 2021[17]).

Several ongoing initiatives exist at the international level that aim to further conceptualise and develop circular economy monitoring frameworks for policy makers, including initiatives led by the European Commission, the United Nations Economic Commission for Europe (UNECE), the Platform for Accelerating the Circular Economy (PACE), the European Environment Agency (EEA), and the OECD.

9 Financing the circular economy transition

This chapter provides an overview of public funding mechanisms to facilitate the circular economy transition in Hungary, including direct and indirect EU funding as well as other international and national financing opportunities.

9.1. Financial resources are needed to drive the circular economy transition

The transition to a circular economy needs resources to drive the uptake of new business models, support the development of innovative technologies and motivate behavioural change within society. Governments can support the transition to a circular economy by using specific economic instruments.

Economic instruments provide important market signals, which can influence the behaviour of producers and consumers. Implemented across different life cycle stages, they help internalise environmental costs in decisions made by firms and households, and help establish incentives to change behaviour. They may also stimulate greater innovation in technologies and can generate revenues for specific environmental objectives and funds. The economic instruments that can facilitate the circular economy transition in Hungary include taxes on construction aggregates and primary plastics packaging, PAYT-based charges for municipal waste, landfill taxes, as well as EPR schemes and GPP, as presented in chapters 5, 6 and 7.

An additional way for governments to help reorient market forces towards a circular economy is through the use of incentive subsidies. Financing circular economy projects and initiatives through grants and loans helps decrease the cost of capital for circular investments and helps overcome financial and information barriers. Public funding can thereby stimulate the development of new circular business models, innovative technologies and strategic partnerships. This chapter provides an overview of the public funding available to stakeholders in Hungary to hasten the uptake of circular economy practices.

9.2. Principal EU funding instruments

The EU is providing several funding programmes covering a wide range of areas including the circular economy.[1] The three principal funding instruments for the transition to a circular economy include: shared management funds, the Horizon Europe programme, and the LIFE programme.

Shared management funds are EU funds that are shared with Member States and regions. These include the European Structural and Investment Funds (ESI funds), in particular, the European Regional Development fund (ERDF), the European Social Fund Plus (ESF+), the Cohesion Fund (CF), and the Just Transition Fund (JTF) (European Commission, n.d.[1]). The operational programmes, co-funded through shared management funds and by the Hungarian Government, target a number of circular economy topics (Government of Hungary, 2022[2]; Government of Hungary, 2022[3]) (see Box 9.1 for more details) such as:

- The **Environmental and Energy Efficiency Operational Programme Plus** (EEEOP Plus) aims at reducing environmental pollution and the excessive use of resources, and protecting biological diversity and prioritising the circular economy.
- The **Economic Development and Innovation Operational Programme Plus** (EDIOP Plus) aims at increasing the competitiveness of the domestic economy by making the SME sector more resilient, developing the R&D&I ecosystem, improving the adaptability of domestic workers, and ensuring a high quality workforce.
- The **Digital Renewal Operational Programme Plus** (DROP Plus) aims at improving the country's digital readiness and competitiveness, among others, through a green and hi-tech transition promoting the uptake of digital solutions and the shift to a climate-neutral, circular and more resilient economy.
- The **Territorial and Settlement Development Operational Program Plus** (TSDOP Plus) aims at improving the development of regions and counties, with a focus on climate awareness and adaptation to climate change, liveable settlements, and sustainable urban development strategies, among others.

Horizon Europe is the EU's Research and Innovation programme with a budget of nearly EUR 100 billion, running until 2027. This includes almost EUR 5.5 billion from the NextGenerationEU (NGEU) instrument to support greener, digitalised and more resilient societies and economic recovery from the COVID crisis. The budget is divided among 4 pillars and 15 components to support several areas of research and innovation (R&I). The "Global challenges and European industrial competitiveness" (pillar 2) comprises a cluster that also targets the circular economy (European Commission, n.d.[4]):

- Cluster 6 "Food, bioeconomy, natural resources, agriculture and environment" covers the following areas of intervention: environmental observation, biodiversity and natural resources, agriculture, forestry and rural areas, seas, oceans and inland waters, food systems, bio-based innovation systems in the EU's bioeconomy, and circular systems.

Additionally, several partnerships have been established under Horizon Europe to address some of Europe's pressing challenges. One of these partnerships relates to the circular economy:

- The Circular Bio-based Europe Joint Undertaking (CBE JU) is a public-private partnership between the EU and the Bio-based Industries Consortium, which funds projects to strengthen competitive, circular bio-based industries in Europe (Circular Bio-based Europe Joint Undertaking, n.d.[5]).

The **LIFE programme** is the EU's funding instrument for the environment and climate action with a budget of EUR 5.4 billion for the funding period 2021-2027. It has four sub-programmes, one of which covers the circular economy (European Commission, n.d.[6]).

- The "Circular economy and quality of life" sub-programme co-finances projects in the area of circular economy, including the recovery of resources from waste, as well as projects concerning water, air, noise, soil and chemical management, and environmental governance.

Box 9.1. Hungary's Operational Programmes for 2021-2027

Environmental and Energy Efficiency Operational Programme Plus (EEEOP Plus)

The EEEOP Plus is the continuation of the previous EEEOP under the new framework for the period 2021-2027 (as illustrated in Figure 9.1). Its priorities include:

- Water management and disaster risk reduction
- Circular economy systems and sustainability
- Protection of the environment and nature
- A renewable energy economy
- Just transition

The overall budget of the Operational Programme (OP) is HUF 1 612.56 billion (EUR 4.3 billion), with HUF 411.97 billion (EUR 1.1 billion) allocated to the priority covering circular economy systems and sustainability, among others, such as:

- The **waste management objective** funds projects with a focus on: i) improving the existing separate waste collection system; ii) supporting waste recycling and the production of high quality secondary raw materials; iii) developing new waste management centres and upgrading existing ones; iv) optimising municipal waste collection and transport; v) supporting residual waste facilities; vi) rehabilitating abandoned old landfills; and vii) active, experience-based, community-building awareness-raising activities.
- The **circular economy-related objective** is a new topic of the OP. Its aim is to pave the way for a circular transition through small-scale investments targeting mainly SMEs. The funding

focuses on: i) service provision; ii) promoting decoupling of raw material consumption and GDP growth; iii) building value chains/value circles; and iv) developing new business sectors and business models. It targets a diverse range of projects, translating circular economy principles into practice (from both upstream and downstream perspectives), as well as awareness-raising activities and small demonstration/pilot projects.

Figure 9.1. EEEOP Plus and its precursor EEEOP

EEEOP 2014-2020

Priority	Action	Alloc. EUR M	Main respon-sible
1	Water-management	891	MoI
	Disaster management/Climate	154	
2	Drinking water	183	MTI
	Waste water	1031	
3	Waste management	300	MTI
	Remediation	100	MTI
4	Nature protection	100	MoA
5	Renewable energy	314	MTI
	Energy efficiency	600	
	District heating	106	
	Awareness raising	6	
TOTAL		3 785	

EEEOP Plus 2021-2027

Priority	Action	Alloc. EUR M	Main respon-sible
1	Water-management	702	MoI
	Disaster risk reduction	121	
2	Sustainable water-utility systems	652	MTI
	Green and blue infrastructure	190	
	Circular waste management	208	
	Circular economy	52	
3	Remediation/Environmental protection	45	MoA
	Nature protection	112	
4	Promoting energy efficiency measures	883	MTI
	Promoting renewable energy	535	
	Smart energy systems, -networks and -storage	518	
5	Just Transition Fund	295	MTI
TOTAL		4 313	

Source: Hungary's Prime Minister's Office.

The indicators and targets for these two objectives are summarised in Figure 9.2.

Figure 9.2. Indicators and targets of waste and circular economy related actions within the EEEOP Plus

Specific Objective	Action	Indicator		Unit	Baseline		Milestone 2024	Target 2029
		Code	Name		Value	Year		
2.3. Transition to a cicular economy	Circular Waste Management	RCO34	Additional capacity for waste recycling	tonnes/ year	n.r.	n.r.	50 000	250 000
		RCR47	Waste recycled	tonnes/ year	0	2021	n.r.	300 000
	Circular economy	RCO01	Enterprises supported	pcs	n.r.	n.r.	16	160
		RCR04	SMEs introducing marketing or organisational innovation	pcs	0	2021	n.r.	143

Source: Hungary's Prime Minister's Office.

Economic Development and Innovation Operational Programme Plus (EDIOP Plus)

The EDIOP Plus is the continuation of the previous EDIOP under the new framework for the period 2021-2027. The programme includes 6 priorities:

- Business development
- Research, development and innovation
- Sustainable labour market
- Youth guarantee
- Higher education and vocational training
- Tourism and heritage protection

Various aspects of waste management are covered in parallel by resources of the EEEOP Plus, the Recovery and Resilience Facility (RRF) and the EDIOP Plus. While the EEEOP Plus and RRF support the improvement of existing and new waste management systems, respectively, the EDIOP Plus launches actions through the Green National Champions programme to support the production of secondary raw materials and products containing such materials, as well as the transition to substitute products, manufacturing processes related to e-mobility, and energy and water savings. The budget represents HUF 30 billion (EUR 75 million) to be disbursed as grants (with a self-funding of minimum 50%) to eligible SMEs across the following activities: i) new tools for technological improvement; ii) acquisition of new technologies; iii) manufacturing licence/know-how; iv) investment in infrastructure and real estate; v) resource efficiency investments to supply production processes and on-farm installations energy needs; vi) experimental development; vii) acquisition of consultancy services; and viii) information technology development.

Source: Hungary's Prime Minister's Office, and Hungarian Government (2022[2]; 2022[3]; 2022[7]).

9.3. Other financing opportunities at the EU level

Hungarian stakeholders could benefit from a number of other funding opportunities for the circular economy transition.

- **Interreg** is a funding instrument to support cross-border, trans-national and interregional co-operation, as well as for outermost regions. It seeks to tackle common challenges and find common solutions in several areas (European Commission, n.d.[8]). "Interreg Europe" strives for better regional governance through capacity building in a number of topics, including for a smarter and greener Europe (total budget of EUR 379 million). "Interreg Central Europe" aims to improve capacities for regional development in innovation, carbon dioxide reduction, protection of natural and cultural resources, and transport and mobility (total budget of EUR 246 million).
- **Single Market Programme (SMP)** has been designed to help the single European market reach its full potential and ensure Europe's recovery from the COVID-19 pandemic. With a budget of EUR 4.2 billion over the period of 2021-2027, and an additional EUR 2 billion allocated under the InvestEU Fund, the objectives of the programme include food safety (40% of total budget allocation), support to SMEs (24% of budget allocation), strengthening the single market (13% of total budget), and high quality European statistics (also 13% of total budget) (European Commission, n.d.[9]).[2]

- The **New European Bauhaus (NEB)** is a creative and interdisciplinary initiative connecting the European Green Deal to living spaces and experiences. With a budget of EUR 85 million funded by different EU programmes (such as Horizon Europe, LIFE and ERDF), it aims to provide citizens with access to goods that are circular, less carbon-intensive, support the regeneration of nature and protect biodiversity (European Commission, 2021[10]).
- The **Digital Europe Programme (DIGITAL)** is a new EU funding programme. It aims to accelerate economic recovery and shape the digital transformation with its focus on businesses (especially SMEs), citizens and public administrations. Although the scope of this programme is much broader, it also supports the goals of the Green Deal and the Circular Economy Action Plan (European Commission, n.d.[11]).
- The **Innovation Fund (IF)** targets the commercial demonstration of innovative low-carbon technologies. It also funds projects that bring about other environmental benefits within the framework of the European Green Deal, among others, related to the circular economy (European Commission, 2022[12]).
- The **Recovery and Resilience Facility (RRF)** is a temporary recovery instrument that helps finance reforms and investments in Member States (from February 2020 to December 2026). Hungary's Recovery and Resilience Plan foresees the implementation of reforms and investments to drive the transition to a circular economy (component G). These include an investment of HUF 120 billion (EUR 335 million) to develop the waste management infrastructure and an investment of HUF 86 billion net (EUR 240 million) to strengthen intelligent, innovative and sustainable industry and the secondary raw materials market. Altogether HUF 103 billion (EUR 287.7 million) of circular economy-related investments in Hungary will be financed through the RRF (Government of Hungary, 2021[13]).[3]
- The **Technical Support Instrument (TSI)** managed by the EC DG REFORM provides tailor-made technical expertise for designing and implementing reforms at the national, regional and multi-country levels. This instrument covers a wide range of reform areas. More than one-third of all requests in 2022 were related to various "green transition" topics, including the circular economy (European Commission, n.d.[14]).

Additional funding opportunities for circular economy projects are provided by the European Investment Bank (EIB) (European Investment Bank, 2021[15]; 2020[16]). The instruments for climate finance supporting the European Green Deal include:

- **InnovFin - EU Finance for Innovators** is an initiative launched by the European Investment Bank Group (EIB and EIF) jointly with the EC under Horizon 2020 with the aim to expedite access to finance for innovative businesses. The initiative provides loans, guarantees and equity-type funding. This funding targets small and early stage enterprises (including small tech start-ups, large research facilities and circular economy companies) with R&I projects that are riskier and harder to access than traditional investments (European Investment Bank, n.d.[17]). For the circular bioeconomy thematic area, financing is managed through the European Circular Bioeconomy Fund. This venture capital impact fund aims to fill the funding gap in the European bioeconomy landscape, targeting industry sectors such as agriculture and food, forestry, the blue economy (related to the marine environment), industrial biotech, bio-based chemicals and materials, packaging, construction and textiles. The individual investment size ranges between EUR 2.5 million to EUR 10 million (ECBF, n.d.[18]).[4]
- The **InvestEU Fund** combines the European Fund for Strategic Investments (EFSI) and 13 other financial instruments. Operational since 2022 and implemented in partnership with the EC, the fund is expected to stimulate more than EUR 372 billion of public and private investment. The fund provides direct and intermediate financing solutions for private and public entities, public-private partnerships and non-profit organisations. It supports financing and investment operations across

four priorities: i) sustainable infrastructure (including the circular economy); ii) R&I and digitalisation; iii) SMEs; and iv) social investments and skills (European Investment Bank, n.d.[19]).[5] The European Investment Fund is an InvestEU implementing partner, providing guarantees and equity risk-sharing instruments to MSMEs through selected financial intermediaries (European Investment Fund, n.d.[20]).

On the national level, Hungary does not have a specific environmental fund in place to help it achieve its national environmental goals and to provide state support for green and circular economy projects. On the city level, several municipalities have established independent environmental funds to promote environmental protection and nature conservation (City of Budapest, 2009[21]). However, their financial resources remain limited. The country's National Research, Development and Innovation Fund provides state support for research on environmental topics and for business innovation targeting SMEs and start-ups (with funding worth EUR 220 million) and market-oriented R&D (with funding worth EUR 200 million) (Ministry for Innovation and Technology, 2022[22]).

Due to the lack of dedicated national funds, stakeholders have to rely almost entirely on European grant and loan programmes in order to receive financial support for implementing circular economy practices. Accessing these types of instruments might pose challenges to MSMEs as the funds tend to only provide co-financing (i.e. requiring beneficiaries' own resources) and the applicants must go through merit-based application procedures.

The overview of public funding mechanisms for financing the circular economy transition in Hungary is provided in Annex Table 9.A.1.

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Annex 9.A. Supplementary information

Annex Table 9.A.1. Public funding mechanisms for financing the circular economy transition in Hungary

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Environmental and Energy Efficiency Operational Programme Plus (EEEOP Plus) [KEHOP Plusz]	The EEEOP Plus is a continuation of the previous OP, but the priorities reflect the lessons learned from the previous period and the results of the evaluations, and introduces several new investment topics, including the circular economy. With a budget of HUF 1 612 billion (approx. EUR 4.3 billion), the investments focus on five priorities: i) water management and disaster risk reduction; ii) circular economy systems and sustainability; iii) protection of the environment and nature; iv) renewable energy economy; and v) just transition. The budget allocated to the circular economy, including waste management and circular development of SMEs and the sustainability priority, amounts to HUF 97 billion (approx. EUR 258 million). The whole priority amounts to HUF 412 billion (EUR 1.1 billion).	First calls to be announced in 2023. Separate calls will be launched for waste management (mainly municipal waste) and for circular economy development (mainly destined for businesses, but project partners listed under "Beneficiaries" can join the project in consortium).	Depending on the purpose of the investment, they can include: ministries and their background bodies, local governments, their associations and owners of public service companies, state and local government companies, business organisations, enterprises, education and higher education institutions, research institutes, scientific organisations and NGOs, non-profit companies and social enterprises, professional representative bodies and consortia of the above, participants required for R&D&I activities, natural persons and communities (where necessary and effective for the purpose of the investment).	Circular models and projects can be more efficient with several partners. Depending on the type of projects, it is highly recommended to involve several businesses across the value chain, as well as universities for R&D&I aspects.	Waste management funded with a budget of HUF 77 billion (approx. EUR 205 million). Circular economy development funded with a budget of HUF 20 billion (approx. EUR 53 million). Half of the amount (i.e. HUF 10 billion) will be spent on the introduction of business models via combined financial instruments (grant + loan) and the other half on demonstration and pilot projects (e.g. eco-design, circular buildings).	For the introduction of new business models (e.g. sharing economy, servitisation): 10-30% grant and 90-70% soft loan (with low or close to zero interest rate). Large enterprises will be allowed to take part for the benefit of SMEs (e.g. their supply chain). The grant rate for pilot and demonstration projects will be calculated by means of cost-benefit analyses.	To be announced	Calls and tenders announcement website (Link here) EEEOP Plus website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Economic Development and Innovation Operational Programme Plus (EDIOP Plus) and the Green National Champions programme [GINOP Plusz]	The aim of EDIOP Plus is to increase competitiveness of the domestic economy by strengthening the resilience of the SME sector, developing the R&D&I ecosystem, improving the adaptability of domestic employees, and ensuring a quality workforce. The programme includes 6 priorities: i) business development; ii) R&D&I; iii) sustainable labour market; iv) youth guarantee; v) higher education and vocational training; and vi) tourism and heritage protection. The Green National Champions finances the circular economy with a budget of HUF 30 billion.	Last call opened in Q4 2022. New calls expected to open in 2023.	The Green National Champions call is specifically targeted to MSMEs; serving energy efficiency improvements; production-related water efficiency improvements; electromobility; producing and/or using raw materials from secondary sources; manufacturing finished products replacing single-use and other plastic products.	There is no explicit requirement to cooperate.	From HUF 20 million to HUF 1.5 billion	Grants: 50%	30 months	Green National Champions website (Link here)
Digital Renewal Operational Program Plus (DROP Plus) [DIMOP Plusz]	The DROP Plus aims to improve Hungary's digital readiness and competitiveness. Taking a comprehensive approach, the programme addresses emerging global, technological, security and sustainability challenges, and interconnects all relevant policies With an overall budget of EUR 1.87 billion, the programme targets four priority axes: i) A more intelligent Hungary; ii) Hi-tech and green transition; iii) Hungary connected; and iv) Digital Skills. The second priority axis supports green and hi-tech transition to promote the uptake of digital solutions and the shift to a climate-neutral, circular and more resilient economy through the use of data. One of the targeted areas is waste management.	Publication of the call is to be announced. The first call will be published in 2023.	Specialised authorities, municipalities and their associations, higher education institutions, scientific and professional interest groups, waste producers, transporters, collectors, traders, brokers, treatment operators, landfill operators, the general public.	Depending on the type of projects there will be an explicit requirement to cooperate in specific topics.	EUR 48.4 million earmarked for projects creating digital solutions for waste management (related to monitoring of household waste, and locating and preventing illegally disposed waste).	Intensity: 100% The projects have national impact. The breakdown of the support between regions is based on the ratio of the population of Budapest/Hungary, which is 17.72% for the more developed regions and 82.28% for the less developed regions.	Depends on the specific call	DROP Plus website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Territorial and Settlement Development Operational Program Plus (TSDOP Plus) [TOP Plusz]	The programme aims at improving the development of regions and counties, with a special focus on the territorial development of the least developed counties and underdeveloped regions, while strengthening the position of more advantaged regions. With a budget of EUR 5 billion, it primarily supports local government development, focusing on local economic development, employment, tourism, as well as development of municipal infrastructure, municipal management and local public services. Of its six priorities, three are relevant for the circular economy. The respective calls target: i) Climate awareness and adaptation to climate change; ii) Liveable Settlements; and iii) Support for sustainable urban development strategies.	Next calls to be published in May 2023.	The target groups of the calls for Liveable Settlements and Support for sustainable urban development are local municipalities involved in: i) awareness raising activities in this topic; ii) preparing circular strategies for different types of settlements; iii) municipal water management actions; and iv) use of green waste.	There is no explicit requirement to cooperate, but the involvement of local citizens is a key factor.	Funding rates vary: i) HUF 50 million - 500 million ii) HUF 1 million - 10 million iii) HUF 50 million - 5 billion iv) HUF 1 million - 100 million	Grants: 100%	30 months	TSDOP Plus website (Link here)
Horizon Europe Programme	Horizon Europe is the EU research and innovation framework program with a budget of EUR 95.5 billion for the 2021-2027 period. The programme includes three key pillars: i) Excellent Science; ii) Global Challenges & European Industrial Competitiveness; and iii) Innovative Europe – and one horizontal focus area 'Widening Participation and Strengthening the European Research Area'. In addition, Horizon Europe includes five mission areas and 12 public-private partnerships that also share funding. Circular economy is covered in Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment within the 2nd pillar. The total budget for the cluster is EUR 1056 million (2023) and EUR 904 million (2024). The 3rd pillar aims to improve SME growth and the European innovation landscape.	Deadlines across pillars and sub-programmes vary.	Research institutes and universities can apply for all three pillars, while the 2nd and 3rd pillars are the most relevant for the private sector.	6-12 partners from 4-5 countries	Typically EUR 2 million - 20 million	Research and innovation actions: 100% Innovation actions: 70%	Depends on the specific call	Funding and tender opportunities portal of the European Commission (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
LIFE Programme	The LIFE Programme is the EU funding instrument for the environment and climate action. With a total budget of EUR 5.43 billion, the programme consists of four sub-programmes, one of which is "Circular economy and quality of life". This sub-programme has a budget of EUR 1 345 billion, providing mostly action grants for projects implementing innovative and best practice solutions in the areas of waste, water, air, noise, soil and chemical management through Standard Action Projects (SAP). It also covers the implementation, monitoring and evaluation of EU environmental policy and law through the so-called Strategic Integrated Projects (SIP).	Calls are published once a year. The last call was published in Q2 2022.	Beneficiaries of the programme can only be legal entities registered in the EU, with the exception of sole proprietors.	There is no explicit requirement to cooperate, but cooperation is considered an advantage during evaluation of applications.	Typically EUR 2 million - 10 million, but some are lower at EUR 700 000	60% for Standard Action Projects (the co-financing through Other Action Grants is 90%)	Typically 36-48 months, and up to 120 months	Website of the European Climate Infrastructure and Environment Executive Agency (Link here) Funding and tender opportunities portal of the European Commission (Link here)
Common Agricultural Policy (CAP) Strategic Plan	The reformed CAP, set to start in 2023, aims to shape the transition to a sustainable, resilient and modern European agricultural sector. The Hungarian Strategic Plan will receive EUR 8.4 billion from the EU budget, including EUR 2 billion dedicated to environmental and climate objectives and eco-schemes, and EUR 186 million for young farmers. There are four interventions supporting the circular economy: i) Support for green investments linked to the valorisation of agricultural products; ii) Support for green investments in agricultural holdings; iii) Rural development cooperation for the development of a biomass-based economy; and iv) European Innovation Partnership (EIP) cooperation.	Publication date of the call is to be announced.	*Support for green investments linked to the valorisation of agricultural products*					
			Natural persons, legal entities (companies and cooperatives, including social cooperatives), enterprises without legal personality, non-profit organisations with legal personality (such as church, foundations, non-profit-making companies).	No explicit requirement to cooperate.	Total budget earmarked for the intervention is EUR 27.4 million.	Between 50% - 80%. The maximum grant amount per project: EUR 13 million.	To be announced	Hungary's CAP Strategic Plan 2023-2027 website (Link here)
			Support for green investments in agricultural holdings					
			Farmers meeting the eligibility criteria: natural persons; legal entities (companies and cooperatives, in particular social cooperatives); non-profit organisations with legal personality (church, foundations, non-profit-making companies). Additional special conditions apply.	No explicit requirement to cooperate.	Total budget earmarked for the intervention is EUR 1.27 billion.	Between 50% - 80%. The maximum grant amount per project: EUR 15 million.	To be announced	Hungary's CAP Strategic Plan 2023-2027 website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Common Agricultural Policy (CAP) Strategic Plan *(continued)*	*(continued)*	*(continued)*	*Rural development cooperation for the development of a biomass-based economy*					
			Producers and users of biomass feedstock.	Only new partnerships or new activities of existing partnerships are eligible. The focus of intervention will be on local use of biomass funds, therefore both farmers and regional public service actors should be involved.	Total budget earmarked for the intervention is EUR 4.4 million.	Exact rates are to be announced. A maximum of 25% of the grant may be used for cooperation costs (such as project planning and management), and a minimum of 75% must be used for costs directly related to the project objective.	To be announced	Hungary's CAP Strategic Plan 2023-2027 website (Link here)
			European Innovation Partnership (EIP) cooperation					
			Farmers/ farmers' organisations; forest managers/ workers/ organisations; hunters; consultants, advisories, chambers of agriculture; researchers, research orgs; educational/ vocational training orgs; climate/ environment/ nature conservation orgs; service providers; processors, retailers; consumers/ consumer orgs; public authorities; management teams. Additional special conditions apply.	Only new partnerships and new activities of existing partnerships are eligible. Partners in innovation, agriculture, forestry, food, rural dev, research and consultancy. May involve up to one int. partner.	Total budget earmarked for the intervention is EUR 36.2 million.	100% Eligible costs: Actual costs incurred in implementing the project (including investments); indirect costs for research can be accounted for up to a flat rate of 20%.	At least 2 and up to 7 years	Hungary's CAP Strategic Plan 2023-2027 website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Recovery and Resilience Facility (RRF)	The purpose of the Recovery and Resilience Plan of Hungary is to counterbalance the economic and social effects of the COVID-19 pandemic, and to increase the economy's resilience, sustainability and preparedness for the challenges and opportunities related to the green and digital transition. Within its component G, the plan also includes an objective related to the circular economy transition, "Strengthening of intelligent, innovative and sustainable industry and secondary raw materials market". The plan foresees a total investment of HUF 2 300 billion for strategic development projects until 2026.	To be implemented between 2021 - 2026 (the two milestones for the investment are 2023 and 2026).	Companies dealing with waste management and waste recycling, petrochemical and plastic companies, and organisations interested in chemical recycling. The beneficiary is expected to be a large company with significant experience in the sector.	No explicit requirement to cooperate,	Total estimated cost of the investment is HUF 86 billion (net), of which the planned cost to be financed from the RRF is HUF 43 billion (net).	50%	Between 2021-2026	Recovery and Resilience Facility calls website (Link here)
Interreg Europe Interreg Central Europe	Interreg Europe is an interregional cooperation programme aiming to reduce disparities in the levels of development, growth and quality of life in and across Europe's regions. Co-funded by the EU, it has a budget of EUR 379 million to help local, regional and national governments develop and deliver better policy, and support the exchange of good practices and policy learning among the EU 27, Norway and Switzerland. Circular economy is one of the topics covered by the programme. Interreg Central Europe supports transnational cooperation between Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Poland, Slovak Republic and Slovenia to become smarter, greener, more integrated and better connected together. It has a total budget of EUR 224 million from the ERDF. Circular economy is covered by specific objective 2.3.	The first call opened in 2022. The second call will open in Q1 2023.	Interreg Europe: management authorities of development policy instruments, municipalities Interreg Central Europe: public and private partners	Interreg Europe: 6-10 partners from minimum four countries Interreg Central Europe: 6-10 partners from minimum three countries	Typically EUR 1.5 million – 2 million	Interreg Europe: 80% ERDF (70% for private partners) + 15% automatic national co-financing (20% for central budgetary bodies) Interreg Central Europe: 80% ERDF + 15% automatic national co-financing (20% for central budgetary bodies)	Interreg Europe: 2-3 years experience for exchange projects Interreg Central Europe: 2-3 years for cooperation projects	Interreg Europe website (Link here) Interreg Central Europe website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Single Market Programme (SMP)	The SMP is designed to help the single market reach its full potential and ensure Europe's recovery from the COVID-19 pandemic. With funding of EUR 4.2 billion over the period of 2021-2027, the programme supports six key objectives: i) food safety; ii) consumer protection; iii) support to SMEs; iv) a more effective single market; v) high quality European statistics; and vi) effective European Standards. The programme is mainly implemented under direct management by the EC and two supportive Executive Agencies.	Calls open about three times a year. The latest call opened in Q4 2022 and will close in Q1 2023.	The programme strongly supports SMEs. Eligible beneficiaries differ across calls.	Most of the calls require multi-beneficiary applications. Specific conditions for consortium composition, number of beneficiaries and countries vary across calls.	Typically EUR 100 000 – EUR 1.4 million (some calls may require a minimum % of grant to be directed to SMEs)	The costs are typically reimbursed at rates of 90% or 100% (with costs in certain cost categories reimbursed at lower rates, such as 60%). A few calls may have lower funding rates, such as 50%	12-36 months, with up to 42 months	Funding and tender opportunities portal of the European Commission (Link here)
New European Bauhaus (NEB)	The NEB aims to accelerate the transformation of various economic sectors in order to provide all citizens with access to goods that are circular and less carbon intensive. The initiative focuses on three key interconnected transformations: i) places on the ground; ii) the environment that enables innovation; and iii) perspectives and way of thinking. The funding comes from different EU programmes, the Horizon Europe programme, the LIFE programme and the European Regional Development Fund, among others. For the 2021-2022 period there was about EUR 85 million dedicated to NEB projects from EU programmes. In addition, the EC invites Member States to mobilise the relevant parts of their Recovery and Resilience Plans, as well as the programmes under cohesion policy. The EC also established the New European Bauhaus Lab - a "think and do tank" to co-create, prototype and test new tools, solutions and policy recommendations. Among others, this project also explores	Transformation of places on the ground calls 2023-2024: Dedicated calls: Q4 2022, Q1 2023, Q4 2023 Contributing calls: Q4 2022, Q1 2023, Q2 2023, Q3 2023, Q2 2024 Transformation of the enabling environment for innovation calls 2023-2024:	*NEB funded by Horizon Europe Programme*					Transformation of places on the ground calls 2023-2024 website (Link here) Transformation of the enabling environment for innovation calls 2023-2024 website (Link here) Diffusion of new meanings calls 2023-2024 website (Link here)
			All eligible entities under Horizon Europe.	Consortium to include three independent legal entities each established in a different country (unless otherwise specified in call conditions).	Typically EUR 1.5 million - 8 million, and up to EUR 12 million	Research and innovation actions: 100% Innovation actions: 70% (rate for non-profit of up to 100%) Coordination and support actions: 100%	Depends on the specific call	

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
New European Bauhaus (NEB) *(continued)*	innovative funding solutions, and intends to create a one-stop-shop for small projects across Europe and offer the best funding solutions for each project via crowdfunding, philanthropy, or EU public funding.	Dedicated calls: Q4 2023 Contributing calls: Q4 2022, Q42023 <u>Diffusion of new meanings calls 2023-2024:</u> Dedicated calls: Q4 2022, Q3 2023 Contributing calls: Q4 2022, different submission deadlines in 2023, Q4 2023	*NEB funded by Erasmus+ Programme*					*(continued)*
			Public and private organisations active in education and training or working with or for young people outside formal settings, research institutions, science parks, innovation agencies, companies, chambers and associations, social partners and enterprises, sectoral skills councils.	Requirements for consortium composition vary across calls: 4-8 EU Member States/ third countries, and minimum 5-12 applicants. Requirements on the background of applicants also vary across calls.	Typically EUR 1 million - 4 million (funding rate for "European Youth Together" is lower at EUR 150 - 500 000)	The lump sum value is limited to a maximum of 80% of the estimated budget	24-48 months	
			NEB funded by Creative Europe Programme					
			Organisations active in audio-visual, cultural and creative sectors.	Both single applicants and consortia are allowed.	No limit	60%	24 months	
			NEB funded by European Urban Initiative					
			Public authorities	Consortium to include the main and associated urban authorities, and delivery and transfer partners.	Typically EUR 5 million	Up to 80%	Up to 3.5 years	

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Digital Europe Programme (DIGITAL)	Investments under DIGITAL aim to support the EU's twin objectives of a green transition and a digital transformation, and strengthening the EUs resilience and digital sovereignty. The programme supports projects in five key areas: i) supercomputing; ii) artificial intelligence; iii) cybersecurity; iv) advanced digital skills; and v) ensuring a wide use of digital technologies across the economy and society. With a planned overall budget of EUR 7.6 billion, the programme is implemented by means of multiannual Work Programmes. Actions are implemented mostly in direct management by the EC and a supportive Executive Agency.	There were three calls for the 2021-2022 Work Programme in Q4 2021, Q1 2022, and Q3 2022. The latter is open through Q1 2023.	The programme supports industry, SMEs and public administrations in their digital transformation, with a reinforced network of European Digital Innovation Hubs (EDIHs). Eligible beneficiaries differ across calls and to pics.	Multi-beneficiary applications are mandatory and specific conditions for consortium composition, number of participating beneficiaries and countries vary across calls and topics.	Typically EUR 1 - 8 million, and up to EUR 30 million	Simple grants: 50% SME support actions: 50%, and 75% for SMEs Coordination and support actions: 100%	18 - 48 months, and up to 60 months	Funding and tender opportunities portal of the European Commission (Link here)
InnovFin - EU Finance for Innovators through the European Circular Bioeconomy Fund (ECBF)	InnovFin is an initiative launched by the EIB and the EC. It aims to facilitate and accelerate access to finance for innovative businesses and entities supporting projects, which by their nature are riskier and harder to assess than traditional investments. It provides loans, guarantees and equity-type funding, either directly or via a financial intermediary. The financing for circular bioeconomy thematic area is managed through the ECBF, with a budget of EUR 300 million. In addition, InnovFin Advisory provides guidance to promoters on how to structure R&I projects in order to improve access to finance.	Continuous	Growth-stage companies (SMEs, mid-caps, possibly large caps and special purpose vehicles) in the European bioeconomy, with Technology Readiness Level (TRL) of 6-9. Targeted industry sectors: agriculture and food, forestry, blue economy, industrial biotech, bio-based chemicals and materials, packaging, personal and home care, construction, textiles, and others.	No explicit requirement to cooperate.	Typically EUR 2.5 million - 10 million	The ECBF invests with equity, mezzanine financing or debt instruments.	Not specified	European Circular Bioeconomy Fund website (Link here)

Programme	Description	Calls	Beneficiaries	Cooperation	Funding rate	Co-financing rate	Duration	Links
Innovation Fund (IF)	The IF is a key funding instrument for delivering the EU's commitments under the Paris Agreement and its objective to achieve climate neutrality by 2050. With a budget of EUR 38 billion, IF funds the demonstration and commercialisation of first-of-a-kind highly innovative projects. This is done through calls for large and small-scale projects focusing on: i) innovative low-carbon technologies and processes in energy-intensive industries; ii) carbon capture and utilisation (CCU); iii) construction and operation of carbon capture and storage (CCS); iv) innovative renewable energy generation; and v) energy storage. Certain calls may support projects on innovative clean-tech manufacturing of components and final equipment, where the main innovation lies in the product or production processes in line with circular economy principles. The fund is financed by revenues from the auctioning of allowances from the EU ETS and is implemented by the European Climate, Infrastructure and Environment Executive Agency (CINEA). Additionally, the EIB provides the project development assistance to promising projects that are not sufficiently mature.	Calls for proposals open about twice a year for large and small scale projects. Previous calls were opened in Q3 and Q4 2020, Q4 2021, and Q1 and Q4 2022. The latter is open through Q1 2023.	Beneficiaries must be legal entities (public or private bodies) and be established in one of the eligible countries: any country in the world.	No explicit requirement to cooperate.	Large-scale projects with a capital expenditure above EUR 7.5 million. Small-scale projects with total capital costs below EUR 7.5 million.	Grants: Up to 60% of the additional capital and operational costs of large-scale projects, and up to 60% of the capital costs of small-scale projects. Project development assistance (PDA): available to both large and small-scale projects, the support is provided as a tailor-made technical assistance to advance financial, technical or operational maturity of projects, with a view of potential re-submission under future IF calls.	3-15 years	Funding and tender opportunities portal of the European Commission (Link here) National contact point for Hungary (Link here)

Source: Own elaboration based on the information received from the Prime Minister's Office and from the Ministry of Agriculture, and retrieved from the website of the European Commission (2023[23]) and the respective programme websites (European Climate Infrastructure and Environment Executive Agency, 2023[24]; Interreg Europe, 2023[25]; Interreg Central Europe, 2023[26]; ECBF, n.d.[18]; New European Bauhaus, n.d.[27]).

Notes

[1] There are two different types of EU funding: direct and indirect. *Direct funding* represents funds that are directly managed by the European Commission. This comprises tenders and grants to specific projects related to EU policies, including Horizon Europe, LIFE and the Single Market Programme (SMP). *Indirect funding* are funds managed by national and regional authorities. These are mainly disbursed through shared management funds (European Commission, n.d.[28]).

[2] The Programme for Competitiveness of Small and Medium-Sized Enterprises (COSME), which existed as a stand-alone programme, has now been integrated within the SMP.

[3] Using an average conversion rate of HUF 358 to EUR 1 in 2021 reported by the Hungarian National Bank.

[4] In addition to financing, the InnovFin Advisory provides guidance on how to structure R&I projects in order to improve their access to finance.

[5] Additionally, the InvestEU Advisory Hub assists promoters and intermediaries with financial, advisory and technical assistance for the identification, preparation and development of investment projects. For instance, the Circular City Funding Guide supports municipalities and businesses in creating circular cities through providing information on financing and funding sources, as well as guidelines for setting up funding programmes to support the transition to a circular economy (Circular City Funding Guide, n.d.[29]).

Annex A. Summary of the Strategic Environmental Assessment

Rationale for the Strategic Environmental Assessment

The purpose of this Strategic Environmental Assessment (SEA) is to assess and report on the potential environmental impact of the policy recommendations and proposed activities of the action plan outlined in the OECD report *Towards a National Circular Economy Strategy for Hungary* (hereinafter referred to as OECD report). This report was developed by the OECD as the final output of the project, Technical Support for the Development of the National Circular Economy Strategy (NCES) and Action Plan for Hungary, and funded by the Directorate-General for Structural Reform Support (DG REFORM) of the European Commission.

Hungary will need to adopt a comprehensive circular economy policy framework if it is to fully exploit the circular potential of its economy and comply with national and international programmes and pledges that aim to tackle climate change. The OECD report is a major element of this development process, assisting the Hungarian Government in the creation of the NCES and its transition to a circular economy.

The OECD report is a milestone, not a final programme or plan. The content of the SEA is therefore adapted to the purpose and function of the OECD report, complementing the provisions related to national and EU legislation.

The SEA highlights the most important environmental and socio-economic impacts of the policy recommendations and actions outlined in the OECD report, with the objective to provide detailed practical feedback in identifying the positive environmental effects of the future NCES.

The experts working on the OECD report had the opportunity to react to the findings and proposals of the draft SEA that was under preparation. Following consultations, some of the proposals from the SEA were incorporated into the final OECD report. However, it should be noted that some of the proposals and remarks of the SEA were outside the scope of the OECD report, for example, those related to energy security, water management and nature based solutions.

The OECD report outlines effective circular economy policy recommendations

The OECD analysis applies a life cycle approach that focuses on design, production, (re)use and end-of-life stages, thus identifying Hungary's circular potential as well as policy gaps that need to be addressed across the priority areas in all stages of the value chain. Accompanied by recommendations, the OECD report lays down strong foundations for the first holistic circular strategy, which is specific, measurable, achievable and relevant. By applying the SEA methodology, it can be established that the OECD report outlines effective circular policy recommendations up to 2040.

The OECD report focuses on the three selected priority areas of biomass and food, construction and plastics, which were selected following a multi-criteria analysis of 24 topic areas. Strengthened by horizontal perspectives, namely, research, development and innovation (R&D&I) and education, as well as circular business models with a focus on small and medium-sized enterprises (SMEs) and digital

solutions, the OECD report provides all the key elements required for the paradigm shift from a linear economy to a circular one. The proposed policy framework is capable of transforming Hungary's economy as a whole, bringing circularity to the heart of policy with the aim to positively impact on the environment.

The results of the environmental assessment have shown that the proposed policy framework contains neither policy recommendations nor actions that would specifically endanger the status of any environmental element or system during its implementation. A significant part of the suggested policy recommendations and activities aims to (directly or indirectly) reduce the use and pressure on environmental elements and systems, as well as improve human health and quality of life while acknowledging environmental concerns.

The policy recommendations and action plan of the OECD report sufficiently respond to all the identified gaps. Through its proposed measures, it was found that the priority area with the most positive outcomes and least damage to the environment is construction, followed by plastics, and biomass and food.

Measures proposed for the biomass and food priority area will positively impact climate the most

According to the OECD report, Hungary's long-term policy efforts will need to shift focus from waste management (composting and anaerobic digestion) towards strategies aimed at supporting the use of bio-based resources in agricultural practices and the development of the circular bioeconomy in order to accelerate sustainable consumption, and biomass and food production. Key policy recommendations of the OECD report for this priority area include the development of a regulatory framework that supports and ensures the use of quality compost and digestate in agriculture. Economic incentives are provided to boost separate collection of municipal bio-waste by supporting "pay-as-you-throw"-based (PAYT) household waste charges and by increasing landfill taxes. The development of educational and awareness-raising tools is deemed necessary to acquire further knowledge on the circular bioeconomy.

The measures in this priority area related to bio-fertilizers and alternative proteins serve as visionary initiatives to support the circular bioeconomy in Hungary.

Bio-fertilizers will have a positive effect on **soil and air quality** as the structure of the soil improves with a higher content of organic matter, giving soil greater structural stability and decreasing the amount of dust caused by deflation. The spread of bio-based products can reduce the emission of pollutants derived from the use of fossil hydrocarbons. Air pollution can also be minimised by reducing food surplus and bio-waste that would otherwise be dumped or incinerated.

Supporting the greater use of soil conditioners and organic matter in agriculture is expected to have a positive impact on **water management**. The production of alternative plant-based proteins (such as peas, soy and lentils) in place of animal proteins would increase the amount and quality of soil organic matter resulting in better water retention. At the same time, the cultivation of these high-protein plants would require less water than for raising animals. Bio-degradable products can have a positive effect on water if they replace fossil-based plastic products as their use does not result in microplastics pollution. Reduced food waste through food donation also preserves water resources as food production is an extremely water-intensive process.

Bioenergy production can increase the amount of arable land used and the intensity of land management required, negatively affecting biodiversity in the competition for space and putting pressure on food production systems. Sustainable food production and consumption help protect **biodiversity**, and composting helps to improve soil fertility and soil microbial diversity. In addition, stricter quality standards for composts will decrease contamination from microplastics and propagules (seeds) of non-native (sometimes invasive alien) plant species.

The implementation of actions and recommendations outlined in the OECD report may indirectly contribute to **mitigation and adaptation to climate change** by reducing pressure on the natural environment. Measures that enhance soil quality may lead to better water absorption capacity as well as better CO_2 emissions capture. Food donations can reduce food production in the long term, resulting in lower CO_2 emissions and reducing the need for intensive land use, giving space to natural vegetation, which in turn helps in the mitigation and adaptation of climate change. However, when planning the use of bio-based products and biomass for energy generation it is important to consider unfavourable climate change-driven processes, such as droughts, floods, heat stress and soil erosion, which is estimated to decrease the total supply of bio-based products in the future. In general, it is more judicious, from an environmental perspective, to reduce overall consumption than to rely on bio-based production processes.

The impact of the recommended measures on **human health** is fundamentally positive. Healthier food is one of the advantages of bio-based solutions in agriculture and food production. Raising awareness of the meaning behind the "best before" label, incentivising the separate collection of municipal bio-waste, and strengthening education on the circular bioeconomy are expected to have a positive influence by arousing environmental consciousness among the general public.

The development of new facilities (biorefineries, bio-waste processing and recycling facilities) may result in **environmental conflicts** (i.e. social conflict arising from environmental degradation or by the unequal distribution of environmental resources), especially if built in a greenfield area. A trade-off could emerge between the land use structures dedicated to food production versus biomass for bioenergy production. The cultivation of plants for alternative proteins may also result in a greater demand for agricultural land (with a potential conflict of land use affecting grasslands). Substituting meat with plant-based alternatives can increase the exploitation of land. In Hungary, the majority of grassland habitats and their valuable flora and fauna can be maintained only through regular grazing or mowing, which is linked to extensive animal husbandry.

To summarise, measures introduced to increase the circularity of the biomass and food priority area have the biggest positive impact on climate, human health and lifestyle of the three priority areas examined. At the same time, a growing environmental public consciousness and the positive impact on air quality, soil and biodiversity are all desired benefits of a circular economy.

Measures proposed for the construction priority area will yield positive environmental impacts on air quality, water, biodiversity, climate and the built environment

The instruments proposed for adoption by the Hungarian Government include specific actions related to each life cycle phase of buildings construction in the form of economic and regulatory measures. The proposal also covers several horizontal tools targeting better coordination, education, information, digitalisation, and business support to SMEs. To facilitate a transition to a circular construction, Hungary will need to strengthen its existing policy instruments to include an increase in the landfill tax rate, better enforcement of waste regulations, and extended renovation support schemes tailored to promote the circular economy. The development of quality standards for secondary raw materials, the introduction of a tax on selected virgin construction aggregates, and the integration of minimum recycled content requirements into green public procurement (GPP) criteria will drive the uptake of the secondary materials market. The downstream measures propose to: focus on introducing end-of-waste criteria for additional construction waste streams; establish a mandatory selective demolition system; and consider the development of an extended producer responsibility (EPR) scheme for construction products as incentives for construction and demolition waste (CDW) recycling and reuse.

The outlined support for the use of secondary raw materials in construction will have an overall positive effect on **soil** as the extraction of primary construction raw materials, especially open-pit mines, has a harmful effect on the environment.

The use of secondary raw materials in construction has a positive effect on **air quality** as the opening of new open-pit mines would be avoided, which would have significantly increased local particle contamination. If this were accompanied by the closure and recultivation of open-pit mines, the positive effect on air quality would be even more significant. Increasing landfill taxes on CDW will also have a positive effect on air quality as the transportation and treatment of such waste generates significant dust emissions.

Increasing the use of secondary raw materials in the construction industry benefits the environment as the extraction of primary raw materials, especially the establishment and operation of open-pit mines, disrupts surface and underground water systems and creates **water management** problems. Extending the lifespan of buildings and renovating the building stock can reduce the amount of water used in the construction industry.

Less landfilled waste helps maintain **biodiversity** in a close-to-natural state. However, it is important to state that backfilling of CDW – the most frequent use of CDW waste diverted from landfills – can be dangerous for natural and semi-natural areas. This is enabled by the weak legal status of soil and nature protection measures and by the simplified approval procedures of local authorities currently in place.

The use of secondary raw materials in construction has a positive effect on the climate. The implementation of all the actions and recommendations in the OECD report will fundamentally reduce pressure on the natural environment and have a positive effect on **climate mitigation and adaptation**. As a result of the application of circular planning guidelines and actions to directly support secondary raw materials use, the expected number of green building elements and sites in urban settings will contribute significantly to climate adaptation.

As bio-based materials will partly substitute traditional construction raw materials (cement, steel), the appearance of the **built environment** will change positively (for example, the use of covering clay or reeds in green façades). Extending the lifespan of the built environment and promoting more intensive and flexible uses will preserve the current landscape. The use of secondary raw materials will also contribute to conserving the appearance of traditional built structures, which is a desired outcome. Valorisation of CDW through more efficient recovery and utilisation therefore encourages a cleaner built environment and their surroundings (for example, by reducing illegal dumping and littering).

Newly constructed or renovated buildings built to new standards of circularity, including standards for secondary raw materials use and renovation, would provide people with better living conditions. The policy recommendations aimed at renovation are also expected to lower the **environmental conflicts** caused by construction activity as circular strategies promote a shift away from the extraction of raw materials for new buildings, thereby mitigating their associated environmental impact.

Measures proposed for the plastics priority area will positively affect human health and lifestyle the most

The intervention logic of the policy recommendations identified in the plastics priority area is versatile and builds on the economic possibilities that exist in Hungary, while also using examples from international best practices. The OECD report identified a mix of economic, regulatory and information instruments that could be applied in the transition towards a more circular life cycle for plastics. The recommendations target the most frequently used polymers in applications, including packaging, single-use plastics and construction. The report recognises the importance of national specificities and the possibilities that lie in education and awareness raising, as well as in research and development efforts.

The planned actions would positively influence human health and improve lifestyles, while stirring environmental consciousness and easing environmental conflicts whenever they arise.

Raising the landfill tax and educating consumers is shown to have the most favourable indirect effect on soil quality. Awareness-raising campaigns are essential to reduce the amount of illegally dumped and littered waste, which – for the most part – ends up in the **soil** and **surface waters**. Incentivising separate waste collection and implementing PAYT schemes are other actions that will reduce the amount of plastics found in illegal plastic waste deposits and other organic sources of pollution in waterways.

Illegal waste dumping also has a negative effect on **biodiversity** as a result of soil and water contamination of the natural habitat for wildlife. Extended producer responsibility (such as take-back and deposit refund schemes) contributes to safeguarding biodiversity by reducing the amount of illegally disposed waste and thus avoiding the degradation of plastics into microplastics and the unpredictable, deleterious effects they have on the food chain.

Most of the planned actions have indirect positive effects on **air quality**. Combustion products from plastics pollute the air significantly. Incineration taxes, the circular reuse of plastics and recycling would therefore reduce air pollution.

Policy recommendations in the plastics priority area have either direct or indirect effects on human **lifestyle, health and environmental consciousness.** End consumers are targeted through awareness-raising campaigns that explain how to properly dispose of waste, providing them with pertinent knowledge about plastic pollution.

The recommendations are expected to lower the risk of **environmental conflicts** caused by plastics as they aim to close the loop on intensive plastic materials use. However, environmental trade-offs might occur. For example, the reduction in landfilling will require new recycling facilities to be built, which will need new land sites. Moreover, the rate of plastics use across sectors might show an improvement despite an increase in cumulative primary plastics consumption. In addition to improvements in resource productivity and share of recycled content it is therefore equally important to closely monitor the potential increases in the absolute amount of plastic materials intake by the industry.

Horizontal approaches positively impact all environmental elements

The horizontal flagship actions recommended in the OECD report relate to strengthening the effectiveness of education, capacity building, knowledge transfer and education, providing more financial support for eco-innovation and technological development, better tailoring government support for the circular transformation of SMEs, and improving existing data collection and monitoring systems.

Horizontal tools listed in the OECD report support the promotion of sustainable consumption and lifestyle patterns and, hence, are positive for all environmental and social elements. These are usually indirect effects, yet they are significant as they establish a “sustainability frame” around the priority areas and support the paradigm shift to a more circular economy. Greater emphasis should be placed on the reduction of material flows such as the elimination of packaging rather than promoting the use of easily recyclable alternatives or promoting local farmers’ markets, that is, actions should ultimately drive down consumption.

Additional protective measures could be considered to avoid negative externalities on the environmental factors examined

The OECD report proposes policy recommendations and actions that have – for the most part –positive effects on the different elements of the environment. However, these measures can occasionally be in

conflict with other policy measures outside of the scope of the NCES. To mitigate these adverse effects, the SEA proposes additional measures that need to be taken into account to prevent negative impacts on the environmental factors examined.

- In the **biomass and food** priority area it is essential to protect soil and water from potential pollutants originating from compost and sewage sludge.
- The use of secondary raw materials coming from the **construction** and **plastics** priority areas are to be handled with precaution (reuse of demolished materials should be encouraged even though the use of bio-based materials is also desirable).
- In the **construction** priority area, the financial subsidies for households need to be redesigned towards the circular economy by awarding the same amount for renovations than for new buildings in order to extend the life span of existing homes.
- The implementation of **horizontal tools,** especially in terms of awareness raising and education, needs to start as soon as possible to quickly shape attitudes and change the behaviour of people and businesses.

These proposed protective measures extend the scope of the policy recommendations to achieve better synergy, and which can be considered during the finalisation of the NCES.

The OECD report proposes a comprehensive monitoring system for the evaluation of the circular economy transition in Hungary

The OECD report describes the monitoring framework for the implementation of the NCES, in which a three-tiered structure of indicators is proposed.

- Indicators to measure the attainment of strategic objectives formulated in the vision of the NCES:
  - **Resource productivity:** Gross domestic product divided by the total amount of materials directly used by the economy (EUR/kg)
  - **Contribution of recycled materials to raw materials demand:** Circular material use (CMU) rate (%)
  - **Circular jobs:** Number of persons employed in circular activities as a share of total employment (%).
- A specific list of indicators for each priority area to monitor the progress of circular transition:
  - The **biomass and food** priority area has the most indicators as it is the most complex domain. Indicators will measure the progress related to waste management, the rate of GPP in procuring food and catering services, and investments in the circular bioeconomy.
  - For the **construction** priority area, the proposed indicators cover the domestic extraction and material consumption of construction minerals, the waste management of CDW (generation, recycling, recovery and landfilling), and the rate of GPP in construction tenders.
  - For the **plastics** priority area, the following indicators have been proposed: the use of non-recyclable plastics in the food and construction sectors; the collection of plastic bottles; recycled content of plastics; the generation and recycling of plastic packaging waste; and the green procurement share of plastic products.
- A set of complementary indicators is proposed to monitor the economy-wide circular transition in Hungary regarding **consumption and production**, **waste management**, **secondary raw materials**, **competitiveness** and **horizontal tools**.

All indicators comply with the criteria of policy relevance, analytical soundness and measurability.

Towards a National Circular Economy Strategy for Hungary

The growing demand for raw materials in the Hungarian economy projected up to 2050 is expected to exert significant additional pressure on the environment, putting the country at risk of missing important environmental goals and opportunities to strengthen the competitiveness and resilience of its economy. Despite the notable progress in decoupling environmental pressures from economic activities over the past 20 years, several challenges remain. The transition to a circular economy has significant potential to address these challenges. To fully realise the circular potential of its economy, Hungary will need to adopt a comprehensive circular economy policy framework. This report outlines a set of key elements for the development of the Hungarian national circular economy strategy and action plan. It identifies priority areas that are deemed critical to the Hungarian circular economy transition, including: biomass and food, construction and plastics, as well as cross-cutting horizontal tools to facilitate an economy-wide circular transition. It also provides 45 policy recommendations and suggests specific implementation actions across the priority areas for the short, medium and long term.

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