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Circular economy and climate change mitigation – analysis and guidance on including Circular Economy actions in climate reporting and policy making

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Summary / Description

In order to meet the EU's energy and climate targets for 2030 and beyond, Member States are required to establish 10-year National Climate and Energy Plans (NECPs) for the period 2021-2030. The first final plans were released in early 2020, with final updates to these initial plans anticipated for mid-2024. New final plans are then required in early 2029 for the period 2031-2040. National Energy and Climate Progress Reports (NECPRs) are required biennially (as of 2023) to ensure the status of NECPs and EU progress to targets are continuously tracked.

NECPs allow Member States to provide comprehensive and integrated plans for national targets, trajectories, and Policies and Measures (PaMs) to achieve EU targets. Mostly PaMs reported in the NECPRs are linked to energy consumption/supply, transport, or agriculture/Land Use, Land Use Change, and Forestry (LULUCF). Only a small share of measures reported link to waste policies, and currently broader circular economy and resource efficiency (CE) PaMs are less considered than other policy areas.

Work has been done already to try and connect the two policy areas, yet most are on an aggregated (international) level or are sector specific. This report, instead, focuses on the country level, with the aim to develop knowledge on the mitigation potential of CE actions and to help develop further policy development within the CE and climate mitigation nexus. Second, the report provides guidelines for how countries can include CE PaMs in their climate modelling and policymaking, e.g. in their NECPs and National Determined Contributions (NDCs), drawing on different modelling approaches.

1 Introduction

Until recently, the policy fields of circular economy and climate change developed largely independently of one another. Circular Economy (CE) Policies and Measures (PaMs) have received little attention in the policy area of climate change, and their climate change mitigation potential has not been fully explored, nor exploited.

However, it is clear that CE PaMs should be considered in climate reporting and policy making, since several studies have already demonstrated the decarbonization potential of CE PaMs for specific sectors, and/or on an aggregated (international) level (e.g. IRP, 2020; Trinomics et al., 2018; Ellen MacArthur Foundation and Material Economics, 2019; EEA, 2020a; IPCC, 2022). A growing interest and number of initiatives can be observed that aim at linking CE and climate on an international level (e.g. Diaz-Bone et al., 2021; UNEP et al., 2023). Also, the European Green Deal (EGD) acknowledges the interaction of different policies and foster synergies between them. As part of the EGD, the EU Circular Economy Action Plan (CEAP) indicates 'Circularity as a prerequisite for climate neutrality'. It states that in order to achieve climate neutrality, the synergies between circularity and reduction of GHG emissions need to be stepped up. Furthermore, CE contributes to strategic autonomy, reducing the climate agenda's dependency of raw materials.

There might be several reasons why only a small minority of the measures reported in the National Energy and Climate Plans (NECPs) for 2021-2030 seem to be related to CE. First, there are several methodological approaches, but not yet established practices and procedures for including the climate change mitigation potential of CE PaMs. The legal base for NECPs, the Governance Regulation, does not include references to the CE. It was adopted in 2018, when the decarbonisation potential of the CE was still not sufficiently recognized in science and policies. Secondly, the cross-sectoral and cross-border effects of CE PaMs pose challenges for assessing their decarbonisation potential within the Greenhouse Gas (GHG) emissions reporting system. Climate policies address territorial emissions, whereas CE PaMs rather have an impact on consumption-based emissions over the whole life cycle or embodied emissions and therefore affect emissions worldwide (see Box 1.1).

This report aims to develop the knowledge on the mitigation potential of CE actions at the Member State level, to foster policy development within the CE and climate change mitigation nexus. It includes an analysis of the reporting on CE PaMs (across the two halves of the nexus) and the relevant overlap and gaps. It provides further guidance for Member States on how to include CE PaMs in their future NECPs (and NECPRs), and how to estimate and monitor their effects. On the other hand, it encourages countries in general to do the same in their respective reporting and National Determined Contributions (NDCs). **Overall, it should contribute to a better understanding of the EU emissions landscape and provide additional insights in how actions at the Member State level will contribute to achieving EU climate targets.**

In Chapter 2, the status of interlinkages between CE and climate change mitigation policies and measures is discussed, based on an analysis of the CE country profiles (EEA - Eionet, 2022) and the EEA Database of Climate change mitigation PaMs. It relies, for comparability reasons, on the same definition of CE applied in the survey conducted to prepare the CE country profiles, according to which CE is an economy "where the value of products, materials and resources is maintained […] for as long as possible, and the generation of waste minimized […]" (EC, 2015a). Chapter 3 presents a number of model approaches for calculating the climate change mitigation potential of CE PaMs. Chapter 4 discusses some examples of countries that assessed the climate change mitigation potential of their CE PaMs. In Chapter 5, we provide guidelines for EU Member States, on how to (progressively) introduce, assess and monitor CE PaMs in climate planning and reporting.

Box 1.1 CO_2 emissions: different accounting perspectives

In general, the use of the territorial perspective to the estimation of emissions and removals is the basis for the climate change commitments by countries under the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, and also for the tracking of progress and the assessment of the achievement of those objectives. The consumption perspective is a more recent development and is less commonly used. The principle of consumption-based carbon accounting assigns the responsibility of emissions to the consumers of products and services rather than to the producers.

Territorial emissions (*$GHG_{territorial}$*):
Those emissions that are released to the atmosphere from within a countries' border and areas under a countries' jurisdiction. This is from the perspective that a country is accountable for the emissions that take place within its territory. (EEA, 2013)

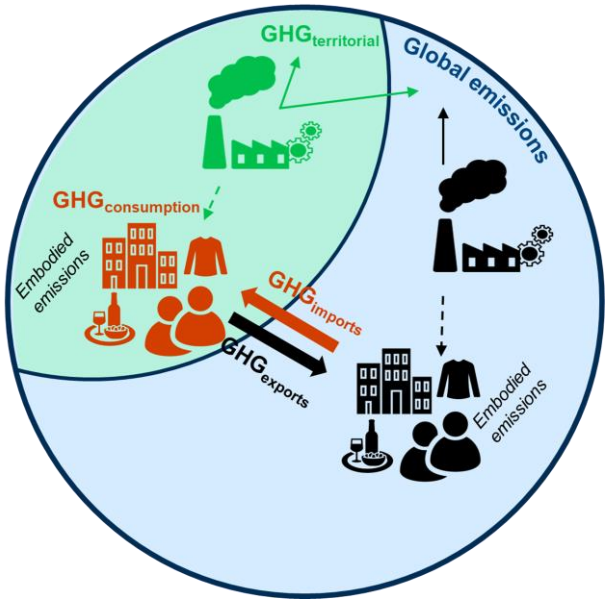
Consumption footprint ($GHG_{consumption}$):
Those emissions over the whole life-cycle resulting from the national consumption of goods and services within a country, irrespective of the geographic location where production of these good and services results in emissions. This is from the perspective that a country is accountable for the emissions resulting from domestic consumption of goods and services. (EEA, 2013)

Embodied emissions:
Embodied or embedded emissions refer to emissions resulting from the production of goods and services from the extraction, manufacturing and transport. Embodied emissions can thus also be attributed to emissions resulting from goods and services that are either imported or exported ($GHG_{imports}$ or $GHG_{exports}$). (EEA, 2013)

Consumption-based carbon footprints calculate emissions that are related to consumption activities within a territory. For this purpose, the domestic and import-related environmental impacts are added together and the export-related environmental impacts are subtracted. A simplified calculation for consumption-based carbon accounting is thus (Lenk et al., 2021):

$GHG_{consumption} = GHG_{territorial} + GHG_{imports} - GHG_{exports}$

Figure1.1 Territorial emissions versus consumption footprint concepts



Source: ETC CE, 2023

2 Circular Economy and Climate Policy

The main question addressed in this chapter is: 'To what extent are countries already integrating CE PaMs in their climate change mitigation policies?' The aim is to provide an overview of selected **CE PaMs** in place at the national level and to give an indication of their **level of integration into climate policies**.

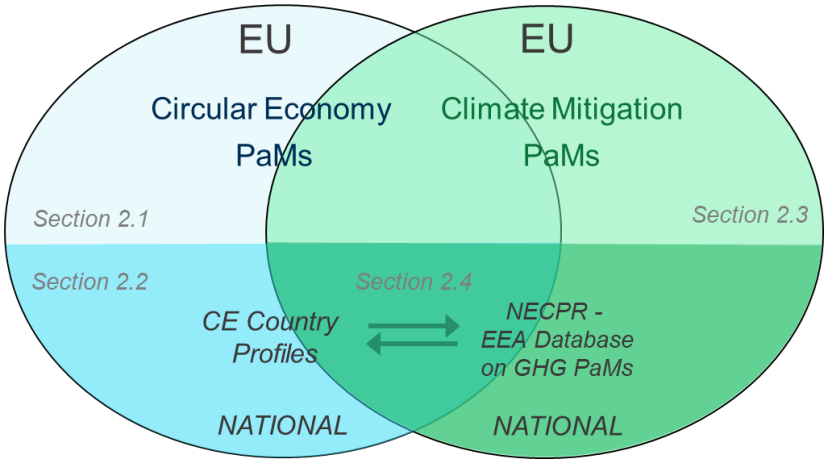
Two main sources of information are analysed in this respect:

- The EU Country Profiles, which are published on the EEA website (EEA - Eionet, 2022);
- The EEA database on integrated national climate and energy policies and measures in Europe[1].

After a brief discussion of both the CE (section Circular Economy policy at EU level) and climate (section Climate Policy at EU level) **targets and objectives** in EU policy and legislation, we focus on national CE PaMs, and we investigate (Figure 2.1):

- the development of dedicated **CE PaMs** (strategies, roadmaps, action plans) and the adoption of CE targets/objectives at national level, additional to the EU ones, based on the **CE Country Profiles** (section 2.2);
- **CE PaMs** which are explicitly linked in the **CE Country Profiles** to **Climate Policies** (section 2.4);
- **CE-related PaMs** included in climate policies, as reported by countries (through Article 17 and 18 reporting under the Governance Regulation) to the EEA Database on GHG PaMs (section 2.4).

Figure 2.1 Chapter 2 scope: CE PaMs and Climate change mitigation PaMs, and their intersection



Source ETC CE, 2023

The 27 EU Member States are covered in the analysis, as well as selected EEA countries, based on the available information: Kosovo, Norway and Switzerland in paragraph 2.2 and Iceland, Norway and Switzerland in paragraph 2.4.

[1] EEA database on integrated national climate and energy policies and measures in Europe (http://pam.apps.eea.europa.eu/)

2.1 Circular Economy policy at EU level

Policy initiatives

Following the **2015 Circular Economy Action Plan** (CEAP; EC, 2015b), a **new CEAP** was adopted in **2020** (European Commission, 2020), in the context of the **European Green Deal** (EGD). Its main strategic objectives are to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advances towards keeping its resource consumption within planetary boundaries, reduces the consumption footprint, and doubles the circular material use rate in the coming decade.

The current EU legislation (especially the waste legislation) already sets several binding targets and requirements that support CE. The 2020 CEAP schedules further actions that address the different phases of the product lifecycle (production, consumption, and waste management), while specific initiatives focus on the sustainability challenge posed by selected value chains. Moreover, CE is expected to make a decisive contribution to achieving climate neutrality. In order to step-up the **synergies between circularity and reducing GHG emissions**, the Commission will analyse how to measure the **impact of circularity on climate change mitigation/adaptation; improve modelling tools** to capture the benefits of the CE on tackling climate change; and **strengthen the role of circularity in future revisions of the NECPs**. Moreover, the Commission has proposed an EU-wide voluntary framework for certifying carbon removals (EC, 2022h) to support the achievement of climate neutrality.

Since the way a product is designed determines up to 80% of its environmental impacts (EC, 2020a), the 2020 CEAP planned a sustainable product policy legislative initiative, to ensure that all products placed on the EU market become increasingly sustainable and circular. The new proposed **Regulation** (EC, 2022g) widens the scope of the **Eco-design Directive** (EU, 2009) and will introduce eco-design requirements (beyond energy-efficiency) for further products, such as **textiles** and **furniture**. In **production** processes, circularity is promoted in the context of the ongoing review of the **Industrial Emissions Directive** (IED) (EU, 2010) and (EC, 2022d), through the integration of CE practices in upcoming **Best Available Techniques reference documents** (BREFs).

Another key priority of the 2020 CEAP is to strengthen the **role of consumers** and public buyers in the green transition. The **EU consumer law** is being revised. The proposal is complemented by additional measures on substantiating **green claims** (EC, 2023b) and the **right to repair** (EC, 2023a). Moreover, minimum mandatory **GPP criteria and targets** will be set, as part of the proposed Regulation on Eco-design (EC, 2022g).

With regard to the end-of-life phase, in order to strengthen the EU market for **secondary raw materials** (SRMs), the CEAP measures provide for: the creation of harmonised systems to track information on relevant **chemicals substances** and identify those substances in waste; the development of methodologies to minimise the presence of substances that pose problems to health or the environment in recycled materials/articles; and the establishment of requirements for **recycled content in products**.
The 2020 CEAP focuses on **key value chains,** namely **electronics and ICT**, **batteries** and **vehicles**, **textiles**, **packaging**, **plastics**, **construction and buildings**, **food**, **water** and **nutrients,** posing specific sustainability challenges[2]. Table 2.1 summarizes the most important actions planned by the Commission to address these challenges.

[2] Note: the main initiatives that, as of 31st March 2023, have already been adopted or which are ongoing under the different priority areas are reported in the table in italics.

Table 2.1 Initiatives scheduled by the 2020 CEAP to address key value chains

Value chain	EC planned initiatives
Electronics and ICT	Circular Electronics Initiative to promote longer product lifetimes, including the following: • *Revision of the Ecodesign Directive legislation* (EU, 2009; EC, 2022d - ongoing) to improve the sustainability and eco-design of electronics and ICT (mobile phones, tablets and laptops). • Implementation of a 'right to repair', focusing on ICT & electronics as a priority sector (EC, 2023a). • Shape *regulatory measures on charges for mobile phones and similar devices* (EU, 2022b - adopted). • Improve WEEE collection/treatment, exploring options for an EU-wide take back scheme to return/sell back old mobile phones, tablets, etc. • Revision of the Directive on restrictions of hazardous substances in EEE (EU, 2011a).
Batteries and vehicles	• *New regulatory framework on batteries* (EU, 2006 and EC, 2020b – ongoing), including: rules on recycled content; measures to improve collection/recycling of batteries; measures addressing non-rechargeable batteries; sustainability and transparency requirements for batteries. • Revision of the End-of-life Vehicles (ELVs) Directive (EU, 2000) including: link design issues to end-of-life treatment; consider rules on mandatory recycled content for certain materials; improve recycling efficiency; improve the collection and environmentally sound treatment of waste oils.
Packaging	• *Revision of the Packaging Waste Directive* (EU, 1994 and EC, 2022f - ongoing) to reinforce the essential requirements and reduce overpackaging and packaging waste. • Drive design for reuse and recyclability of packaging. • Consider reducing the complexity of packaging materials (number of materials and polymers used). • Consider introducing an EU-wide labelling that facilitates the correct separation of packaging waste at source. • Establish rules for the safe recycling into food contact materials of plastic materials other than PET. • Monitor the implementation of the requirements of the Drinking Water Directive (EU, 1998) to make drinkable tap water accessible in public places.
Plastic	• Proposal of mandatory requirements for recycled content and waste reduction measures for key product such as *packaging* (EU, 1994 and EC, 2022f - ongoing), *construction materials* (EC, 2022i), and vehicles. • Development of a *policy framework* on 1) sourcing, labelling and use of *bio-based plastics* and 2) use of *biodegradable or compostable plastics* (EC, 2022a- adopted). • With regard to microplastics, introduction of: *restriction of intentionally added microplastics* (ECHA, 2021 - ongoing); labelling, standardisation, certification and regulatory measures on unintentional release; methods for measuring unintentionally released microplastics; measures to improve scientific knowledge related to the risk and occurrence of microplastics in the environment, drinking water and foods.
Textiles	*EU Strategy for sustainable and circular textiles* (EC, 2022b - adopted), including: • Application of the new sustainable product framework to textiles (by developing eco-design measures and empowering business and private consumers to choose sustainable textiles). • Provision of incentives and support to product as-service models, circular materials and production processes. • Provision of guidance to achieve high levels of separate collection of textile waste. • Increase the sorting, re-use and recycling of textiles, including through innovation and extended producer responsibility (EPR).
Building and construction	Comprehensive EU Strategy for Sustainable Built Environment, including: • *Revision of the Construction Product Regulation* (EU, 2011b; EC, 2022h - ongoing). • Promote measures to improve the durability and adaptability of built assets and develop digital logbooks[3] for buildings. • Use Level(s)[4] to integrate life cycle assessment in public procurement and the EU sustainable finance framework and exploring the appropriateness of setting of carbon reduction targets. • Consider the revision of material recovery targets set in EU Waste Framework Directive (EU, 2008) for construction and demolition waste and its material-specific fractions. • Promote *initiatives to reduce soil sealing and the circular use of excavated soil* (EC, 2021b - EU Soil Strategy, adopted).
Food, water, nutrients	• Revise the Waste Framework Directive (EU, 2008) to propose a target on food waste reduction. • Determine the scope of a legislative initiative on reuse to substitute single-use packaging, tableware and cutlery by reusable products in food services. • Facilitate water reuse and efficiency including in industrial processes; see the ongoing IED initiative; EU, 2010; EC, 2022e). • Develop an Integrated Nutrient Management Plan (to stimulate markets for recovered nutrients) and consider reviewing *Directives on wastewater treatment* (EU, 1991; EC, 2022f - ongoing) and sewage sludge (EU, 1986).

Source: 2020 CEAP (European Commission, 2020)

[3] A digital building logbook is a dynamic tool that comprises a record of major events and changes over a building's life cycle, such as change of ownership, tenure or use, maintenance, refurbishment and other interventions.

[4] Level(s) is an assessment and reporting tool for sustainability performance of buildings, developed by the EUCOM.

Circular Economy targets and objectives at EU level

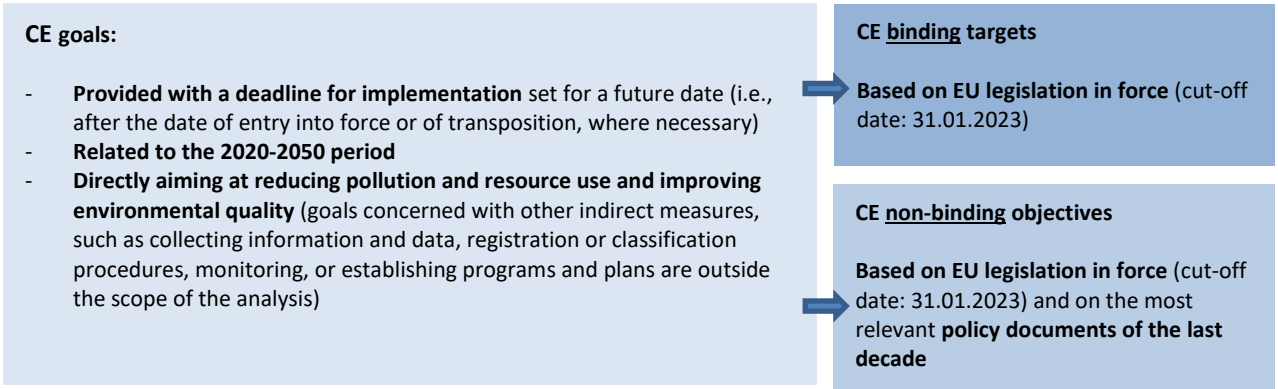
Here we provide an overview of CE goals, i.e., binding targets and non-binding objectives, in EU policy and legislation. As in previous reports (ETC/WMGE, 2019), the terminology as explained in Figure 2.2 applies.

CE goals have been identified based on an expert evaluation according to the criteria specified in Figure 2.2.[5] In a second step, the goals were classified into the following eight categories:

- **resource efficiency**[6] (e.g., increasing the circular material use rate);
- **product making** (e.g., recycled content requirements);
- (end-user) **consumption** (e.g., increasing the availability of repair services);
- **waste generation** (e.g., reducing food waste generation);
- **waste collection** (e.g. separate collection of textiles);
- waste **reuse, recycling and recovery**[7] (e.g., increasing the recycling of packaging waste);
- **waste disposal**, i.e., waste **incineration**[8] **and landfill** (e.g., reducing the amount of municipal waste landfilled);
- **other** CE goals, not covered by the above categories.

These categories stem from a 'bottom-up' approach and aim to assign CE goals to different conceptual stages of circular value chains. Together, they address the whole life cycle of products or materials (i.e., production, consumption, and waste management, including waste collection, recovery – both material and energy recovery –, and disposal). Some of the categories (such as resource efficiency and waste generation) have a cross-cutting nature, since they do not focus on a single phase in the value chain.

Figure 2.2 CE goals, targets, objectives: terminology used in this report



Source: own elaboration based on ETC/WMGE (2019)

Results are summarized in Table 2.2. Overall, a total of **18 legally binding targets and 14 non-binding objectives** have been identified for the 2020–2050 period. The full list of EU CE goals is provided in Annex 1: CE targets and objectives in EU policy (strategic documents) and legislation, for 2020-2050. Most of the goals (17) are set for **2030**. Targets and objectives addressing '**waste reuse, recycling, and recovery**' are the most common. Also '**product making**' is addressed several times in legislation. Conversely, there are no binding targets within the categories of 'consumption' and 'waste generation' – only non-binding objectives –, and no objectives within the category of 'waste collection' – only binding targets. This distribution of objectives across different categories provides a rough indication of the medium-term trend

5 Note: The aim of the analysis was to explore and illustrate the diversity of CE-related goals. It did not aim to provide a comprehensive and detailed overview of all CE-related goals in EU legislation.

6 Resource efficiency: creating more (economic) value with less input of resources (raw materials, energy, water, air, land, soil, and ecosystem services) and reducing the environmental impacts associated with resource use to decouple economic growth from the 'use of nature' (source: https://link.springer.com/referenceworkentry/10.1007/978-3-642-28036-8_728#citeas)

7 Note that recovery also includes energy recovery (by incineration), so it is not only 'material recovery'.

8 Incineration without energy recovery (as a disposal operation).

in the evolution of the whole framework, since the introduction of a binding target by EU legislation is generally preceded by its announcement as an objective in (strategic) policy documents. Member States are required to report every year on the implementation of most of the targets.

Table 2.2 Classification of CE targets and objectives in EU legislation and policy, 2020-2050

CE Category	CE Goals identified (total)	Non-binding Objectives	Binding Targets
Resource efficiency	2	2	0
Product making	6	2	4
Consumption	1	1	0
Waste generation	2	2	0
Waste collection	4	0	4
Waste Reuse, Recycling, Recovery	12	3	9
Waste disposal	4	3	1
Other	1	1	0

Note: based on EU legislation in force, as of 31 January 2023

Apart from the two overall packaging recycling targets, the number of goals set for plastics (plastic packaging and/or single-use plastic, SUP) is noteworthy. **Plastics** are subject to 9 targets and 4 objectives. **Paper**, **metal**, and **glass** are covered by 3 targets each; and **wood** by 2 targets. Moreover, **municipal solid waste** (MSW) is addressed by six goals (4 targets and 2 objectives), **textiles** by 5 goals (1 target and 4 objectives). Finally, **biowaste/food waste** and **construction and demolition** (C&D) waste are respectively addressed by 2 and 1 goals.[9]

EU legislation in force also sets a relevant number of CE targets (18) with a deadline before 2020 (but still applied). These are listed in Annex 2: CE targets set by EU legislation in force with a deadline before 2020, along with the related reporting requirements for the Member States. As for the 2020-2050 period, most of the targets are related to '**waste reuse, recycling and recovery**' (7 targets) and '**product making**' (5 targets). They mainly concern **electrical and electronic equipment** (6 targets), followed by **batteries** and **packaging** (3 targets each), and **vehicles** (2 targets).

2.2 Circular Economy Policy in European Countries

In the 2015 and 2020 CEAPs, Member States are encouraged to develop **dedicated CE policies** (strategies, roadmaps, action plans). Table 2.3 shows when first CE policies were adopted in several countries, indicating countries formal interest in the CE. Up to now, **23 EU Member States and Norway** have issued this kind of policies. Two Member States (Hungary and Lithuania) have drafts under consultation or finalisation, which are likely to be adopted in the near future. Others, like Slovakia, have already carried out some preparatory work (ETC/CE, 2022). Moreover, several countries, like Belgium, Denmark, Finland, Luxembourg, Netherlands, Portugal, Spain and Sweden, have launched updates to their first CE policies (often consisting of detailed action plans). With regard to non-EU countries, Norway published its CE strategy in 2021 (One Planet Network, 2022), while Kosovo and Switzerland currently have no national CE strategies in place.

An extensive **overview of CE goals** (including both binding targets and non-binding objectives) in national policy and legislation related to the **2020-2050 period** is summarized in Annex 3: Types and categories of

[9] Please note that a single target/objective may address several materials, products or waste streams and may be, therefore, double counted.

national CE goals additional to EU ones: overview (2020-2050). The analysis covers the **EU 27 Member States**,[10] **and Switzerland** and it is updated to 31 January 2023. Similarly, to the overview of EU CE targets and objectives, binding goals established by national legislation are called 'targets', while all other goals are classified as (non-binding) 'objectives'. Only goals directly aiming at reduced pollution and resource use, and improving environmental quality are considered (see criteria in Figure 2.2). National targets and objectives for Member States covered by this review are **only those that are additional to or more ambitious than EU ones**. The main focus is on measurable targets or objectives, i.e., quantitative goals, provided with a deadline for implementation and, where relevant, a baseline.

Table 2.3 European countries which have adopted a dedicated CE strategy

Year	2015	2016	2017	2018	2019	2020	2021	2022
Cumulative number	0	3	4	10	11	16	20	25
Countries* with a national CE strategy		Belgium Finland Netherlands	Portugal	Denmark France Greece Luxembourg Slovenia	Poland	Germany Latvia Malta Spain Sweden	Cyprus Czechia Ireland Norway	Italy Romania Austria Bulgaria Estonia

Source: ETC/CE (2022) *and online updates* (as of 31 January 2023)

**Countries in this analysis included: EU27 + Kosovo, Norway and Switzerland.*

The list of CE goals, and their level of stringency is summarized in Table 2.4. Some countries have set at least one binding target (plus eventual non-binding objectives) for the types included in each CE category, while others have set one or more non-binding objectives (and no binding targets).

National CE goals were classified under the same eight categories used for EU CE goals. Then, they were further divided into **64 more specific 'types'**, which are not mutually exclusive (Table 2.4, Table 2.5). For example, waste reduction targets include reduction targets applying to selected waste streams, such as WEEE, packaging waste, food waste, etc. To avoid double counting, each national target/objective has been classified only under the most appropriate and specific 'type'.

Table 2.4 National CE goals 2020-2050, additional to EU ones, across different categories

CE Category	CE Goals identified (total)	Non-binding Objectives[11]	Binding Targets[12]
Resource efficiency	34	33	1
Product making	40	6	34
Consumption	14	6	8
Waste generation	30	26	4
Waste collection	14	10	4
Waste Reuse, Recycling, Recovery	34	23	11
Waste disposal	13	9	4
Other	6	5	1

Source: ETC/CE (2022) and online updates (as of 31 January 2023)

10 With regard to Belgium, as CE targets/objectives are set at the regional level, two separate analyses have been developed for Flanders and Wallonia.

11 Number of types within a certain category for which countries have set at least a non-binding objective (but no binding targets)

12 Number of types within a certain category for which countries have set at least a binding target (plus eventual non-binding objectives)

Overall, **217 national CE goals** related to the 2020-2050 period have been recorded. These goals are mostly set by CE policies (e.g., CE strategies, waste prevention/management programmes, etc.) and laws (especially waste laws, even if a few CE laws have also been adopted, e.g., in France and Spain). Other goals are embedded into 'non-CE policies', which can have a cross-cutting nature (like sustainable development strategies or innovation strategies) or can be sector-specific. The latter encompass climate/energy policies and legislation. Some CE goals, e.g., have been shaped by the 2021-2030 NECP of Flanders and by the 2015 French Law on energy transition for green growth.

From this analysis, it becomes clear that, although CE goals are widely used across European countries, different approaches are currently applied with regard to their level of stringency. **A few countries (like France and Spain) rely on CE legislative binding targets,** but overall, there is a **clear prevalence of non-binding objectives over binding targets at country level**.

A high number of CE goals address '**product making**', but also goals for '**reuse, recycling, and recovery**', '**resource efficiency**', and '**waste generation**' are well represented. However, while in '**product making**' the number of binding targets predominates over the non-binding objectives, the relationship is reversed in the '**resource efficiency**' and '**waste generation**' categories. A more balanced situation can be observed in '**waste reuse, recycling, and recovery**' (Table 2.4).

Box 2.1 Limit values for embedded GHG emissions or Life Cycle Emissions

Former EEA reports have shown that the construction sector is crucial for achieving climate targets. Up until recently, circular economy policy instruments mostly focused on the end-of-life phase of buildings to limit or reduce construction waste, such as extended producer responsibility systems (e.g. in France), obligations for material recovery (e.g. in Switzerland after 2027 for tarmac), landfill taxes (e.g. in the Netherlands). However, end-of-life measures only have limited effect on climate mitigation. For example, recycling concrete reduces land use for landfilling and GHG emission by about 5-10 % vis-à-vis ordinary concrete. In contrast, a smart combination of several circular economy actions can lead to a reduction in GHG emissions up to 60 % (Nova Energie and Carbotech, 2021).
The design phase of buildings and embedded environmental impacts in materials are receiving more and more attention. As part of its "Fit-for-55" package, the EU is revising its existing Energy Performance of Buildings Directive (EC, 2021c). The EU Commission's proposal stipulates that member countries must record and limit the GHG emissions of buildings over their entire life cycle. Some countries, like France (Gouvernement de la République française, 2023; République française, 2021) and Denmark (Danish Ministry of the Interior and Housing, 2021), have introduced limit values for either embedded GHG emission or Life Cycle Emissions of buildings, while others are in the process of adopting new legislation. The main idea is to set emission targets per meter squared of a building becoming more stringent over time, incentivizing architects and planners to find suitable solutions to comply. Circular economy as the reuse of building structures or materials, biobased or low-emission materials, low-weight buildings etc. can contribute to achieving those targets. The revision of the EU Construction Products Regulation is an important complementing project (EC, 2022i).

Almost half of the **binding targets** within the '**product making**' category is related to the **ban or reduction of (selected) plastic items** placed on the market or consumed. This is probably driven by the EU legislation on plastic (particularly the Packaging Waste Directive (EU, 1994) and the SUP Directive (EU, 2019). A significant number of countries (10) have also established binding targets for distributors on **reusable/refillable packaging** (including SUP). In the '**consumption**' category, seven countries have adopted **green public procurement (GPP)** targets that are broad in scope or directly CE-specific (Table 2.5).

Moving to **non-binding objectives**, within the '**resource efficiency**' category, ten countries have objectives in place addressing **'resource efficiency', 'resource productivity', 'raw material productivity' or 'material intensity'** and seven have adopted an objective related to the **'circular material use rate'**. On the other hand, in the '**waste generation**' category, nine countries have set objectives to **reduce municipal waste**

generation and six countries to **reduce food waste generation**. In the '**waste disposal**' category, six countries have established objectives to **reduce the landfilling** of **municipal and/or non-hazardous waste**.

Table 2.5 Categories and types of national CE goals, additional to EU ones, for which at least a binding target or non-binding objective has been set by European countries[13]

Category	Type	Total goals	Non-binding Objective	Binding Target
Resource efficiency	Material footprint (RMC)	3	3	0
	Domestic material consumption (DMC)	2	2	0
	Households' material consumption	1	1	0
	Direct material input (or demand) (DMI)	1	1	0
	Resource efficiency, resource productivity, raw mat. productivity or mat. intensity	11	10	1
	Water intensity/efficiency	2	2	0
	Circular material use rate -CMUR	7	7	0
	Decrease in use/replacement of unsustainable resources (fossil, non-renewable, abiotic…)	1	1	0
	Decoupling economic growth (GDP) from waste production	6	5	1
Product making	Ban on products containing microplastics	2	0	2
	Ban/reduction of (selected) plastic items placed on the market or consumed	14	0	14
	Obligation/targets to place on the market reusable packaging (including SUP)	5	2	3
	Targets for distributors on reusable/refillable packaging (including SUP)	10	0	10
	Recyclable plastic/packaging	3	1	2
	Recycled content – General (incorporation of waste in the economy)	1	1	0
	Recycled content - Plastic (in packaging or other items)	2	1	1
	Recycled content - Paper	1	0	1
	Recycled content - C&D waste (or waste fractions) in new construction products or materials	1	1	0
	Eco-design of (new/renovated) buildings	1	1	0
Consumption	Prohibition to destruct unsold products	1	0	1
	GPP targets/obligations (broad in scope or directly CE-specific/relevant)	10	3	7
	Market share of eco-labelled products	1	1	0
	Repair targets for WEEE	1	1	0
	Increase the use of rechargeable batteries	1	1	0
Waste generation	Reduction of waste	3	2	1
	Reduction of municipal/ household waste	10	9	1
	Reduction of biowaste	2	2	0
	Reduction of food losses/waste	7	5	2
	Reduction of WEEE	1	1	0
	Waste generation – Reduction of packaging waste/plastic waste	2	2	0
	Reduction of bulky waste	2	2	0
	Reduction of industrial waste	1	1	0
	Reduction of hazardous waste	2	2	0
Waste collection	Separate collection of glass, plastic, metal, paper	5	4	1
	Separate collection of biowaste	4	2	2
	Separate collection of food waste	2	2	0
	Separate collection of furniture	1	1	0
	Separate collection of bulky waste	1	0	1
	Separate collection of C&D waste	1	1	0

13 figures indicate the number of countries where this is the case

Table 2.5 (continued)

Category	Type	Total goals	Non-binding Objective	Binding Target
Reuse (RU), Recycle (RE), Recovery (RY)	RU - Amount of reused goods (per capita)	1	1	0
	RU - Municipal waste	1	0	1
	RU - Packaging waste	3	1	2
	RU - Plastic waste	1	1	0
	Waste reuse + recycling	2	2	0
	RY+RU of municipal, household waste	3	2	1
	RY+RU of packaging waste (overall and material-specific)	10	5	5
	RU+RY of plastic waste	1	0	1
	RY of non-hazardous waste	1	0	1
	RY of hazardous waste	1	1	0
	RY of metal waste	1	1	0
	RU+RY+RE of C&D waste (or fractions)	4	4	0
	RY and RE of biowaste	4	4	0
	RE - Waste	0	0	0
	RE of ELVs	1	1	0
Waste Disposal	Reduction of waste incineration	1	1	0
	Reduction of incineration of plastic waste	1	1	0
	Reduction of waste landfilled (particularly municipal and non-hazardous waste)	8	6	2
	Reduction of biodegradable municipal waste landfilled	1	1	0
	Landfill ban - Recoverable municipal waste	1	0	1
	Landfill ban - C&D waste	1	0	1
Other	Number of CE-related jobs	1	1	0
	Number of companies with CE practices	1	1	0
	Number of regional strategies incorporating CE aspects	1	1	0
	Targets related to land take	1	1	0
	Targets to reduce littering	2	1	1

Source: ETC/CE (2022) and online updates (as of 31 January 2023)

A significant number of goals are set for '**packaging**' (23 countries with at least 1 binding and 9 countries with only non-binding goals), **'plastic/SUP'** (34 binding and 11 non-binding goals) and '**municipal/household waste**' (6 binding and 19 non-binding goals). Specific goals have been set for other waste streams or value chains such as **food, bio-degradable or green waste** (4 binding and 15 non-binding goals) and **buildings or C&D waste** (1 binding and 7 non-binding goals).[14]

It should be underlined that, as in the 2020 CEAP (European Commission, 2020), **most national CE policies identify sectors and value chains that are responsible for large amounts of GHG emissions** and/or that play a relevant role as **carbon sinks as priorities**: e.g., food & agriculture, forests, construction & buildings, textiles, packaging, and plastics.

Both the ETC/CE 2022 (ETC/CE, 2022) and the previous EEA/ETC 2019 (EEA, 2020c) survey addressed CE elements entering or linked to other policies (including climate policies). By comparing the two surveys, it emerges that **the connection between CE and climate policy has been strengthened** (ETC/CE, 2022). About twenty countries link one or more components of their CE policy (such as the related rationale,

[14] Please note that when a "type" mentions several waste streams/products within its name, it has been double counted. It has also to be underlined that, apart from types explicitly mentioning a certain waste stream, the same waste stream can be addressed by multiple types. For instance, many types which only mention plastic or SUP are also relevant to packaging waste or some types which only mention biodegradable waste are also relevant to municipal waste, etc.

objectives, or lines of actions) to climate policy. This is not surprising, as the EGD has been published in the meantime and several countries have updated/adopted their policies recently. Contributing to climate change mitigation or carbon neutrality is frequently reported as a fundamental goal of CE policies (e.g., by Austria, Finland, Malta, Norway, Portugal, Spain, and Sweden). Furthermore, Luxembourg and the Netherlands have involved climate ministries in aligning national initiatives. Finland has launched a formal low-carbon CE agreement and invited stakeholders from different sectors, companies, regions, and municipalities to join the initiative by making their own commitments. Other countries have promoted synergetic CE/climate innovation. Another interesting new development compared to the previous EEA/ETC survey is that in a few countries (i.e., France and Spain) CE is being implemented with binding targets.

2.3 Climate Policy at EU level

EU Climate Policy initiatives

The EU is committed to driving the transition towards a low carbon CE. Key energy and climate objectives were set in the European Green Deal (EC, 2019); the European Climate Law (EU, 2021); the 'Fit for 55'-Package (EC, 2021a); and the 'REPower EU' Plan (EC, 2022c). The ultimate goal is to balance EU-wide GHG emissions and removals by 2050, thus reducing emissions to net zero by the mid-century in line with the UN Paris Agreement on climate change.

To help the EU reach its 2030 Climate and Energy targets through a common set of planning, reporting and monitoring rules, the Governance Regulation (EU, 2018) was established. The Energy Union Strategy, which forms the backbone of the Governance Regulation, considers five dimensions: decarbonization (GHG emission reductions and removals, and renewable energy); energy efficiency; energy security; internal energy market; and research, innovation and competitiveness.

To reach the climate neutrality goal, intermediate targets were set for 2030, for each of the five dimensions of the Energy Union. Table 2.6 shows more details about these goals related to climate and energy policy initiatives. Targets are regularly evaluated and (upwards) revisions are regularly proposed by the Commission where necessary and feasible.

Role of NECPs and NECPRs, and link with the EEA Database on GHG Policies and Measures

As noted, the Governance Regulation is the core to monitoring and tracking progress towards key climate and energy targets in the EU. This is achieved via multiple fundamental provisions and reporting requirements of the legislation. The reporting on PaMs can be split into two key concepts:

- National Energy and Climate Plans (NECPs),
- Specific reporting on PaMs:
    - Since 2021, Article 18 reporting on GHG PaMs[15] and projections, and
    - Since 2023, National Energy and Climate Progress Reports (NECPRs) – which includes integrated climate and energy reporting on PaMs.

The NECPs are the foundation for EU countries to provide a clear plan for how they intend to meet their climate and energy targets. Therefore NECPs help Member States deliver together on the energy and climate objectives under the **European Green Deal** (EC, 2019), the **European Climate Law** (EU, 2021) and the **Fit for 55 package of proposals** (EC, 2021a). They also play a key role in delivering on the **REPowerEU plan** (EC, 2022c).

[15] According to the Governance Regulation, "Policies and measures" are all instruments which contribute to meeting the objectives of the integrated national energy and climate plans and/or to implement commitments under points (a) and (b) of Article 4(2) of the UNFCCC, which may include those that do not have the limitation and reduction of greenhouse gas emissions or change in the energy system as a primary objective.

Table 2.6 Climate targets and objectives in EU Climate and Energy Policy

Greenhouse gas emissions	
Reference	*Target/objective and deadline **
EU Climate and Energy Package (2007)	Reduce GHG emissions with 20% by 2020)
Revision of the Renewable Energy Directive (COM(2021)557-final (Legislative proposal)	Reduce GHG emissions with 40% by 2030
Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')	**Domestic reduction of at least 55% in economy-wide greenhouse gas emissions as compared to 1990 by 2030** **Binding objective of climate neutrality in the Union by 2050**
Renewable energy	
Reference	*Target/objective and deadline*
EU Climate and Energy Package (2007)	20% share of renewable energy by 2020
Renewable Energy Directive (DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources)	32% share of renewable energy consumed in the EU in 2030 by 2030
Renewable Energy Directive (DIRECTIVE (EU) 2023/2413 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 October 2023 as regards the promotion of the use of energy from renewable sources)	**42.5% share of renewable energy by 2030, aiming for 45%**
Energy efficiency	
Reference	*Target/objective and deadline*
EU Climate and Energy Package (2007)	20% improvement in energy efficiency by 2020
Energy Efficiency Directive (DIRECTIVE (EU) 2018/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 amending Directive 2012/27/EU on energy efficiency)	Improvement of 32,5% by 2030(final and primary energy consumption) (relative to 2007 modelling projections for 2030)
Energy Efficiency Directive (DIRECTIVE (EU) 2023/1791 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 September 2023 on energy efficiency)	**Collective reduction of energy consumption of 11.7% by 2030** (compared to the projections of the EU 2020 Reference Scenario)
Interconnection	
Reference	*Target/objective and deadline*
Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council)	10% interconnectivity by 2020 (10% of electricity produced on the territory of a member state can be transported across borders to neighbouring country)
Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council)	**15% interconnectivity by 2030**
Climate in EU funded programmes	
Reference	*Target/objective and deadline*
EU Budget 2014-2020 (Council Regulation (EU, Euratom) No 1311/2013 of 2 December 2013 laying down the multiannual financial framework for the years 2014-2020)	20% of the 2014-2020 budget
EU Budget 2021-2027 (COUNCIL REGULATION (EU, Euratom) 2020/2093 of 17 December 2020 laying down the multiannual financial framework for the years 2021 to 2027)	**30% of the 2021-2027 budget**

Note: proposed revised targets are in italic

The first draft **NECPs** (2021-2030) had to be submitted to the Commission by the end of 2018, with the final versions by the end of the 2019. Final versions of the NECPs, together with the Commission's individual assessments, were published online in September 2020[16].

By June 2023, Member States were obliged to **update** their national plans for 2021-2030 (draft plans). Final updates are expected by June 2024[17].

National Energy and Climate Plans describe:

- the **process and methodologies** followed for establishing the integrated NECP;
- **national objectives, targets and contributions** in relation to the 5 dimensions of the Energy Union;
- the planned **policies and measures** in relation to the corresponding objectives, targets and contributions, and an overview of the investments needed;
- the **impacts** of the planned policies and measures to meet climate objectives, and the impacts on competitiveness;
- the **current situation** of the five dimensions of the Energy Union, including with regard to the energy system and greenhouse gas emissions and removals;
- regulatory and non-regulatory **barriers** and hurdles, where applicable.

Article 18 reporting on GHG PaMs and projections refers to reporting previously undertaken under the Monitoring Mechanism Regulation (MMR), which required EU countries to report biennially on their GHG PaMs and projected emissions. The purpose of this policy was to align and integrate EU climate reporting to ensure timely, transparent, accurate, consistent, comparable and complete reporting by the Union and the Member States to the UNFCCC Secretariat. These requirements continued under the Governance Regulation in the form of Article 18 reporting, requiring biennial reporting (as of 2021). Countries can further make significant updates in intermediate years. Countries report the **main characteristics of PaMs**, such as their description, objective, instrument type, status, sectors affected, related Union Policy, entities responsible for their implementation, implementation period, etc. Where data is available, reporting is required on the **quantitative information on the GHG emissions savings achieved** of the PaMs, both ex post (retrospectively) and ex ante (anticipated), as well as the projected and realised costs and benefits. Also, non-EU countries like Iceland, Norway and Switzerland report information under Article 18. The last round of data, from 2022, is available publicly in the resulting "EEA Database on GHG Policies and Measures in Europe".

As of 2023, countries are expected to provide NECPRs on the status of implementation of their NECP. Each country must submit these progress reports **every 2 years**, according to the format and process set out in the Implementing Regulation (EU, 2022a). Reporting on PaMs under Article 18 of the Governance Regulation has therefore been integrated with new reporting elements focused on renewable energy, energy efficiency, finance of policies, and policy impacts on air quality. This reporting is therefore referred to as 'integrated climate and energy policies and measures'. The EU27 countries reported for the first time on integrated climate and energy PaMs in March 2023.

The data from this NECPR is submitted to the Reporting platform Reportnet 3.0. It is subsequently processed and compiled by the EEA, together with its European Topic Centre on Climate Change Mitigation and Energy (ETC/CM). This data will subsequently update EEA PaMs related products, including the EEA database on PaMs, referenced above.

In the next section, we verify to what extent GHG PaMs are also addressing CE-related topics. On the one hand, we look for references to climate policies as reported in the CE Country profiles. Conversely, we analyse the EEA Database on GHG policies and measures for CE-related topics.

16 National energy and climate plans (europa.eu)

17 See Article 14 and requirements of Chapter 2 and Annex I of the Governance Regulation.

2.4 CE-related PaMs in national Climate Policies

Linkages between CE-related PaMs and Climate Policies as reported in the CE Country Profiles

In the 2022 'Country profiles on Circular Economy in Europe', each country provides an overview of CE policy elements included in other policies. **Twelve countries report linkages between CE and NECPs or other energy and climate policies** (Table 2.7)[18].

Table 2.7 Countries explicitly reporting in the CE Country Profiles to have included CE policy elements in NECPs or other climate-related policies

Country	*CE Policy Element*	*Included in climate-related policy*
Austria	Development of technologies and processes that close material cycles and thereby reduce the use of primary energy and raw materials. Depolymerisation of hard-to-recycle used plastics.	Integrated National Energy and Climate Plan for Austria 2021-2030
Belgium	Decrease of residual waste incineration.	Flemish Energy and Climate Plan.
Croatia	Establishment of a waste management system; Circular building design, construction and renovation; Recycling of industrial waste; Improving sustainability of urban environments.	Low carbon development strategy of the Republic of Croatia to 2030 with a view on 2050
Finland	A comprehensive foreign policy on the CE as part of its climate and innovation policy will reinforce Finland's role in the international implementation of the SDGs.	Climate and innovation policy
France	Sustainable public procurement; Consumer-product environmental information; establishment of a regulatory framework for carbon compensation and carbon-neutral claims; promotion of bulk selling; advertising regulation.	Climate and Resilience Law
Greece	Making the circular economy a policy priority to attain a reduction in greenhouse gas (GHG) emissions.	National Energy and Climate Plan
Hungary	Elimination and prevention of illegal dumping of waste; Deposit-refund scheme for glass and plastic bottles; Prohibition of single-use plastics.	Climate and Nature Protection Action Plan
Ireland	Awareness raising; GPP; Waste collection and management; Bioeconomy action plan; Food waste separation, collection and treatment; Reduce resource consumption and incentivise reuse and recycling.	Climate Action Plan 2021
Poland	Increase the role of biomass in the energy sector.	Energy Policy of Poland to 2040
Portugal	CE as part of the socio-economic scenarios for the roadmap.	Roadmap for Carbon Neutrality 2050
Slovenia	Decarbonisation through CE.	Strategic project of decarbonisation
Spain	Responsible use of energy resources; promotion of local consumption; adaptation of infrastructure to efficient and circular consumption systems; Reduction of greenhouse gases.	Long-term decarbonisation strategy

Source: CE Country Profiles (2022), own analysis.

Note: countries not explicitly reporting in their CE Country profile on the inclusion of CE in climate and energy policies are: Belgium, Bulgaria, Cyprus, Czechia, Denmark, Estonia, Germany, Italy, Kosovo, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Romania, Slovakia, Sweden, Switzerland, Türkiye.

[18] For comparison: 13 countries reported linkages between CE and energy and climate plans in the EEA (2019) survey "Even more from less"

Many other countries do not mention this link. CE is usually linked to **environmental policies** in general, **waste prevention** and management plans, **raw material strategies**, **sustainable production and consumption** strategies, national **water** plans, **recovery and resilience** plans, **bioeconomy**, **GPP**, **public awareness** campaigns, **innovation** and R&D, etc.

CE-related PaMs in the EEA Database on GHG Policies and Measures

Two versions of the Database on GHG PaMs were analysed for this report. The 2022 database on GHG PaMs consisted of **2,304 records**[19]. The updated 2023 version[20] consisted of **3,232 records**. It was not yet quality checked. The scope of the database is (in both cases) EU27+ Norway, Iceland and Switzerland. The draft 2023 version however lacked information for Poland. Group policies and measures (135 in total) were excluded from the analysis.

We defined a list of **'CE key terms'** (see Annex 4: Key words and corresponding search terms used to select CE related PaMs from the "GHG Policies and Measures"-database) to identify the PaMs which were related to CE. These key terms refer to the five themes in CE Policies at EU level: **production**, **consumption**, **waste management**, the **raw secondary material** market and **innovation** ((Pinyol Alberich et al., 2023). On the other hand, they relate to the general definition of "Circular Economy" (Kirchherr et al., 2017), i.e.: an economic system that is based on **business models** which 'replace the end-of-life concept with **reducing**, alternatively **reusing**, **recycling** and **recovering** materials in **production**/distribution and **consumption** processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish **sustainable development**, which implies creating **environmental quality**, **economic** prosperity and **social equity**, to the benefit of current and future generations'.

Applying a search on the 'Policy names', using these CE key terms, resulted in a reduced dataset counting 554 Policies and Measures for the 2022 version and 593 PaMs for the 2023 update. The most frequently appearing CE key terms were 'Waste', 'Reduce', 'Product' and 'Consumption'. Many of the PaMs in this first selection only had a weak link to the CE concept. Part of them were merely related to Energy Consumption or Supply sectors: demand management or reduction, energy efficiency improvements, renewable energy. Others were related to transport (fuels): low carbon fuels, electric transport, higher vehicle efficiency. These PaMs were therefore left out of the CE-dataset, which reduced the selection further to 338 PaMs for the 2022 version and 308 PaMs for the 2023 update.

Finally, this list was evaluated by an **ETC CE expert** to eventually keep **173 'Circular Economy PaMs' (8 % of the records) from the 2022 version, and 148 CE PaMs (5 % of the total number of records) from the 2023 update.** The resulting list of CE PaMs registered in the EEA Database on GHG Policies and Measures (2022) is added in Annex 5: CE PaMs included in the EEA database on GHG policies and measures in Europe and summarized in Annex 7 – Ex-ante estimation of GHG emission reductions for CE-related PaMs in the EEA GHG PaMs Database.

In order to obtain a comprehensible overview, the CE PaMs were categorized into **types** (46 for the 2022 dataset, and 61 for the 2023 update), and further divided into **8 categories.** The same categories were used as for the analysis of PaMs in the CE Country Profiles (Section 2.1 and 2.2). These categories reflect the CE concept, as they address the whole life cycle of products or materials (i.e., production, consumption, and waste management, including waste collection, material and energy recovery, and disposal). Summarized results for the number of CE PaMs in each category are provided in Table 2.8 and Table 2.9. Types under each category are listed in Table 2.10 and Table 2.11.

19 Status on 09/02/2023 (last update was on 25/10/2022).

20 Status on 24/08/2023

Table 2.8 Classification of CE-related climate change mitigation policies and measures in EU countries (EEA Database on GHG PaMs, 2022)

CE Category	CE PaMs identified (total)	Number with quantified CE-objective*	Number with estimated GHG emissions impact (in 2025, 2030, 2035 and/or 2040**)
Resource efficiency	3	1	0
Product making	37	7	5
Consumption	22	3	5
Waste generation	11	6	2
Waste collection	15	2	3
Waste Reuse, Recycling, Recovery	51	17	12
Waste disposal	22	3	3
Other	12	2	0

*Quantified CE-objectives: aiming for a specific impact on circularity.

**GHG-emissions impact: explicitly indicating the effect on GHG emissions, expressed in kt CO_2eq/year.

Table 2.9 Classification of CE-related climate change mitigation policies and measures in EU countries (EEA Database on GHG PaMs, update 2023)

CE Category	CE PaMs identified (total)	Number with quantified (CE) objective*	Number with estimated GHG emissions impact (in 2025, 2030, 2035 and/or 2040**)
Resource efficiency	3	0	0
Product making	33	8	5
Consumption	13	1	1
Waste generation	7	4	1
Waste collection	14	1	0
Waste Reuse, Recycling, Recovery	48	12	1
Waste disposal	20	5	2
Other	10	4	0

*Quantified CE-objectives: aiming for a specific impact on circularity.

**GHG-emissions impact: explicitly indicating the effect on GHG emissions, expressed in kt CO_2eq/year.

Table 2.10 Classification of CE-related climate change mitigation policies and measures in EU countries (EEA Database on GHG PaMs, 2022)

Category	Type	Total	Number with quantified CE-objective	Number with estimated GHG emissions impact
Resource efficiency	Decrease in use/replacement of unsustainable resources (fossil, non-renewable…)	1	1	0
	Resource efficiency, resource productivity, raw mat. productivity, mat. Intensity	2	0	0
Product making	Livestock and animal feed management	5	1	0
	Local food production	4	1	0
	Nutrient cycle: manage C-sinks in soils	5	2	0
	Nutrient cycle: reduce N-losses	22	3	5
	Recycled content plastic	1	0	0
Consumption	General consumption	3	0	3
	GPP targets/obligations	1	0	0
	Locally produced food	1	0	0
	Market share of eco-labelled products	1	0	0
	Modal shift	7	1	0
	Repair targets	1	1	1
	Shared mobility	8	1	1
Waste generation	Reduction of food waste	4	3	2
	Reduction of plastic waste	2	2	0
	Reduction of solid waste	5	1	0
Waste collection	Extended Producer Responsibility schemes	2	0	0
	Raising public awareness and sorting skills	1	1	0
	Separate collection of biowaste	4	0	1
	Separate collection of non-specified recyclable waste	7	1	1
	Separate collection of textile waste	1	0	0
Waste reuse, recycle and recovery	Compost and biogas recovery	1	1	0
	Packaging waste recycling	4	1	0
	Plastic recycling in construction sector	1	1	0
	Plastic recycling in agricultural sector	1	1	0
	Promote reuse	1	0	0
	Promotion of recycling	2	0	0
	Recovery of organic waste	3	2	2
	Recovery of sludge	1	0	0
	Reduce losses in plastic recycling	1	0	0
	Refrigerating fluids recovery	2	0	0
	Sorting bulky waste	1	0	0
	Tariffs and taxes	3	1	0
	Waste Management Strategy	27	9	8
	Waste preparation for treatment	1	1	1
	WEEE reuse, recovery and recycling	2	0	0
Waste Disposal	Landfill ban on combustible waste	3	0	0
	Reduction of biodegradable municipal waste landfilled	9	2	2
	Reduction of waste incineration	2	0	0
	Reduction of waste landfilled	8	1	1
Other	Awareness campaigns	1	0	0
	CE Roadmap	5	2	0
	Funding/Investment mechanisms	3	0	0
	Mobility programme	1	0	0
	Waste management plan	2	0	0

Table 2.11 Classification of CE-related climate change mitigation policies and measures in EU countries (EEA Database on GHG PaMs, update 2023)

Category	Type	Total	Number with quantified CE-objective	Number with estimated GHG emissions impact
Resource efficiency	Promote resource efficiency	1	0	0
	Resource efficiency, resource productivity, raw material productivity, material intensity	2	0	0
Product making	Circular production processes	1	0	0
	Livestock and animal feed management	2	1	0
	Local food production	7	4	1
	Nutrient cycle: livestock feed management	2	2	2
	Nutrient cycle: manage C-sinks in soils	2	0	0
	Nutrient cycle: reduce nitrogen losses	9	1	2
	Organic food production	1	0	0
	Recycled content - Plastic (in packaging or other items)	1	0	0
	Reduce clinker in cement production	1	0	0
	Sustainable construction	1	0	0
	Sustainable forest management	4	0	0
	Sustainable wood	2	0	0
Consumption	CMUR	1	1	0
	General consumption	1	0	1
	GPP targets/obligations (broad scope or directly CE-specific/relevant)	3	0	0
	Healthy and environment friendly nutrition	4	0	0
	Increase recycled content in construction products	1	0	0
	Restriction on placing certain products on market	1	0	0
	Sustainable construction	2	0	0
Waste generation	Reduction of food waste	3	2	1
	Reduction of plastic waste	1	1	0
	Reduction of solid waste	3	1	0
Waste collection	Biowaste collection	1	0	0
	Extended Producer Responsibility scheme	2	0	0
	Improve waste collection	1	0	0
	Raising public awareness and sorting skills	1	0	0
	Separate collection of biowaste	3	0	0
	Separate collection of non-specified recyclable waste	5	1	0
	Separate collection of textile waste	1	0	0
Waste reuse, recycle, recovery	Biowaste strategy	1	0	0
	Circular Economy Strategy	1	0	0
	Implement low emission waste treatment technologies	1	0	0
	Increase plastics recycling	1	0	0
	Increase recycling	1	1	0
	Packaging waste recycling	2	0	0
	Plastic recycling in construction sector	1	1	0
	Plastic recycling in agricultural sector	1	1	0
	Promote Reuse	1	0	0
	Promotion of recycling	2	0	0
	Recovery of organic waste	4	2	1
	Recovery of sludge	1	0	0
	Reduce food losses	1	1	0
	Reduce losses in plastic recycling	1	0	0
	Refrigerating fluids recovery	1	0	0
	Sorting bulky waste	1	0	0
	Tariffs and taxes	1	0	0
	Waste Management Strategy	21	5	0
	Waste water management	4	1	0
	WEEE reuse, recovery and recycling	1	0	0
Waste disposal	Landfill ban on combustible waste	3	0	0
	Landfill management	1	0	1
	Reduce landfill of waste	1	0	0
	Reduction of biodegradable municipal waste landfilled	7	3	1
	Reduction of waste incineration	2	0	0
	Reduction of waste landfilled (particularly municipal and non-hazardous waste)	3	1	0
	Waste tax	3	1	0
Other	Circular Economy measures	1	0	0

Category	Type	Total	Number with quantified CE-objective	Number with estimated GHG emissions impact
	Circular Economy Strategy	4	1	0
	Funding / Investment Mechanisms	1	0	0
	Sustainable nature management	1	0	0
	Tools for evaluating sustainable construction works	1	1	0
	Waste Management Strategy	2	2	0

For most CE-related PaMs, goals are only expressed in a qualitative way. For a minority of CE-related PaMs, however, quantified goals are reported in the database. These are sometimes expressed in terms of GHG reductions, but not always.

Similar to what was found for the goals in the CE Country profiles, most of the CE PaMs included in the EEA GHG PaMs database (2022) are related to **waste management**. They address topics like waste generation, collection, reuse, recycling, recovery and disposal (incineration or landfilling). Also, in the updated database (2023), numerous PaMs are situated in the waste sector: waste management strategies in general, recycling and landfill management (with a focus on the avoidance of food waste and the landfilling of biodegradable waste).

Some of the PaMs retained in our dataset are not 'core'-CE-measures, but can be considered as closely related to CE. For example, several sustainability measures target agricultural systems and products. Measures to promote **local food production -** in order to shorten supply chains- are popular. Also, livestock feed and manure management can contribute to **lower methane emissions, lower nitrogen emissions or improved carbon storage**. These measures are usually part of a wider strategy to manage and close **nutrient and carbon cycles**, and produce more with less. Reducing nitrogen and carbon losses can for example also include the optimisation of fertilization practices, or even increasing carbon storage by changing soil tillage practices.

Ex-ante and ex post estimation of GHG emission reductions for CE-related PaMs in the EEA Database on GHG PaMs

Further to the analysis of the types of CE PaMs that occurred in the EEA Database, it was also assessed to which extent the impact of these PaMs was calculated. For the 2022 database, ex ante estimations were mapped, and for the 2023 update, also ex post estimations were added to the scope. Quantified estimates of ex ante GHG reductions per year were only reported for **32 (18 %) of the CE-related PaMs,** identified in the studied database (see Annex 7 – Ex-ante estimation of GHG emission reductions for CE-related PaMs in the EEA GHG PaMs Database for details).

Table 2.12 and Table 2.13 give an overview of the **16 countries** where such a calculation was done for the 2022 database, and the type of PaMs that were assessed. It is clear from the analysis that these PaMs are mostly related to waste management, and more in particular, the management of **bio(degradable), organic or food waste**. The climate change mitigation potential of **nutrient cycle management** was calculated in four countries (Germany, Greece, Latvia and Norway). Two countries (Croatia, Germany) also looked into the climate change mitigation potential of a **change in general consumption behaviour**.

From a comparison of the 2022 PaMs assessed above and the more recent 2023 PaMs (Table 2.14 and Table 2.15), **there seems to be a growing variety of PaMs related to product making and consumption**, acknowledging the effect on (non-territorial) GHG emissions. For example, some measures promote local food production and consumption, with attention for the management of emissions related to livestock, carbon sequestration in soils and nutrient cycles in general. Green (public) procurement is promoted, with sustainable construction, using more recycled materials. Remarkably, PaMs related to shared mobility seem to have disappeared in this draft version of the database.

As in the previous version of the database, quantified goals and estimations of the climate change mitigation impact of these measures are scarce. Furthermore, the **methods or models** used by the member states for these ex-ante estimations are **not always documented** in the database. It is thus not clear to what extent calculation methodologies are harmonized. Moreover, it is also not clear if, and to what extent the calculated impacts were also integrated into the NECPs of these countries. Finally, there are no **reference figures** which would allow to assess the relative impact of these PaMs compared to the situation before their implementation. For a more thorough assessment of the potential of CE-related PaMs for climate change mitigation these **gaps must be filled**.

Table 2.12 Countries for which GHG emission reductions (in t CO_2eq/year) of CE-related PaMs were estimated and reported in the EEA GHG PaMs database (2022)

Category	Type of measure	Belgium	Croatia	Czechia	Finland	France	Germany	Greece	Latvia	Lithuania	Luxembourg	Malta	Norway	Poland	Romania	Slovenia	Spain
Product making	Nutrient cycle: reduce nitrogen losses						X	X	X				X				
Consumption	General consumption		X				X										X
	Repair targets									X							
	Shared mobility (car sharing, carpooling)																X
Waste generation	Reduction of food waste						X			X							
Waste collection	Separate collection of biowaste										X						
	Separate collection of non-specified recyclable waste					X											
Waste reuse, recycle, recovery	Recovery of organic waste							X	X								
	Waste Management Strategy	X	X	X	X							X		X	X		X
	Waste preparation for treatment								X								
Waste disposal	Reduction of biodegradable municipal waste landfilled												X			X	
	Reduction of municipal and non-hazardous waste landfilled										X						

Table 2.13 GHG emission reductions (ex ante estimations) for CE related PaMs, as reported in the EEA GHG PaMs database (2022)

Category	Type	Number of PaMs with estimated GHG emissions impact	Country	Quantity of ex ante emission reductions of CE PaMs (kton CO_2eq)	Year
Product making	Nutrient cycle: reduce N-losses	5	DE	880	2030
			GR	750	2030
			GR	200	2030
			LV	66	2030
			NO	10	2030
Consumption	General consumption	3	HR	6366	2030
			HR	26054	2030
			DE	1229	2030
	Repair targets	1	LT	3	2030
	Shared mobility	1	ES	20	2030
Waste generation	Reduction of food waste	2	DE	110	2030
			LT	22	2025
Waste collection	Separate collection of biowaste	1	LU	318	2030
	Separate collection of non-specified recyclable waste	1	FR	4000	2030
Waste reuse, recycle, recovery	Recovery of organic waste	2	EL	1100	2030
			LV	2	2030
	Waste management strategy	8	BE	330	2030
			HR	61898	2030
			CZ	330	2030
			FI	3361	2030
			MT	2873	2030
			PO	3995	2030
			RO	597892	2030
			ES	17251	2030
	Waste preparation for treatment	1	LV	4	2030
Waste disposal	Reduction of biodegradable municipal waste landfilled	2	NO	620	2030
			SI	448	2030
	Reduction of waste landfilled	1	LU	8975	2030

Table 2.14 Countries for which GHG emission reductions (in t CO_2eq/year) of CE-related PaMs were estimated and reported in the EEA GHG PaMs database (Update 2023)

		Ex Ante estimations						*Ex Post Estimations*		
Category	**Type of measure**	**Ireland**	**Finland**	**Germany**	**Greece**	**Latvia**	**Norway**	*Denmark*	*Ireland*	*Norway*
Consumption	General consumption			**X**						
Product making	Local food production					**X**				
	Nutrient cycle: livestock feed management	**X**						X	X	
	Nutrient cycle: reduce nitrogen loss		**X**		**X**					
	Sustainable construction			**X**						
Waste collection	Separate collection of biowaste									
Waste disposal	Landfill management				**X**					
	Reduction of biodegradable waste landfilled						**X**			X
	Reduction of waste landfilled						**X**			X
	Waste tax							X		
Waste generation	Reduction of food waste			**X**						
Waste reuse, recycle, recovery	Promotion of recycling						**X**			X
	Recovery of organic waste					**X**				
	Wastewater management			**X**						

Table 2.15 GHG emission reductions (ex-ante and ex-post estimations) for CE related PaMs, as reported in the EEA GHG PaMs database (Update 2023)

Category	Type	Number with estimated GHG emissions impact	Country	Quantity of ex ante emission reductions of CE PaMs (kton CO_2eq)	Year	Ex post evaluation	Year
Product making	Local food production	1	LV	14,91	2030	NA	-
	Livestock feed management	2	IE	1,25	2030	NA	-
			IE	1,19	2030	NA	-
	Nutrient cycle: reduce nitrogen losses	2	FI	14	2030	NA	-
			EL	200	2030	NA	-
Consumption	General consumption	1	DE	1220	2030	NA	-
Waste generation	Reduction of food waste	1	DE	84,04	2030	NA	-
Waste reuse, Recycle, Recovery	Recovery of organic waste	1	LV	2	2030	NA	-
Waste disposal	Landfill management	1	EL	750	2030	800	2015
	Reduction of biodegradable municipal waste landfilled	1	NO	783	2030	516	2020

2.5 Conclusions

There is an increasing number of countries in Europe with a **national CE strategy or policy** addressing EU ambitions: from 3 countries in 2016 to 24 countries in 2022. Accordingly, increasing number of national CE goals are set, in addition to the EU CE targets and objectives. This suggests that national CE legislation has been pushed by EU initiatives. There is a prevalence of **non-binding objectives** over binding targets for these national CE policies and measures. However, recently some countries, e.g., France and Spain, also put national CE **binding targets** in place.

The **connection between CE and climate policy** has been strengthened. About 20 countries link one or more components of their CE policy (such as the related rationale, objectives or lines of actions) to climate and climate policy. Yet, only five countries explicitly report these linkages between CE policy elements and climate policies in their CE Country Profiles. The contribution to climate change mitigation is frequently mentioned as a fundamental goal of **CE policies**.

Conversely, many **CE-related PaMs** are included in the **PaMs reporting**, as appears from the EEA GHG PaMs database. CE-related PaMs account for 5 % of the total number of policies and measures stored in this database (in 2023, whilst in 2022 it was 8 %). For many of them binding CE-targets and (non-binding) CE-objectives are under development. This is for example the case for resource efficiency policies, initiatives to increase recycled content (for plastics), GPP targets, the promotion of eco-labelled products, repair targets (for WEEE), the reduction of various waste streams, separate collection of selected waste streams, recycling of waste streams (plastics, C&DW), reduction of (biodegradable) waste landfilled.

Overall, the link between CE and climate policies is most often established in waste management plans. **Separate collection of waste streams** often comes up, aiming for more recycling and material recovery. **Landfill bans** mainly target **bio-degradable waste**, to reduce GHG emissions (methane) from disposal sites. The **focus has thus so far been on the end-of-life**. However, reducing greenhouse gas emissions from incineration, applying carbon capture and storage, is not yet on the agenda. Production, consumption and use are life cycles phases which are currently addressed by fewer initiatives (even if relevant measures are being developed, at the EU level, based on the 2020 CEAP; see Table 2.1).

PaMs in the field of **resource efficiency** are less prominent in the GHG PaMs database compared to the national CE-PaMs. Decreasing the use of unsustainable resources or increasing resource efficiency, resource productivity or raw material productivity, are only mentioned three times in the database, whereas in the CE Country Profiles, 34 national goals in this category were found. Probably, this is due to the fact that resource efficiency primarily relates to 'material input', whereas Climate Policies rather address 'GHG output'. Yet, it is clear that reducing material consumption results in a lower demand for (raw) materials and thus in a reduction of GHG emissions related to raw material sourcing and processing. This value chain perspective is therefore also important for climate policies.

A topic which is generally not addressed in CE PaMs, but came forward in the analysis of the GHG PaMs is the food chain: nutrient cycles, local food production, livestock and animal feed management. This again illustrates how CE, climate change mitigation and agriculture policies are intertwined, while the linkages and synergy are not yet fully exploited.

Interestingly, several countries (15) report measures promoting modal shift and **car sharing** – which are examples of 'circular use' – in the GHG PaMs database. Increasing the efficiency of car use and lowering the impact of freight transport indeed often serves both CE and climate goals. However, no CE-goals were found in the CE country profiles for these PaMs.

The GHG emission reductions generated by CE-related PaMs are - up to now – very seldom calculated. We found quantified estimates for various CE-related PaMs in 16 countries in the 2022 version of the database and in seven countries in 2023.

Neither in the CE-plans, nor in the PaMs reporting there seems to be a consistent way of assessing the impacts of CE measures on climate change mitigation. Countries need further guidance and harmonization of calculation models and methods for the assessment of the climate change mitigation potential of CE-related PaMs, so that the knowledge base can be strengthened.

3 Model approaches for calculating the decarbonisation potential of the Circular Economy

3.1 National greenhouse gas footprints

Various approaches for modelling greenhouse gas footprints exist and substantial scientific progress has been made over the past decade. Some tools and databases already provide greenhouse gas footprints for countries (see chapter 5). Calculating the national greenhouse gas footprint is important to establish a benchmark. Eurostat, for example, publishes carbon footprint indicators for the EU member states and the most important EU trading partners. The carbon footprint data is calculated and provided via the so-called FIGARO tables (**F**ull **i**nternational and **g**lobal **a**ccounts for **r**esearch in input-**o**utput Analysis). However, when it comes to calculating effects on a sectoral level and of policy interventions, a more in-depth analysis is needed. Chapter 3.2 offer an overview over the literature and existing assessments as well as the strengths and weaknesses of different approaches.

3.1 Overview of assessments

Approach of the literature review

The literature review has two objectives: First, it aims to provide an overview of studies that examine CE measures and instruments in terms of their contribution to reducing GHG emissions. In that respect, the main questions to be answered are: Which measures and instruments are usually modelled for which sectors or materials? Which GHG emissions are investigated (domestic emissions or the carbon footprint perspective which includes also abroad emissions)? What is the geographical focus of these studies?

Secondly, the studies are evaluated regarding their modelling approach. This will answer the question of which modelling approaches are used to model the potential for reducing GHG emissions through CE measures and instruments. The advantages and disadvantages of the different methodological approaches are assessed and knowledge gaps are identified.

Scientific databases such as google scholar and SCOPUS were consulted with various keyword combinations such as 'circular economy', 'GHG emissions', 'resource efficiency' or 'resource use'. It became clear that the possible selection of literature displayed with these keyword combinations is rather extensive, indicating that the research field of CE has gained significant importance in recent years. Therefore, two criteria were applied in the selection of the studies that were shortlisted for the literature evaluation: 1) it was ensured that quantified results were presented in the study and 2) it was checked whether a modelling approach was chosen that allows quantification of the aggregated (e.g., saving steel consumption in one or more sectors and not only for a specific product) GHG savings potentials of CE measures. Thus, all studies that either did not quantify GHG emission saving potentials through CE measures or studies in which the analysis of decarbonisation potentials through CE measures is based on individual case studies (e.g., only based on individual products, oftentimes used in LCA studies) were excluded. Several meta-overview studies that have not carried out quantitative estimates, were kept on the shortlist, as were several studies suggested by members of the Advisory Board.

A total of 40 studies/reports/publications were screened. In addition to the selection criteria (see above) and the decision not to re-evaluate studies that had already been evaluated in previous meta-studies, another limiting factor was the time available. Therefore, in the end, significantly fewer studies were screened than in other projects such as the Horizon project "Circular Economy Modelling for Climate Change Mitigation (Circomod)"[21]. Of the almost 40 literature entries in the initial list of potential studies to be evaluated, 21 studies were finally evaluated by the project team (see appendix). Around half (12) of

[21] https://circomod.eu/

these studies were published or commissioned by governmental or intergovernmental institutions. Another four studies/reports were published or commissioned by industry associations, NGOs, or think tanks (e.g., Material Economics). Finally, the sample also includes five peer reviewed articles (which sometimes provided the scientific basis for the published report, for instance, the method described by Donati et al. (2020) partly underpins work by Circle Economy (Circle Economy, 2023)).

Overview of the analysed literature

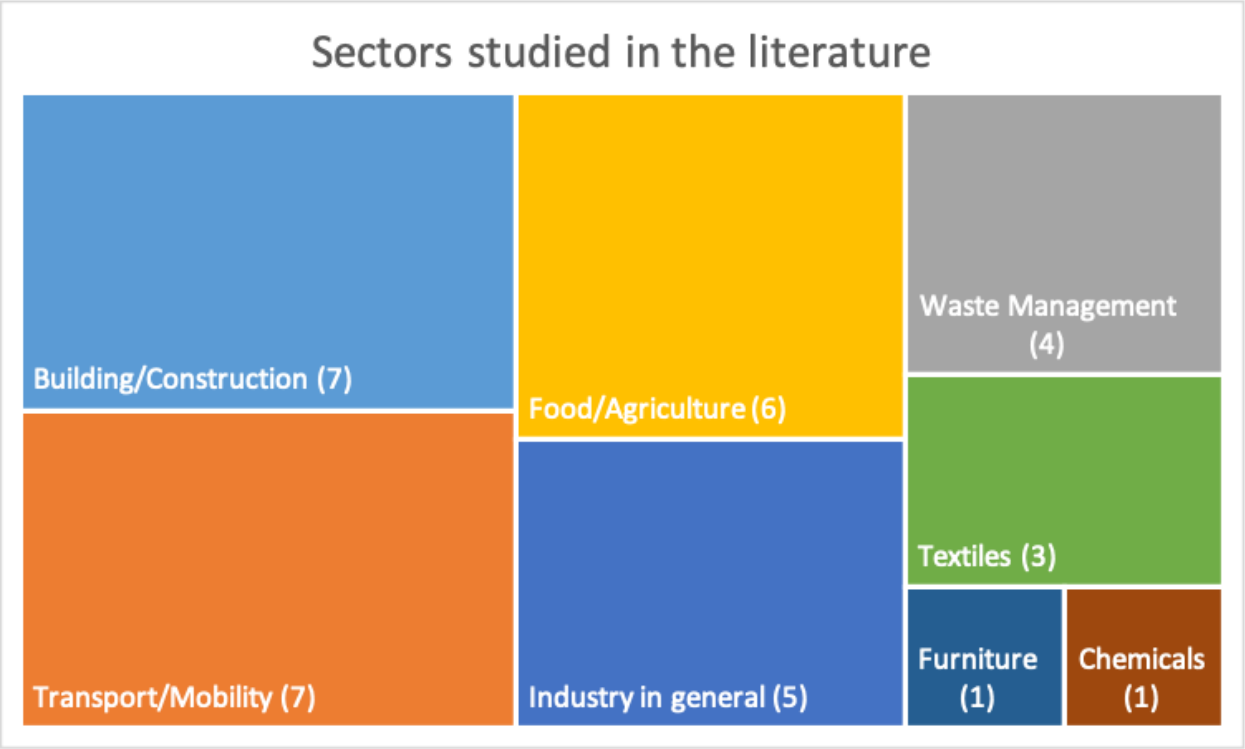
The **geographical scope** of the studies is often linked to the geographical location of the publisher or the client that ordered the studies we had in our small sample. The Public Waste Agency of Flanders (OVAM) is a pioneer in modelling CE measures and their contribution to GHG emission reduction. Accordingly, seven of their studies (Raes et al., 2019, 2018; Borms et al., 2021a, 2021b; Christis and Vercalsteren, 2019; Breemersch et al., 2020; Brusselaers et al., 2021) are included in the literature selection and each of them obviously has the region of Flanders as its geographical scope. Furthermore, five studies in our selection estimate the GHG emission saving potential for the EU (e.g. Ramboll/Fraunhofer ISI/Ecologic, 2020). Studies in our sample published directly by think tanks (e.g. Circle Economy, 2023) usually have a global perspective. Furthermore, we have three studies/articles that estimate GHG emission saving potential through CE measures for Germany (Deloitte/BDI, 2021; Günther et al., 2019; Walz et al., 2019); one study with focus on Switzerland (Wiprächtiger et al., 2023), Chile (Serrano et al., 2021) and one for the National Capital Region in India (Bherwani et al., 2022). Finally, our sample also includes reports by the International Resource Panel (IRP, 2020; Pauliuk and Heeren, 2020), which estimates the potentials for the regions/countries G7, China and India. A larger sample of studies would also have provided a broader geographical coverage. The concentration on only a few countries is due to the selection of the studies and does not mean that there is no experience in other countries with modelling the contribution of a CE to the reduction of GHG emissions (see e.g. the section on the experience in Spain in the next chapter).

In our selection, there are studies that deal with only one GHG emission-relevant sector (e.g., transport, buildings, or textiles). However, most of the literature examines CE measures in different sectors or CE measures that are intended to influence the use/production of different materials. Not all studies in the literature review indicate which CE measures in which sector/for which material contribute to the documented GHG emission saving potential. For example, the RESCUE studies of the German Environment Agency (Günther et al., 2019) or by Walz et al. (2019) only report the total GHG emission savings in different scenarios.

Most studies (16) examine CE measures and their potential to save GHG emissions with a sectoral focus. However, there are also studies that, for example, examine the increase in the share of secondary materials across sectors (Deloitte/BDI, 2021) and then estimate the resulting savings potential of GHG emissions. In total, three studies (Material Economics, 2019; Deloitte/BDI, 2021; ICF/Fraunhofer ISI, 2022) focus directly on specific materials. In two studies, material-specific estimates are made as well as sectoral investigations. For example, in the publication of the Ellen MacArthur Foundation and Material Economics (2019), the data for important materials of the industrial sector (steel, aluminium, plastics and cement) is supplemented by a sectoral approach for the food sector.

Relevant shares of GHG emissions that can be addressed by CE measures arise from the production of energy-intensive materials (cement, aluminium, steel, chemicals). Many studies therefore address CE measures in the production of these materials or in the sectors in which these materials are mainly used. Typically, CE measures then aim to increase the efficiency of the use of carbon-intensive materials (e.g., less production waste) or aim to fundamentally reduce the sectoral demand of carbon-intensive materials through material substitution. Other studies focus on sectors or areas in which product use is associated with high GHG emissions (e.g., buildings/housing or transport/mobility) and are therefore particularly interesting for the evaluation of sufficiency measures such as re-use or sharing (Figure 3.1). Accordingly, these sectors and materials are often the focus of most of the literature that evaluated CE measures and their contribution to reducing GHG emissions.

Figure 3.1 Sectors represented in the literature review



Source: ETC/CE

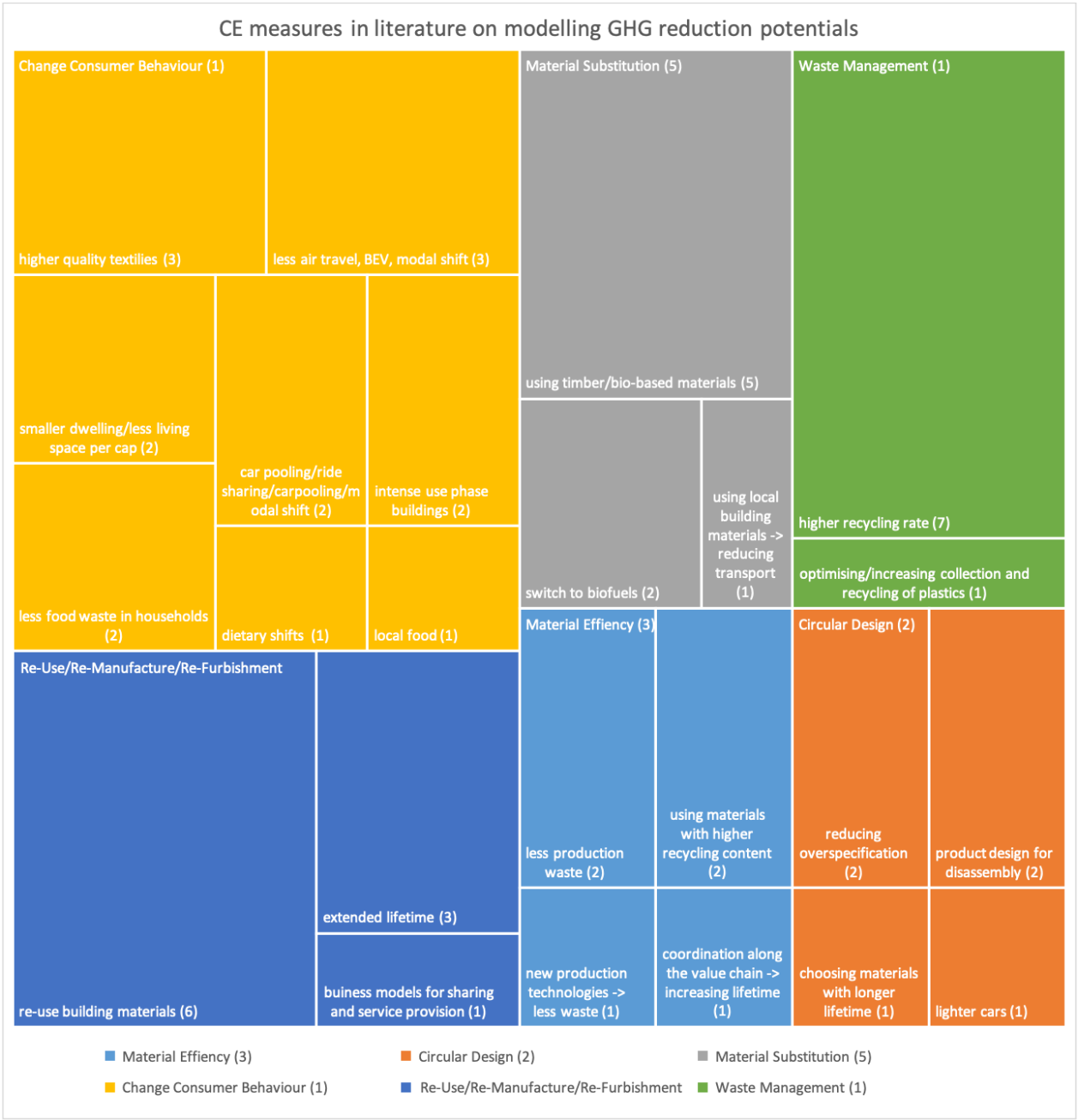
In Figure 3.2 measures mentioned in the examined literature are sorted by category. The number after the upper category, e.g., material efficiency, indicates the number of literature sources without more concrete information on the exact measures with the goal of increasing material efficiency. The number after the specific measure, on the other hand, is the number of studies in which this measure was specifically mentioned or (also) modelled.

A relatively large number of measures can be classified under the heading of changes in consumption or **changes in consumer behaviour** (yellow tiles). However, some of those have only a low frequency of nomination in the 21 literature sources examined. For example, measures such as changes in dietary behaviour or use of local food to minimise distance for transport are only mentioned in the OVAM study on Food and CE (OVAM, 2021) and Circularity Gap Report (Circle Economy, 2023). Other measures in the category 'Changing consumer behaviour' concern measures of changing mobility behaviour by increasing either car sharing or carpooling; i.e., measures that ensure that cars are used more intensively. In some scenarios, measures are modelled that are intended to contribute to the use of less climate-damaging forms of travel (fewer flights) or an acceptance of e-mobility. Other measures concern the building sector and aim at reduced living space per capita, so that smaller buildings can be constructed. A third topic in the field of consumption concerned measures that extend/increase the use and quality of textiles and thus counteract the short use phases (fast fashion).

At the beginning of the value chain of products is the **design phase** (orange tiles). Here as well, various measures are discussed and modelled in the literature where GHG emissions can be reduced. In two studies, these measures were not further specified. In two other studies, the measures referred to the thesis that steel and concrete are currently used for structural elements in buildings beyond what is necessary. This would be, according to the authors of the study, due to exaggerated safety considerations. If this overspecification were reduced, enormous amounts of steel and concrete could be saved, which in turn would lead to high GHG emission savings. In addition, "circular design" that already considers and provides for later disassembly and deconstruction could also contribute to the reduction of GHG emissions. The use of durable materials, on the other hand, should also be considered in the planning

process, because it can extend the useful life of the products. Finally, regarding private mobility, measures for the construction of lighter passenger cars were mentioned, which can reduce GHG emissions during the use phase of the passenger cars.

Figure 3.2 CE measures in literature on modelling GHG reduction potentials, per category



Source: ETC/CE

The **production phase** (light blue tiles) is characterised in the evaluated literature by measures that are intended to increase the material efficiency of production. On the one hand, production technology is either optimised or reinvented in the scenarios, which can reduce the amount of production waste. Another concrete measure depicted in the modelling of the literature evaluated, was the use of materials with a higher proportion of secondary raw materials. The study by Deloitte/BDI (2021) is limited exclusively to this measure, without discussing concrete steps on how this can be achieved. Rather, this study used expert interviews to estimate the potential of secondary material shares for nine different materials and thus estimated the primary material savings for these nine materials and determined their effect on GHG

emissions in Germany via input-output modelling (see next section) if these primary material savings were implemented. Another measure mentioned in a study was the coordination of actors along the entire value chain. The idea behind this measure is that, among other things, through a coordinated (mostly digitalised) system (smart factory), the wear and tear of components can be detected in time and thus the useful life of capital goods can be extended.

At the same time, materials with a high carbon footprint can not only be used more efficiently in production, but can also be replaced by other materials, such as renewable raw materials (grey tiles). **Material substitution** is mentioned very generally in five studies without further differentiating the term. However, one example that was frequently mentioned (in five studies) is the use of wood or other renewable raw materials in the building industry. Whether as construction or insulation material, through this substitution raw materials with a high carbon footprint such as cement, concrete or bricks or also insulation material made of mineral wool or plastics can be replaced. Two studies also modelled the substitution of energy sources away from fossil fuels towards biogas or similar, and one study modelled the use of locally/regionally available (construction) raw materials to reduce transport costs.

Upstream R-strategies like reuse, remanufacturing and refurbishing (dark blue tiles) have been identified and modelled in the literature as measures for reducing the use of new primary materials and thus contributing to the reduction of GHGs. More in particular, measures for the reuse of components or the extension of the useful life through the reprocessing of consumer and capital goods are mentioned here.

Finally, **waste management** (green tiles) measures are modelled in the literature. In the first instance, however, the concrete approach is limited to increasing the recycling rate. However, this measure is considered as a CE measure in as many as one third of all the studies examined. In part, this higher recycling rate is also translated into a higher recycled material use rate, where technical limits of recycled material use of the different materials are used as a potential of primary material saving via literature research. Subsequently, the difference in the carbon footprint of one unit of secondary and primary material is used as an indicator of the contribution of waste management to the reduction of GHG emissions. How the recycling rates can be achieved to reach these rates or whether there is enough recyclate available is not addressed in the studies but is assumed to be exogenous. It is also not analysed (at least in the studies examined) whether reaching the technical limits makes sense from an ecological point of view. For this purpose, the use of consequential LCA methods would be necessary to determine whether it makes ecological sense to raise the last 5-10 % of the technically possible quotas or whether this is only feasible, for example, with an enormous input of energy that cancels out the GHG savings effects of the use of secondary materials. In another study, a distinction was made between different waste streams (less food waste in households as part of the changing consumer behaviour category of measures and optimising the collection and processing of plastic waste). One study (Wiprächtiger et al., 2023) mentioned carbon capture and storage of waste incineration as an important measure complementing other measures at the end of waste hierarchy.

Which of the various CE measures will have the greatest impact in the individual studies depends heavily on the study design and the assumptions made in the scenarios. However, it can be summarized that in the analysed set of studies policy measures most often mentioned as having a significant potential for the reduction of greenhouse gas emissions are in the areas housing and construction (i.a. floor space per capita, sufficient design, reduction and substitution of high impact products), mobility (i.a. car sharing), nutrition (i.a. food waste and diets). So far, in the analysed studies, effects on territorial and emissions abroad have not been presented separately. It would be important that study designs allow for this distinction in the future.

3.2 Evaluation of modelling approaches

In the 21 studies and reports that were analysed, different modelling approaches can be identified. The procedure is usually the following: at the beginning specific measures are defined and their influence on the current situation is estimated. This is usually done through literature evaluations and expert interviews, which are then translated into scenarios, for example to estimate the influence or potential that the implementation of a measure (such as the re-use of building materials) could have on the demand of building materials. On this basis, change in the future demand of primary materials can be estimated. Life cycle assessment (LCA) methods can be used to calculate the emissions factors also for other approached. The research design may differ in the further procedure: either input-output (IO) analyses can be used to estimate the effect of CE measures on total emissions, or bottom-up data can be combined with life cycle assessment (LCA) data. Other possibilities are large economic models or dynamic stock and flow models. All types of modelling have their justification and offer various advantages and at the same time have disadvantages that must be considered when choosing a method.

Bottom-up approaches Using LCA

Studies that remain in the world of bottom-up analysis can calculate the effects of material changes on the development of GHG emissions very well by linking them to LCA data. Examples for bottom-up national GHG footprints are Matasci et al. (2021), Frischknecht et al. (2018) and Corrado et al. (2019). The advantages of this approach are that the calculation and interpretation of results is rather straight forward. The use of bottom-up approaches can be well adapted to the country-specific data situation and the instruments and measures can be modelled very concretely. In addition, the LCA data can be adapted very well to country-specific aspects (e.g. energy mix) and there are extensive databases that can be used (EcoInvent[22], Umberto[23] etc.), some of which are also available free of charge (Ökobaudat[24] in Germany, for example).

For the EU-27 and individual EU member states, the European Commission regularly reports the Consumption Footprint (Sala et al., 2019b; Sala and Sanye, 2022). The Consumption Footprint is a bottom-up approach that quantifies the environmental impacts of a basket of representative products (food, mobility, housing, household appliances, and household goods) using official consumption statistics and LCA calculations. By adjusting life-cycle inventory data in the foreground (i.e., the choice of products consumed) and background system (e.g., choice of the underlying energy mix, overall production efficiencies, or recycling rates), it is possible to assess the benefits and trade-offs of (CE) changes on the environmental impacts related to 16 impact categories[25] as well as a single consumption footprint score. For example, the EU has recently tested the influence of policy options regarding eco-innovations and changes in consumption patterns on the consumption footprint indicator in the context of the Zero Pollution Outlook 2022 (EC, 2022k).

However, the straight-forward approach is also the limitation of the bottom-up approach: only the direct effects of the measures and instruments are modelled. Possible rebound effects or limiting or reinforcing effects cannot be considered. It is also questionable whether the results of different individual observations (e.g. if different measures are modelled) can simply be added together.

22 https://ecoinvent.org/

23 https://www.ifu.com/umberto/lca-software

24 https://www.oekobaudat.de/

25 Climate change (CC); ozone depletion (ODP); human toxicity, non-cancer (HTOX_nc); human toxicity, cancer (HTOX_c); particulate matter (PM); ionizing radiation (IR), human health (IR); photochemical ozone formation, human health (POF); acidification (AC); eutrophication, terrestrial (TEU); eutrophication, freshwater (FEU); eutrophication, marine (MEU); ecotoxicity, freshwater (ECOTOX); land use (LU); water use (WU); resource use, fossils (FRD); and resource use, minerals and metals (MRD) (Sala and Sanye, 2022).

Table 3.1 Overview of bottom-up/LCA models

Bottom up/LCA models	
Characteristics	• Models specific measures and instruments
Incorporation of CE measures	• Measures can be modelled individually • By linking to LCA data, these measures can be linked to environmental impacts • Upscaling is possible either through scenarios or in combination with other modelling approaches
Strengths	• A large number of different instruments and measures can be modelled and their effectiveness assessed • Simple straight-forward approach that quickly provides initial estimates • Modelling can be adapted to country-specific data availability • Established LCA databases are available, some of them free of charge
Weaknesses	• Measures are modelled in isolation: Interlinkages or rebound effects cannot be modelled in this way • Economic effects (employment, prices, structural change) of implementing the measure cannot be modelled • Interdependencies between different measures cannot be mapped

Environmentally Extended Input-Output Models

Standard input-output modelling applies potential changes in the form of 'what if' scenarios to today's economic structure, which is represented by an IO table. However, future changes in the economic structure or even future growth cannot easily be depicted in static input-output tables. The change in demand in physical quantities from the bottom-up perspective must also be converted into a monetary value so that monetary input-output models can be used. This is usually done by analogously transferring percentage changes in physical quantities to monetary quantities. However, IO models are very well suited to represent the potentials of the modelled measures in the form of GHG emission savings potentials through their extension with ecological indicators. In this context, input-output models also allow a distinction to be made as to where savings take place: domestically and/or in the countries of origin of the raw materials/products.

The environmentally extended input-output (EEIO) models and analysis as a top-down methodology are a common method to assess climate change impacts resulting from consumption activities (Han et al., 2022). The EEIO models show how production and imports of goods and services in an economy are used by economic sector and how they are sold to others or to final demand. An analysis of the model allows to describe globally dispersed production networks. Extending these monetary models with environmental data, allows to link emission data across the networks to final demand. For example, it allows to link emission data from agriculture, the food industries, transport, and retail sector to the final demand of food products, to estimate the carbon footprint of these products (Schepelmann et al., 2020).

The model consistently links economic data for the global economy to associated environmental data. As a result, it makes it possible to map and analyse in detail the impact of production and consumption activities and patterns on the environment and the economy throughout the entire value chain. It can provide an answer to questions such as: "Which economic sectors and which consumption behaviour cause the most environmental pressure?", "Where does this environmental pressure arise: in which sector and in which country?" or "Where in the chain is added value created, and how does this relate to the associated environmental impacts?".

The calculation and analyses of the (carbon) footprint of consumption is based on the static structure presented by EEIO models. Next, small changes can be applied to these models to estimate the effect thereof on the footprint. Examples of such changes are the introduction of CE-policy measures to certain sectors and the introduction of technical changes to the production recipe of economic sectors. However, often a preliminary study is needed to model the specific scenarios.

The **advantages** of EEIO models are their transparent structure linked to many different official statistics. EEIO analysis using multiregional models covers complete globally extended production networks. Multiple MRIO models exist and each has different strengths and limitations related to factors such as the extent of the use of official statistics, the range of available environmental extensions and the level of disaggregation. An example of such multiregional model is the 'Full international and global accounts for research in input-output analysis' (FIGARO) tables developed by Eurostat. Others are GLORIA, the OECD ICIO database, World Input-Output Database WIOD, GTAP, Exiobase, see www.environmentalfootprints.org/databases/ for descriptions and documentation). The choice of the most appropriate model is strongly related to the aims and scope of the analysis. Not all databeses cover all GHG emissions at the moment, some only CO_2 (OECD, Figaro). The quality of results can be improved by combining environmentally extended national IOT with MRIOT. Due to its structure, these models allow to put a territorial perspective next to a consumption (global) perspective: it shows the overlap and the difference between both perspectives.

The **limitations** regarding EEIO models are mostly linked to the limited details provided by the existing models. As a macro-economic model, the level of detail is limited to the disaggregation of sectors and countries and the availability of environmental impacts. Others are GLORIA, the OECD ICIO database, World Input-Output Database WIOD, GTAP, Exiobase[26]. The choice of the most appropriate model is strongly related to the aims and scope of the analysis. Not all databases cover all GHG emissions at the moment, some only CO_2 (OECD, Figaro). The quality of results can be improved by combining environmentally extended national IOT with MRIOT. Also, the representation by monetary flows between sectors and other economic actors can be affected by changes and fluctuations in prices.

Table 3.2 Overview of environmentally extended input-output (EEIO) models

Input-output models	
Characteristics	• Consider the entire economy of a country or region
Incorporation of CE measures	• Splitting off CE sectors (e.g. repair or recycle sector) • Incorporating environmental and climate indicators • Introducing CE policy measures and/or business models for certain sectors • Introducing technological shocks associated with a CE transition
Strengths	• Economy-wide modelling of impacts on macro-economic indicators (employment, GDP, economic activity, trade balance, climate impacts, environmental impacts, etc.) • Transparent model (direct and indirect impacts are visible) • Captures complete value chain networks
Weaknesses	• Monetary-based models → no material or product flows • Unless based on a combination of national IOT with MRIOT, results on a sectoral level have to be interpreted with caution • Static model, i.e. a picture of the economy at a moment in time

The Eurostat FIGARO database provides detailed modelling estimates of carbon dioxide (CO_2) 'embodied' in products (goods and services) for final demand ('footprints') for 46 geographical entities (including all EU countries), 65 economic activities (nace_r2), and 5 categories of final consumption during the time period 2010-2020 (Eurostat, 2023a). Given that the accounts are provided by Eurostat and continuously updated, the Figaro carbon footprints may provide a feasible source for doing first hot-spot analysis of economic activities with high CO_2 emissions for EEA member countries. Furthermore, other resource/environmental footprints such as for air emissions, energy use, raw materials, and land are being derived and the latest progress discussed in the Eurostat working group document on consumption based accounts and derived footprint type indicators (Eurostat, 2023b).

[26] see www.environmentalfootprints.org/databases/ for descriptions and documentation

An example of analysing the effect of CE-scenarios on climate change is the RaMa-Scene web-based tool (Donati et al., 2020). The online tool allows to implement CE-scenarios and efficiency improvements and to visualize the resulting change in greenhouse gas emissions. Another example is the RESCUE study (Günther et al., 2019). The RESCUE study describes in six scenarios possible development paths towards a resource-efficient and GHG neutral Germany until 2050. The calculation model behind both examples are EEIO-models.

Dynamic Stock-Flow-Models with Environmental Extensions

An example of a dynamic material stocks and flow (MFA) model is the open dynamic material system model (ODYM) for resource efficiency and climate change mitigation (RECC). ODYM-RECC is an open-source MFA model that incorporates major end-use sectors and material cycles for a range of climate-relevant bulk materials (e.g., cement, iron, copper, and aluminium) (Pauliuk and Heeren, 2020; Pauliuk et al., 2021). The model's system definition includes the different life-cycle phases of a material including mining, primary production, manufacturing, the use phase (in products), and end-of-life management. ODYM-RECC links future material demands for physical services such as housing and transport to climate change via environmental extensions of the processes included in the model. Resource and material efficiency strategies can be looked at such as, e.g. more intense product use, lifetime extension, re-use, and vehicle light-weighting (Pauliuk and Heeren, 2020). The model is at the centre of the report by the International Resource Panel entitled "Resource Efficiency and Climate Change" and has been applied to the G7 countries (IRP, 2020). Compared to other modelling approaches, dynamic material flow and stock models have the advantages that they allow a detailed bottom-up estimation of the anticipated changes in material flows/stocks associated with CE changes for selected sectors (e.g., transport and housing). However, these models generally do not capture the whole economy such as EEIO-models and direct and indirect impacts on other sectors may therefore not be captured. Nevertheless, ODYM-RECC is fully open access which would allow future adaptation to other sectors, countries, and regions including a detailed examination of individual CE policy measures. Further details on advantages and disadvantages of this modelling approach are given in Table Table 3.3.

Table 3.3 Overview of dynamic stock/flow models with environmental extensions

Dynamic Stock/Flow Models with environmental extensions	
Characteristics	• Focus often on specific sectors or materials
Incorporation of CE measures	• Effects of various CE measures on the change in demand for materials estimated in scenarios • Dynamic Stock Models also taken the material stocks into consideration, relevant for some CE measures (e.g. lifetime extension) • Changes in material flow systems are translated into changes in GHG emissions with LCA data • For upscaling the effects: often combining with IOT or other macroeconomic models
Strengths	• Disaggregated, allowing to model the impact of a large number of CE measures can be modelled • Transparent model/scenarios, results can be well communicated • Data requirements are lower, modelling is easier than computable general equilibrium models
Weaknesses	• Impacts on other economic sectors or indicators not always captured (only in hybrid models) • No rebound effects or spill over-effects are part of the results • Economic shocks, e.g. lack of labour, price changes, cannot be mapped.

Computable general equilibrium models (CGE)

Computable general equilibrium (CGE) models are large macroeconomic simulation models that rely on a set of input-output (IO) accounts, i.e., a social accounting matrix (SAM), for their calibration. However, compared to IO models, CGE models can provide a better picture of economic interactions as they have a more flexible structure, making them more suited for long-term analyses where, for instance, shifts in technology occur (Conrad and Schmidt, 2000; Koks et al., 2016; Piermartini and Teh, 2005). The behavioural assumptions underlying CGE models differ from IO models as the former cover both the supply

and demand side of the economy and can thus consider price effects. On the other hand, IO models focus only on the demand side and have a simpler, linear mathematical setup. By combining the initial model data from the SAM with economic equations grounded in Walrasian equilibrium theory that describes agents' behaviour, CGE models can assess the effects of policy changes for economic as well as environmental and climate indicators. The CGE model equations imply that supply and demand are equal for all the goods, services, and factors covered (Burfisher, 2017; Wing, 2004). The downsides of CGE models are that (1) they are often considered as 'black boxes' due to the complexity regarding the forces that drive the results, (2) they can face empirical concerns for their operationalisation (e.g. lacking data for parameter specification), and (3) their development requires a considerable investment in terms of human capital (Mikic and Gilbert, 2009; Piermartini and Teh, 2005; West, 1995).

In the context of CE and climate change, CGE models have been used due to their ability to capture economy-wide impacts. However, the focus of most existing studies is limited to recycling and resource efficiency, for instance, as in Bohringer & Rutherford (2015) or Winning et al. (2017). CGE studies that examine CE strategies that have a higher potential or priority in the waste hierarchy (e.g., product-lifetime extension) are rather scarce at present. Several reasons can be found for this. For example, disaggregating certain CE activities is not always possible in macroeconomic models, which often consider the sectoral rather than the product/material level. Also, the implementation of well-targeted CE policies that capture strategies that are more efficient than recycling can be difficult. Brusselaers et al. (2021) assess the impact of fiscal policies targeting repair activities of household appliances in Belgium using a CGE model. They find that expansionary policies are more effective for stimulating circular (repair) activities while restrictive policies are better suited for discouraging linear activities. Moreover, they observed an increase in CO_2 emissions from a territorial perspective due to the CE policies, but a decrease in emissions from a consumption perspective.

CGE models, as the one used by Brusselaers et al. (2021), usually rely on conventional economic classification codes for model calibration. These codes generally do not provide a sufficient level of detail in order to split off more efficient CE activities or the codes simply do not capture these CE activities (yet). As a result, the more promising CE strategies remain understudied in quantitative macroeconomic research. Lahcen et al. (2022) developed a supply chain equilibrium (SCE) model based on a dual approach of material and economic efficiency, allowing the assessment of CE policies and practices aimed at material efficiency gains while considering the market interactions that govern the allocation of resources along a supply chain. The SCE model used to a Belgian case study of single-use bottles and a hypothetical reusable plastic bottle initiative and incorporates CE strategies such as reduce, reuse, prolonged use, and recycle. The results show that the more conventional CE policies that focus on waste management, such as a recycled content standard or waste tax – as currently proposed by the European Commission – are not very effective at reducing material use. The authors propose a more systematic approach whereby the whole life cycle of materials and products is considered, and suggest that coordinating CE policies along the supply chain can bring about synergies. While not assessed in this case study, the developed SCE modelallows integrating LCA indicators in order to also examine the environmental and climate impact of CE policy measures along the supply chain. The downside of this modelling approach is that it does not consider the economy as a whole and thus rebound effects that go beyond the markets that are modelled are not captured. OECD ENV-LINKAGES is a dynamic economic neo-classical CGE model developed by the Organization for Economic Cooperation and Development (OECD). The model has been augmented to include a wide range of material flows (in addition to $C0_2$-emissions) and is used in the OECD Materials Outlook to generate a global outlook to 2060 for future materials use at the sectoral and regional level for 61 different materials (OECD, 2019).

Table 3.4 Overview of CGE models

CGE models	
Characteristics	• Consider the entire economy of a country or region
Incorporation of CE measures	• Splitting off CE sectors (e.g. repair or recycle sector) • Incorporating environmental and climate indicators • Introducing CE policy measures and/or business models for certain sectors • Introducing technological shocks associated with a CE transition
Strengths	• Economy-wide modelling of impacts on macro-economic indicators (employment, GDP, economic activity, trade balance, climate impacts, etc.) • Account for technological shifts (without a detailed specification of the technologies involved) • Capture spill-over and interaction effects between sectors, and provide insights into rebound effects
Weaknesses	• Monetary-based models → no material or product flows • High level of aggregation → no sectoral level details • Data requirements are high and human capital investment for developing such models are high • Black box critique

Combined and Hybrid methods

A number of hybrid approaches exist in which different modelling and estimation approaches are combined to derive figures for the GHG-emissions potential savings of CE measures. For example, a case-study by (Serrano et al., 2021) for Chile combines IPCC/UNFCCC activity/sectoral classifications and scenarios with GHG reduction potentials from a broad literature review for each activity (e.g., mining, residential, electricity generation, etc.). The proposed sector-specific CE measures were found to potentially reduce by 37% the GHG emissions in 2030 compared to BAU levels, thus putting the country on track to fulfil its nationally determined contributions (NDC) commitments. Advantages of the study include the direct connection to IPCC categories and scenarios. However, results represent first estimates, as the study relies on approximate GHG savings estimates from a literature review.

A study by the Joint Research Centre (JRC) on the environmental impacts of EU production and consumption (Sala et al., 2019a) has combined LCA with IOT analysis. Also, Nathani et al. (2022) combined an environmentally extended national IOT with trade data and LCA data. Another hybrid approach to link national IOT with either emission factors or with Multiregional Input-Output-Tables GLORIA, as used by the Swiss Federal Statistical Office (FSO).

Wiprächtiger et al. (2023) show, that the application of IO analysis to a nation allows an overview of sectoral hot spots in an economy. However, for an in-depth understanding of relevant flows, processes, and their environmental impacts, the additional application of MFA and LCA are important. Input-Output analyses are often not resolved enough to cover individual products; hence the combination with MFA/LCA allows the flows to be modelled more accurately. Combining the methodologies allows for identifying the most relevant sectors, analysing these in-depth, designing and assessing relevant CE scenarios and comparing the scenarios across different sectors. The analysis considers that also in the future, incineration of remaining waste will be necessary and thus carbon capture and storage (CCS) needed. Results highlight an environmental impact mitigation potential of around 11.9 Mt CO_2eq for the year 2050, which equals approximately 14 % of the current consumption-based and 22 % of the current production-based climate change impacts of Switzerland.

3.3 Conclusion

Many studies evaluate and quantify various concrete CE measures with regard to their effect on the reduction of GHG emissions. For this purpose, scenarios are usually developed to estimate the individual effects of the measures using various assumptions or target values. These can either be derived from targets to be achieved by a certain period (e.g., 50 % less meat consumption by 2030) or potentials are estimated that are achievable according to literature research and/or expert interviews (e.g., 36-46 % less steel use in the construction sector by avoiding over-specification in the design phase). Subsequently, the impact of the implementation of the measures is converted into a potential saving of greenhouse gas emissions. Various approaches are available for this purpose.

When choosing which modelling approach to select, in addition to a general preference for individual approaches (e.g. because there is already corresponding expertise here), a thematic approach to the questions that are to be answered with the modelling can also be considered. If, for example, dynamic, time-lagged macroeconomic effects are to be modelled, this can almost only be done well with complex CGE models. At the same time, however, CE measures can only be considered in CGE models on a highly aggregated scale. It is often very difficult to translate concrete CE measures in such a way that they can be analysed in CGE models.

Table 3.5 Overview of opportunities and limitations of models

	EEIO	Dynamic Stock Flow Models	CGE	Bottom-up Models
Disaggregation of the measures	depending on the detail of the IOT	very disaggregated	depending on the CGE model, but generally limited	very disaggregated
Transparency of the modelling approach	good, if the IOTs used are available (e.g. Exiobase)	good, if the model used is available (e.g. ODYM)	difficult	good
direct modelling	No, transforming in monetary flows necessary	yes	No, transforming in monetary flows necessary	yes
depict macroeconomic effects (employment, prices, etc.)	partly	partly	yes	no
Complexity of modelling/expert knowledge necessary	medium, knowledge in input-output modelling necessary	medium, knowledge of Python programming necessary if ODYM is to be used	Very complex and elaborate, only a few experts available	Relatively simple, knowledge of LCA necessary
Differentiation according to territorial effect of GHG emission saving	yes	No (additional analysis necessary)	yes	no (generally possible, but additional analysis necessary)

In **bottom-up assessments**, the individual contributions of the measures to the reduction of greenhouse gases are usually calculated with the help of LCA data. For example, in the case of a 50 % reduction in meat consumption, different weightings of the different types of meat with their different carbon footprints could be considered. Such basic 'what-if' scenarios for individual measures can be easily calculated with

the help of Excel and existing LCA software. They are useful if only the isolated contribution of a measure to the reduction of GHG emissions is to be estimated without, for example, considering the impact of this measure on other sectors or other effects of such a measure. In our example, such effects would be e.g., possible job losses in the meat processing industry or also in the upstream value chain, if 50 % less meat consumption also means less feed is needed.

If these upstream and downstream effects are to be considered with regard to demand, the results of the scenarios should be modelled with **environmentally extended input-output (EEIO) models**. The sectoral interdependency of an economy, which is embedded in the input-output model, ensures that modelling a CE measure as a change in one or more sectors entails changes in all sectors which are related with these sectors. However, input-output models are predominantly monetary models: a 50% reduction in meat consumption would therefore first have to be translated into a monetary quantity. Moreover, IO models represent the current status of the economy. Scenarios for 2030 or 2045 cannot really be depicted with EEIO models. Rather, the consequences of a future measure are depicted based on today's economic structure. The advantage over simple bottom-up modelling, however, is that EEIO modelling makes it very clear where possible greenhouse gas reductions are taking place (nationally, internationally, in which sectors). EEIO models are particularly suitable modelling tools if, on the one hand, the sectoral differentiation of the input-output structure is sufficiently high to be able to depict the change induced by the CE measure with sufficient accuracy. In addition, the effect triggered by a CE measure must also be translatable into a monetary change. Due to their static nature, however, EEIO (as well as bottom-up modelling) are not suitable for estimating the impact of possible rebound effects or other trade-offs. Moreover, capacity bottlenecks and the price changes derived from them, which can act as a supporting or restraining factor, do not play a role in IO models.

Macroeconomic equilibrium models such as CGE models have the advantage of being able to solve many of the disadvantages of the other modelling approaches described so far. However, it is often not possible to prepare very specific CE measures in such a way that they can be adapted as exogenous factor within the more aggregated economic structure of CGE models. Moreover, how these measures translate into different changes within a macroeconomic equilibrium is not comprehensible to non-experts. The complexity of CGE models can also require an enormous amount of time to model a set of CE measures. As a result, there are only a few providers of CGE models that can be used for environmental economic calculations in the context of the CE at present, especially when looking at CE measures beyond recycling. On the other hand, CGE models allow for a comprehensive evaluation of measures that also includes other economic indicators such as job effects or the impact on GDP. If CE measures are to be assessed not only in terms of their effectiveness in reducing GHG emissions, but also in terms of other macroeconomic indicators or their social impacts, macroeconomic equilibrium models are recommended.

Dynamic Flow-Stock models are more complex than simple bottom-up "what-if" scenarios, but still bottom-up approaches based on MFA (Material Flow Analysis). Dynamic Flow-Stock models are well suited to represent entire material flow systems and therefore well suited to represent material-specific impacts of different CE measures. They represent the different life cycle phases of products and can also anticipate dynamic changes over time by considering the use phases. This is its great advantage over EEIO models. With the ODYM model approach, an open-source software package is available that can be freely used and adapted. However, knowledge of the Python programming language is necessary. As with simple bottom-up scenarios, dynamic flow stock models do not represent the entire economy but only the sectors that function as producers or consumers in the usually material-oriented models.

Most of the studies examined have estimated the reduction of GHG emissions that can be achieved through the implementation of CE measures as GHG footprint emissions. Thus, the studies were mainly interested in the potentials of the overall reduction, regardless of where in the value chain these emissions can be saved. If these potentials are determined via input-output models, however, the distinction between whether these savings take place within domestic linkages or result from imports is readily comprehensible. The differentiation according to territorial effect of GHG emission saving is in general

possible with LCA. However, it is so far not implemented and would have to be integrated in future study designs. With a few exceptions (Ramboll, Serrano), the studies do not prepare their results of the GHG savings potentials according to the IPCC categories or distinguish between sectors that are part of the ETS or not. With an additional analysis step, however, it should be possible to allocate many studies according to the IPCC categories or to distinguish between domestic emissions and emissions that can be saved abroad.

Box 3.1 Overview of climate mitigation potential of circular economy

Despite the differences in scope, methods, and assumptions, the literature reviewed demonstrates that CE holds a key role for climate mitigation and for the EU to reach its climate mitigation targets. Material economics (2018) shows that CE actions can make deep cuts to emissions **from heavy industry** - up to 56% reduction or 296 Mt CO_2eq per year in the EU by 2050. Ramboll/Fraunhofer ISI/Ecologic (2020) show that a combination of eight selected circular economy actions, could save up to 60 % of the CO_2eq emissions related to **construction, maintenance and demolition of buildings** (excluding the infrastructure and energy consumption during the use of buildings) could be avoided in the EU compared to a baseline scenario (2020), or an absolute reduction of 130 Mt of CO_2eq in 2050. Kennedy et al. (2022) studied the potential for emissions reduction in the **food- and agriculture sector** and found that CE actions (incl. regenerative agriculture) could save 2/3 of current emissions from this sector. If we zoom out on a **global scale**, Ellen MacArthur Foundation (2019) found that 45 % of reaching the net-zero target will come from CE-related activities (the rest from energy-related activities). By concentrating on five key areas (cement, plastics, steel, aluminium, and food) CE measures can reduce global GHG emissions by 40 % or 3.7 billion tonnes - equivalent to all transport related emissions. Circle Economy (2023) modelled that If CE was implemented across four global systems (food, manufacturing, construction, mobility), virgin resource extraction could drop by around a third or 30 billion tonnes – this could limit global temperature rise to 2-degrees (assuming 100 % renewable energy).

These and several other studies paint a clear picture of the crucial role that CE plays in climate mitigation. It also points to some areas of the economy which may hold a key climate mitigation potential (hot spots), which include construction, heavy industry, and food systems, and also some materials incl. cement, steel, aluminium and plastics. However, more work is needed to sustain these results and further develop the knowledge with more fine grained and locally applicable results (see Chapter 4). Similarly, more work is being developed on the methodology to better account for the various aspects of CE. Lastly, it is important to underscope that the CE mitigation potentials do not equal the actual emissions savings. Further studies should be made on assessing the actual savings resulted from CE activities (Cantzler et al., 2020).

4 Country Experiences

As the previous chapters have shown, many EEA member countries are already beginning to consider CE and climate change mitigation policies together. The decarbonisation potential of individual CE measures is also increasingly being considered, modelled and evaluated.
Therefore, in the following, some concrete approaches of EEA member countries will be presented as examples, which either look at the interactions of the two policy fields from different perspectives and/or pursue different modelling approaches.

4.1 Belgium (Flanders)

Key theme
Territorial emissions versus carbon footprint

Introduction
OVAM, the Public Waste Agency in the region of Flanders (Belgium), has been studying the link between GHG emissions and how we deal with materials for several years. The high demand for energy in societies is to a large extent hidden in the way materials are used. OVAM is convinced of the strong interlinkages between CE policy and climate policy. The agency has therefore been working closely together with the Flemish Energy and Climate Agency (VEKA) in the past years. This resulted in the circular transition being included as one of the transversal measures in the Flemish Energy and Climate Plan. In 2021, OVAM published a summary report with ten new messages about CE and climate (OVAM, 2021). These messages address both issues at the level of territorial impact and consumption impact. They are all based on scientific research.

Method
Flanders has a long tradition in calculating the material footprint and the carbon footprint of Flemish consumption. Flanders' material footprint is a measure for the total mass of primary raw materials that are mined worldwide for final consumption in Flanders. The footprint perspective is used since the majority of materials and emissions related to the Flemish consumption are mined and emitted outside Flanders. The footprints are calculated using the Flemish environmental input-output model (IO-model) combined with the Exiobase or Eora database.

Flanders has a policy objective to lower the material footprint of Flemish consumption by 30 % in 2030. To monitor this objective, an alternative method is used to calculate Raw Material Consumption (RMC), namely the Eurostat methodology of economywide material flow accounts (EW-MFA).

Different scenarios were modelled using the Flemish extended input-output model:

- A reference scenario (2030) with an increase in final consumer demand, to meet the expectations regarding economic growth, and a decrease in the GHG emissions of ETS sectors, in line with the climate change mitigation objectives. (In this study, the target for Flanders was -43 % reduction of emissions in ETS sectors, compared to 2005.)
- Scenario 1, where the material intensity of production in Flanders was reduced, assuming that Flemish companies would consume 25 % less materials for the same output.
- Scenario 2, where Flemish companies would source more secondary raw materials to replace 25 % of the primary raw materials.
- Scenario 3, assuming that Flemish consumers would consume 25 % less, by using consumer's products longer.

An LCA methodology is also frequently used to estimate the climate impact of certain policy measures. For example, LCA was used to calculate the impact of the policy measures on GHG emissions, for the new waste management plan.

Lessons learned from the method

Although using IO-methodology can be complex, it allows to study the impact of circular strategies on the whole Flemish economy or in different systems of need. Four consumption areas in the Flemish economy (mobility, food, housing and consumer goods) are responsible for the largest share of both the carbon footprint and the material footprint.

Overall, the report shows that **CE strategies addressing consumers and producers have great potential for the climate and the environment**. However, it makes also very clear that **most of the gains will probably not directly be felt on the Flemish territory**. This is for example illustrated by an analysis of the impact of CE strategies on material use, GHG emissions and added value in the Flemish economy.

So far, the focus of the Flemish environmental (climate, materials, waste, …) policies has been very much oriented towards the Flemish territory: territorial emissions, sourcing of raw materials in Flanders, etc. It should be recognized however, that a large part of the resources consumed and transformed in the Flemish economy comes from outside the region. It is thus necessary to broaden the scope of regional CE-policies to the environmental impact outside the Flemish production activities.

Climate goals should not only be translated into energy-related measures, but also into material-related measures. These should indicate the material-consumption limits for an economy to be sustainable.

Key results

The research indicates the potential contribution of the CE to the climate challenge. Climate goals should therefore not only be translated into energy-related measures, but also into material-related measures. These measures should indicate the material consumption limits for an economy to be sustainable. As an example, the Flemish Energy and Climate Plan states that the material footprint of Flemish consumption must be reduced by 30% in 2030. It is important to use a footprint perspective to include both territorial and also worldwide emissions and material use.

General conclusions (OVAM, 2021):

1. Two thirds of the Flemish territorial greenhouse gas emissions are material-related (OECD methodology);
2. The material- and carbon-footprint in Flanders is too high to be sustainable (Flemish environmental Input-Output model);
3. Mobility, food, housing, consumption goods require the majority of materials and produce the majority of emissions;
4. Circular strategies reduce the material and carbon footprint of food consumption;
5. Circular strategies reduce the material- and carbon footprint of textiles consumption;
6. Circular strategies reduce the GHG emissions of our mobility;
7. Circular strategies reduce the material use and greenhouse gas emissions in our buildings;
8. A circular economy is essential for the energy transition;
9. The open character of the Flemish economy influences the effect of circular strategies on material use and emissions;
10. Recycled materials are less carbon intensive than primary materials.

4.2 Germany

Key theme

CE as a prerequisite for climate neutrality

Introduction

In 2019, the German Environment Agency published its scenario study 'RESCUE – Resource-efficient pathways towards Greenhouse-Gas Neutrality' (Günther et al., 2019). The study explores in six scenarios (so-called 'Green-scenarios') different transformation paths towards a material-efficient and GHG-neutral Germany 2050 by systematically examining all key economic sectors and quantifying both GHG-emissions and raw materials demands (biomass, fossil fuels, metal, and minerals). The scenarios focus on different levels of ambition towards achieving GHG-neutrality (GreenLate – slow transition, GreenSupreme – fast transition), improved energy efficiency (GreenEe), enhanced material efficiency (GreenMe), and a wider implementation of sustainable life-styles (GreenLife).

Method

The RESCUE study used in total 5 models. GHG emissions and material demand were calculated following different modelling approaches. GHG emissions were calculated using a cost optimized model for the energy system and special GHG-calculation models for the mobility sector and housing sector. The material demand was calculated using an EEIO model. The model is based on a highly differentiated input-output table, which maps the production ties in the German national economy without any overlapping. It differentiates between 52 raw material categories and 282 production sectors. Scenario analyses giving insights on theoretical future material use under different framework conditions can be done by a comparative-static approach. The model is also fully harmonised with the EU model which is used by Eurostat to calculate the RMI and RMC indicators for the use of raw materials in the EU (Schoer et al., 2018).

Lessons learned from the method

The RESCUE study could not provide information about the decarbonization potential of single CE measures, but the comparison of different scenarios allows an estimation of the potential of bundles of CE measures on a sectoral and economic level like overall and structural changes with effects on resource demand, substitution and recycling options in different sectors (Dittrich et al., 2020).

As the modelling of the raw material demand is following a comparative-static approach measures can only be implemented for corresponding support years of the study. A dynamic course of raw material consumption can thus not be depicted either.

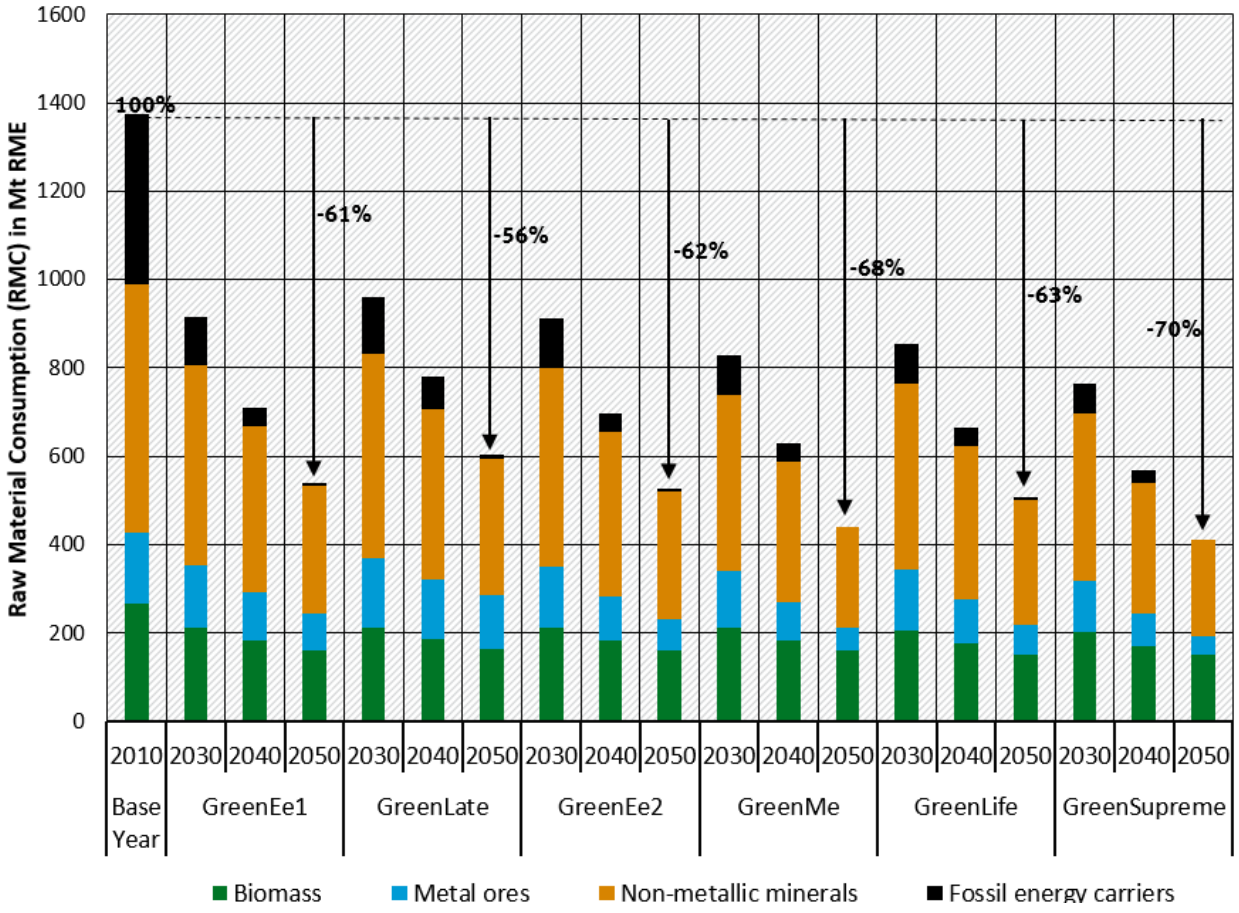
Key results

The RESCUE study highlights that GHG-neutrality in Germany together with a reduction of the material footprint is possible as all scenarios achieve net-zero GHG emissions and, in addition, the material footprint can be significantly reduced in all scenarios from – 56 % (GreenLate) to -70 % (GreenSupreme) (Figure 4.1).

This was essentially achieved through a combination of ambitious measures focusing on the economy-wide phase-out of fossil energy carriers and transition to renewable energy, energy and materials efficiency, materials substitution, use of innovative materials and life-style changes. However, the described transformation pathways will also increase demands for individual raw materials that are central for the transformation towards climate neutrality, e.g., metals like lithium and cobalt. Particularly under the assumption of a globally necessary energy transition and transformation to climate neutrality and against the background of a globally equitable use of raw materials, the study illustrates that significant progress at multiple levels across sectors and institutions will be necessary. Moreover, there is a clear need to consider a broad range of strategies and measures for lowering GHG emissions and raw materials use to ensure sustainable climate change mitigation and natural resource conservation.

Finally, the six scenarios demonstrate that implementing only technical solutions for lowering GHG emissions and raw material consumption is not sufficient. Instead, a broad range of strategies and measures targeting substitution, avoidance, and natural carbon sinks will be needed to influence GHGs in the atmosphere and to decrease the use of raw materials.

Figure 4.1 Raw material consumption (RMC) by raw materials category for all Green-scenarios



Source: (Günther et al., 2019)

4.3 Spain

Key theme

Reducing GHG emissions as one of the targets in the CE Strategy

Introduction

In June 2020 the Spanish CE strategy *España Circular 2030* (Spanish Ministry for Ecological Transition and Demographic Challenge, 2020) was published. Following the Spanish Government, the strategy contributes to Spain's efforts to achieve a sustainable, decarbonised economy, which uses resources efficiently and is competitive.

Its long-term vision is to 'establish the bases to promote a new production and consumption model in which the value of products, materials and resources are maintained within the economy for as long as possible, with minimal waste and reusing as much as possible the waste that cannot be avoided.' (Spanish Ministry for Ecological Transition and Demographic Challenge, 2020).

Additionally, the Strategy established the following goals for year 2030:

- Reducing DMC relative to national gross domestic product (GDP) by 30 %, relative to 2010.
- Reducing waste by 15 %.
- Reducing food waste throughout the entire food chain: 50 % reduction per person in retail and households and 20 % in production chains and supplies relative to 2020, thus advancing towards the Sustainable Development Goal (SDGs).
- Promoting reuse and reuse-enabling activities until 10 % of municipal waste is reused.
- **Reducing GHG emissions to less than 10 million tonnes of carbon dioxide equivalent.**
- Improving water use efficiency by 10 %.

The monitoring of the strategy is currently based to a large extent on the indicators selected by the European Commission in the EU CE monitoring framework. One indicator was added to follow up the contribution of the waste sector to greenhouse gas emissions.

Method

To evaluate the mitigation potential of the measures included in the action plan, the consultancy IK Ingeniería[27] and the Spanish Climate Change Office developed a **methodology and assessment tool**. The basic approach is to use '*what if* scenarios', in which **individual measures** are implemented in the model **and compared with a baseline scenario**. Ideally, this will allow the decarbonisation potentials of measures in the action plan to be estimated.

Lessons learned from the method

With this approach some challenges were encountered with respect to the assessment of the decarbonisation potential of the entire set of measures, and the individual contribution of measures to the targets enshrined in the strategy. For example, the achievement of a sectoral reduction target is due to different measures. The implementation of a single measure does not mean that a full reduction will be achieved. Further, some measures may partially or totally overlap with others. Weighting and correction factors as well as an overlap matrix were therefore proposed as an approach to calculate consistent scenarios implementing different sets of measures.

Key results

The strategy will be implemented through the adoption of three-year action plans, which will enable the necessary adjustments to be made to complete the transition by 2030. The first three-year plan was adopted in 2021 for the period 2021-2023 and includes 116 actions and measures.

4.4 Switzerland

Key theme

Using the GHG Footprint to evaluate CE measures and as a target indicator for public procurement

Introduction

Switzerland has already been including so-called environmental footprints for several years to measure progress towards a resource-efficient economy, in order to show the environmental impacts and resource consumption caused by Swiss final demand in various areas (Frischknecht et al., 2018; Nathani et al., 2022; Swiss Federal Statistical Office, 2023; Matasci et al., 2021)Footprints are calculated for greenhouse-gases, overall environmental impacts, water and biodiversity loss and materials.

[27] https://ik-ingenieria.com/en/

Method

Calculating Switzerland's GHG Footprint

For the calculation of the **GHG footprint** the Federal Statistical Office (FSO) currently uses a combination of the **national Input-Output-Table**, **emission data and import-related emission factors**. Instead of emission factors, it is planned to link the Swiss IOT with the Multiregional Input-Output-Table GLORIA.

Nathani et al. (2022) calculate other environmental footprints on behalf of the Swiss Federal Office for the Environment (FOEN), using the so-called IO-TRAIL method, which is **a hybrid of input-output tables and Trade Information and LCA data**. This involved linking an environmentally oriented input-output model for Switzerland with a life cycle assessment of the imported products.

Using GHG Footprint to evaluate CE measures

In addition to measuring progress and describing need for action on a national level, life cycle analysis (LCA) is used to assess impacts of new environmental technologies and environmental policy instruments. Besides GHG, a main indicator is overall environmental impact footprint (ecopoints) based on the method on ecological scarcity. It aggregates environmental impacts with regard to their distance-to-target, i.e., existing laws and international agreements. The importance of this complementing indicator is inter alia shown, when assessing bio-fuels, which can reduce GHG emissions while at the same time increase overall environmental impacts. The following example on food waste illustrates the use of life cycle assessments to quantify the emission reduction potential.

Using a multiregional **input–output model** combined with detailed **MFA/LCA models**, Wichprächtiger et al. (2023) did an analysis of consumption-based carbon footprints and production-based, direct emissions in Switzerland to evaluate the **hot spots** of the greenhouse-gas emission reduction potential through CE in Switzerland (existing recycling systems have not been considered).

Lessons learned from the method

Both methods currently used by FSO and FOEN build up on the national IOT. Building the analysis on Input-Output data allows to **identify the most important areas of final consumption**, in particular nutrition and agriculture; mobility; and construction and housing. FSO is planning to link the Swiss IOT to the MRIOT Gloria. This allows to profit from the data quality of the national IOT and analytical advantages of the MRIOT regarding i.e. supply chain effects. Data quality of MRIOTs for Switzerland has been found to be too weak, especially on a sectoral level. The method used by FOEN link the Swiss IOT with trade and LCA data, on the one hand because it offers different analytical options, e.g. to analyse effects on a product level for many different environmental indicators.

This information is used i.a., for official communication in the Swiss State of the environment report. Furthermore, it is possible to **compare per capita footprints with planetary boundaries** (Nathani et al., 2022; EEA, 2020b). If deemed relevant, the environmental impact of CE measures is being assessed with LCA studies. This continuous work on environmental footprints and LCA-based impact assessments has provided i.a. the foundation for political initiatives like a legally binding footprint target regarding public procurement to achieve net zero emissions by 2040 (see below). Also, the Swiss Sustainable Development Strategy provides a non-legally binding target to reduce the GHG footprint of nutrition per capita by 25% until 2030 compared to 2020.

Key results

Food Waste

When food is produced but not consumed, this leads to unnecessary GHG emissions, biodiversity loss and land and water consumption. 25 per cent of the environmental impact of our food system is due to food waste (i.e., avoidable food losses). This corresponds to about half the environmental impact of motorised private transport in Switzerland. With the action plan to reduce food waste, the Federal Council wants to halve avoidable food losses by 2030 compared to 2017. This is in line with SDG 12.3 of the 2030 Agenda for Sustainable Development (FOEN, 2023).

An assessment has been conducted to assess the reduction potential of environmental impacts and to create a foundation for targeted measures. According to the study by Beretta & Hellweg (2019), the environmental impact of a tonne of food waste varies greatly depending on which products it is made up of and where in the value chain it occurs. Food waste should be avoided as a priority in the case of foods that have a particularly high environmental impact or are produced in large quantities. Achieving the target of reducing avoidable food waste by 50% until 2030 has been found to reduce GHG emission by about 2 million tonnes CO_2eq.

Scenario analysis

Following the study established by Wichprächtiger et al. (2023) (see higher), the Swiss hot-spots for decarbonization can be found i.a. in the construction industry and housing, the production and processing of food, and the production of chemicals and pharmaceuticals. From a more consumption perspective plastic waste, household waste, furniture and textiles show high potential in addition to construction and housing. To evaluate the contribution of CE measures to the reduction of the GHG footprint, the authors developed different scenarios, for example, a 50 % reduction in food waste; reducing the use of steel and concrete via increased timber construction; the reuse of building structure and low-emission concrete; the collection, recycling and use of more biobased insulation materials; improved recycling of household waste and plastics in particular, and improved recycling or the longer use of furniture and textiles through reuse and repair. The scenario analysis showed that potentially a GHG-saving of around 12 million t CO_2eq./a by 2050 could be achieved, which compared approximately 14% of the current consumption-based and 22% of the current production-based climate change impacts of Switzerland. The GHG-savings will be achieved in Switzerland and outside the country. Waste prevention measures in the field of textiles and furniture (Wiprächtiger et al., 2022) and measures to reduce embedded emissions of insulation materials (Wiprächtiger et al., 2020; Kulakovskaya et al., 2023) have been analysed in more detail.

Using GHG Footprint as a target indicator for public procurement

According to the Climate and Innovation Act of 2023, the central federal administration, should take on a model role and be climate neutral as early as 2040. In doing so, it should also consider emissions that arise over the whole life cycle from goods and services that the administration purchases. The cantonal administrations and also the federally-affiliated companies (e.g., Swiss Federal Railways or Swiss Post) are also to aim for net zero emissions by 2040. The Confederation shall provide the necessary basis for this. To do so, an implementation regulation will be drafted to specify responsibilities, reduction pathways and to establish a framework for possible measures. Circular solutions can play an important role, since they have the potential to reduce emissions over the whole life cycle, i.e., the GHG footprint. For monitoring, purchased products or product categories could be linked to LCA data.

4.5 Cross-country: CO2NSTRUCT project

Key theme

Complement climate change mitigation modelling to develop and evaluate circular options in the construction sector

Introduction

The CO2NSTRUCT project, funded by the European Union's Horizon Europe programme, aims to identify, test, and quantify CE impacts for climate mitigation modelling. It focusses on six construction materials identified as carbon-intensive, namely cement, steel, brick, glass, wood, and insulation materials and consider the whole life-cycle of these materials.
(Lima et al., 2023).

The project starts in 2022 and is planned to be finished in 2026. The project consortium consists of seven partners from Portugal, Greece, Germany, Denmark, Italy, Spain and the United Kingdom and is led by Technical University Denmark.

Method

The project assumes that current assessment tools to evaluate the environmental impact of construction materials are most suitable for assessing linear patterns of economic activity and do not account for material circularity and other CE measures.

Especially climate change mitigation models "need to integrate CE in a better, more holistic way, by transforming linear models used for policy support into circular models" (Lima et al., 2023). Therefore, the CO2NSTRUCT project aims to bring together energy-climate mitigation modelling (using the TIMES model) and several CE analytical tools like life-cycle assessment, Material Flow analysis or Input-output analysis to integrate several aspects from the CE perspective like material flows, closed-loop supply chains, rebound effect, and consumer behaviour.

Lessons learned from the method

Since the project started only one year ago, no findings can be derived from the methodological approach at present.

Key results

No concrete results are available yet. However, these will be made available on the project website https://co2nstruct.dtu.dk/ on an ongoing basis.

4.6 Cross-country: Role of the circular economy as a contributor to industry decarbonisation beyond 2030

Key theme

Developing future scenarios to model the decarbonisation potential of industry.

Introduction

Today, industry accounts for about 25% of EU final energy demand and about 20% of GHG emissions, which is mainly due to key energy-intensive industries, products, and processes, such as steel, cement and ethylene production. The decarbonisation of these industries is therefore critical for the achievement of European climate targets. While many studies deal with the role of CO_2-neutral processes and energy sources, the specific role of a material efficient CE has not been systematically researched within energy system models.

This study takes a current and future perspective on the impacts of CE measures on GHG emissions and energy demand on the EU industry. The overall objective of the project is to improve the assessment of the role of CE measures for industrial decarbonisation by constructing reliable and consistent trajectories of future production for relevant materials in the EU. Scenarios are set out to model the impacts of different CE measures while transforming the EU economy towards near-climate neutrality in 2050.

The report was prepared by Fraunhofer ISI and ICF S.A. under contract to DG CLIMA.

Method

The bottom-up industry model FORECAST is used for the analysis. The model has a high technology and process resolution, which can track technical change on a sub-sector and process level. At the same time, it contains the complete energy demand and GHG emissions of EU industry on a country level.

For the analysis the following five scenarios were developed:

1) Baseline: Describes the continuation of historic trends and includes CE measures that are already implemented or agreed on, e.g., in the 2020 EU's Circular Economy Action Plan.
2) Increased recycling: Describes the enhancement potential of recycling that appears realistic based on the current technological progress (technologies on TRL 5 or higher)
3) Substitution: Addresses substitution potentials in the construction sector with a focus on wood substitution.
4) Reduced demand: Covers the effects of demand reduction measures to be achieved with minimal behavioural change requirements.
5) Combined scenario: Brings together all measures of the different scenarios, while considering their interactions.

Lessons learned from the method

The study does not focus on modelling specific emissions reduction potential for CE actions, but the material efficiency and what this means for the speed of fossil fuel phase out, and dependence on green hydrogen production and CCS. at Provides key insights into different scenarios to compare what is needed to achieve them in this case energy and CCS. The study captures a range of products, but future studies could benefit from a wider range reflecting the heterogeneity of products and complex interactions of CE. Similar further studies could study the potentials of demand reduction based on behavioural change with respect to sufficiency.

Key results

- The analysed CE measures were shown to have significant reduction potentials on primary material production in the analysed what-if scenarios.
- An ambitious increase in energy efficiency, circularity and material efficiency in all sectors is a prerequisite for CO_2-neutral industrial production in the scenarios studied. It reduces final energy consumption in 2050, especially for electricity and hydrogen, and supports a faster phase-out of fossil fuels in the medium to long term.
- A nearly climate-neutral industrial sector in 2050 is possible, but will require a very high level of effort. CO_2-neutral processes must be marketable as early as possible and achieve 100% stock diffusion by 2050.
- CE contributes to the reduction of emissions that are difficult to avoid, i.e., process emissions. This is important on the way to achieving the climate targets, because to avoid process emissions significant changes in the production process, the development of new products or the use of CCUS/ would be necessary.
- The most noteworthy potentials of specific individual CE strategies include demand reduction by extended lifetime of steel production (19% material reduction compared to baseline), demand reduction for primary cement production (e.g., specification and substitution to wood), and increase recycling of aluminium (43% reduction of primary reduction).

5 What to consider when modelling decarbonization potential of Circular Economy measures

Looking at the previous chapters, it can be summarized that CE policies and measures are increasingly being developed and implemented across Europe. Mainly in response to the European Green Deal and the accompanying Circular Economy Action Plan many countries set objectives, and even binding targets at the national level. These goals are, as shown in Chapter 2, currently still very much focusing on waste management (collection of waste streams for recycling or energy recovery) and less on product design, and product use, although ongoing and planned activities are increasingly addressing these aspects as well. Also, with regard to the climate policies of the countries, our analysis shows that CE and climate change mitigation strategies are increasingly interlinked within the countries, although the interlinkage is not always implicit or intended – as was shown by our analysis of the CE Country Profiles. Again, the focus is in most cases on waste management, but also other strategies are emerging, like for example soil and feed management in agriculture, local food systems and car sharing. Our analysis therefore shows, that some countries actively take up the link between the CE and climate change mitigation and try to advance both policy fields together, as the country examples presented show.

5.1 Key challenges for linking circular economy and climate change mitigation

There is a growing interest in the interactions between decarbonization and CE, both among researchers and policy makers. As Chapter 3 shows, methodological approaches are increasingly being developed and used to determine the contribution of the CE to decarbonisation, and the GHG reduction potential of concrete measures or bundles of measures is being assessed at different policy levels. Our analysis shows that different methodological approaches can be used, depending on the aim of the analysis. From bottom-up modelling of the GHG mitigation potential of individual measures without considering interactions, to economy-wide models for considering sectoral or cross-sectoral measures, to dynamic or more complex models for assessing multiple interactions of measures and policies.

It can thus be seen that the link between decarbonization and CE is increasingly being taken up in political processes and strategies in order to exploit synergies and avoid conflicting goals. Hence, various methodological approaches and life cycle assessment data for assessing the decarbonisation potential of the CE are already available. For example, the product environmental footprint (PEF) data will play an important role for implementing the EU eco-design regulation and green claims directive, currently in discussion. Nevertheless, our findings and also discussions with national experts show that there are often still barriers to overcome to actually leverage the decarbonisation potential of the CE. In particular, the partially high complexity of the interactions, combined with open methodological questions and the need for suitable models, are perceived as main obstacles. This is also reflected in the following summary of the frequently discussed challenges:

1. **CE is of cross-sectoral nature:** Beside the lack of knowledge about the decarbonization potential of the CE, different perspectives, policy targets or levels of detail of the policies may hinder the consideration of CE measures in climate policy. Worth highlighting here, that climate change mitigation reporting is strictly set according to the IPCC sectoral categories. In contrast, CE policies and measures are often designed economy-wide or consider whole value chains across different sectors, which means that emissions reduction can be achieved in sectors not directly addressed by the original action. This leads to difficulties in measuring and reporting the climate change mitigation potential of CE measures in the framework of climate reporting. In addition, under EU legislation several reporting schemes (e.g., National energy and climate plans and climate progress reporting) use different reporting frameworks, which makes it more complex to incorporate CE measures into the reporting.
2. **Territorial vs. non-territorial emissions:** In the context of resource conservation and CE monitoring, indicators and targets are often using a **footprint perspective**, considering the resource demand along the whole value chain in the country/region under consideration and

abroad, allowing taken into account the consumption perspective. In contrast, climate reporting is normally carried out according to the **territorial principle**, considering only the territorial emissions of the country/region under consideration.

3. A related aspect is, that the **benefits of the CE do not necessarily translate into lower territorial emissions** or a local reduction in the consumption footprint. This is due to our open and global economy, where materials and products are sourced from outside Europe and products manufactured in Europe are in turn exported worldwide. In some cases, implementing CE measures may even lead to higher territorial emissions, e.g., more recycling within the country instead of importing raw materials or semi-manufactured products might increase territorial emissions but lower emissions elsewhere.

5.2 Six steps to include circular economy in climate reporting and policy making

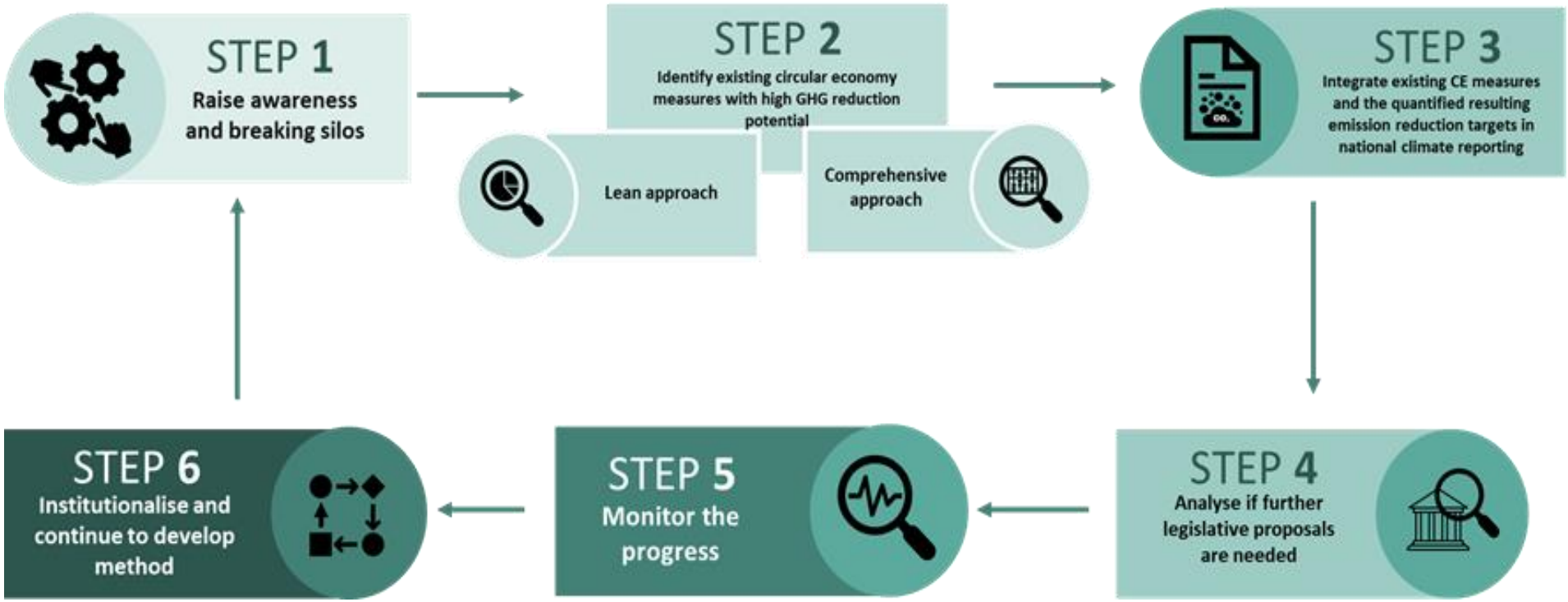
The following sub-sections provide a guideline for countries to include CE into climate reporting and policy making. This six-step approach (Figure 5.1) is to support interested countries in leveraging the decarbonisation potential of the CE, and to make this visible in their climate policies and reporting. The guideline has been developed in collaboration with the Eionet network and the project Advisory Group for this ETC report.[28] The guideline is intended for countries that have some or only limited experience on including CE in climate reporting and policy making.

5.2.1 Step 1 – Raise awareness and breaking silos

Achieving a more circular use of materials is key to reducing the demand for virgin materials and improving resource efficiency (EEA, 2019). In doing so, a CE can minimise the use of materials and energy, while reducing environmental pressures linked to resource extraction, emissions and waste (EEA, 2016). In addition, the CE offers a variety of other positive effects. For example, reducing dependence on primary raw materials can, on the one hand, strengthen strategic autonomy and reduce dependence on certain raw materials, especially those classified as critical. On the other hand moving towards a more CE could increase competitiveness, boost innovation across different sectors of the economy, secure economic growth and create jobs and upgraded knowledge and skills (European Commission, 2020). In addition, a CE is expected to provide high-quality, functional and safe products and product-service models, which implement the principles of the CE and thus implicitly support the implementation of the CE (ibid). This means, CE can act as a cross-sectoral and overarching transformation strategy, supporting raw materials management and supply security and enable a transition towards more sustainable production and consumptions patterns fostering the climate goals. Conversely, this also means that basically every policy area must deal with CE measures. However, this is often a problem in the thematic- or sector-organised policy areas. On the other hand, successful implementation of climate change mitigation also requires economy-wide and cross-sectoral steering of the measures of each policy area. Thus, both policy areas with their transformative strategies actually offer good opportunities to break down present "silos" in order to use existing synergies. The country experiences presented in chapter 4 provide interesting information on these synergies.

[28] Consisting of representatives from the Danish Technical University, Ik ingeniería, Public Waste Agency of Flanders - OVAM), Swiss Federal Office for the Environment.

Figure 5.1 Six steps to include CE in climate mitigation reporting and policy



Source: EEA/ETC

Although the knowledge about the relations between CE and climate change mitigation is steadily increasing, it can be stated that these are still not understood by the greater public and many policymakers. Therefore, the first step should be focusing on awareness raising and continuously expanding knowledge (e.g. via pilot projects) of the existing interactions between the CE and climate change mitigation. It is important to highlight the potential for reducing greenhouse gases through CE measures, but also to address the need for sustainable and efficient use of resources when implementing climate change mitigation measures, as the example from Germany shows. In this context, political decision-makers and the public must be considered, as well as administrative structures. Because of the distributed responsibilities within the administration in the development and implementation of policies and strategies, it is important to focus more on the interactions. The increasing number of analyses and studies on the decarbonisation potential of CE measures can be used as inspiration and argumentation (see chapter Model approaches for calculating the decarbonisation potential of the Circular Economy).

Within the context of climate change mitigation reporting, a countries national system for reporting of policies and measures, is a key tool that countries should strengthen in order to break silos. The national system is the organisational overview of who (and how) within a country evaluates policy and contributes to reporting. Integrating national CE experts into a country's national system for reporting on PaMs can ensure they are more effectively, transparently and robustly integrated into the reporting process. Though there is no 'one-size-fits-all' solution, countries are encouraged to explore best practices and solutions implemented by other countries. Information on this can be found in the national systems data viewer[29].

5.2.2 Step 2 – Identify circular economy measures with high GHG reduction potential

Knowledge of the most relevant CE measures in terms of GHG savings is of great importance, both if the consideration of interactions is still in its infancy and if initial approaches are already being pursued to take CE into account in climate change mitigation policy and reporting. Therefore, this step is key to support climate change mitigation by CE.

Get started - Lean approach

For countries that are currently starting to consider the contribution of the CE to GHG reduction and thus probably have hardly any suitable country-specific data sources and/or methodological approaches available so far, a simplified lean approach can already provide valuable and sufficient information.

The starting point is to identify information on the relevant sectors as well as known CE measures and instruments and evaluate them in terms of potential GHG savings. Due to the increasing scientific and political debate on the interactions between CE and climate change mitigation, the first step should be a systematic literature analysis, which ideally also includes published studies and reports describing the decarbonization potential of CE with regard to their relevance in the context of the CE policy of the country under consideration (see chapter Model approaches for calculating the decarbonisation potential of the Circular Economy for inspiration). The analysis of existing studies shows that some sectors and measures were particularly frequently identified as hotspots and can thus be regarded as obvious fields of action. In particular, the construction sector, the mobility sector, and food production and food waste are described as particularly relevant. One of the most important actions related to these hotspots, especially in the construction and mobility sectors, is the reduction of energy consumption along the whole value chain. For example, replacing cement and steel with low-carbon and light-weight materials (e.g. wood and aluminium) as well as a more intensive use (e.g. by sharing) will reduce energy consumption and GHG emissions. In order to ideally already include country-specific aspects on relevant sectors and/or consumption areas in the consideration, it can be helpful to access databases and analyses from European and international organisations and institutions if no national data are available. For example, the

[29] https://climate-energy.eea.europa.eu/topics/climate-change-mitigation/national-systems/data

environmental footprint datasets of FIGARO[30], the **UNEP SCP-Hat Tool**[31], the **database from the International Resource Panel**[32], the **DG CLIMA report**[33] **"Role of the circular economy as a contributor to industry decarbonisation beyond 2030"**, or the **consumption footprint calculations** done by **EEA (EEIO model)**[34] or **JRC (LCA model)**[35] can be a very good starting point. These can also be used to define an estimated baseline when evaluating reduction potential of selected CE measures adopted to national circumstances.

Based on the work done so far, assessments of emission reduction potential along selected value chains in the identified relevant sectors should be done. This may build up on existing assessments and ideally adapted to country specific aspects, e.g., considering national energy mix or waste treatments. Such basic "what-if" scenarios for individual measures can be easily calculated with the help of Excel and existing LCA software.

Comprehensive approach for countries in the middle of the road

A first good orientation for countries already knowing about the different potentials of CE measures for GHG reduction in relevant sectors in their countries is the stepwise approach developed by Ramboll et al. (2020). As countries for which the comprehensive approach is of interest have already taken initial steps to identify relevant sectors and key CE measures and instruments and have assessed them in terms of potential greenhouse gas savings, the comprehensive approach can thus be divided into the following elements:

Find the country specific hot spots,

a. Look for the fields where CE could reinforce climate change mitigation plans,
b. Define the scope and adjust system boundaries,
c. Choose the appropriate methodological approach,
d. Assessment of emission reduction potential, including complementing environmental indicators, along the value chain.

Hot spot analysis

Again, the starting point can be a systematic review of already published studies and reports describing the decarbonization potential of CE, ideally focusing on the country under consideration in terms of a hot spot analysis to identify the sectors, industries, material flows or product groups that are already in the focus of the CE policy and that show relevant GHG emission and therefore a potentially high decarbonization potential. Conversely, it is also important to identify those sectors and industries that have a high reduction potential from the perspective of climate policy. These should then be mirrored against existing CE policies and strategies to assess whether they are already addressed by CE measures.
Further access to the identification of relevant sectors or hot spots can also be obtained via the evaluation of the most relevant sectors identified in the national energy and climate plans (NECP) and then doing an analysis to identify these sectors for which CE policies are most impactful.

CE and climate change mitigation plans

As our analysis shows, in some cases CE measures are already considered in climate plans and decarbonisation strategies (see chapter 2.3). In some cases, the mitigation potential of individual measures is already being determined within the framework of the NECP (see Table 2.7). However, a closer look shows that the greatest overlap between climate change mitigation plans and CE strategies currently is in the area of waste management. Nevertheless, the measures mentioned are often rather general and

30 https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/information-data#figaro
31 www.scp-hat.lifecycleinitiative.org
32 https://www.resourcepanel.org/global-material-flows-database
33 Forthcoming
34 https://www.eea.europa.eu/ims/europe2019s-consumption-footprint
35 https://eplca.jrc.ec.europa.eu/sustainableConsumption.html

unspecific or address aspects that are only partly addressed by CE policies and strategies. On the other hand, we could show that a wide range of CE strategies already address sectors and value chains that are responsible for large greenhouse gas emissions or that could serve as carbon sinks as priorities. Therefore, knowing the contribution of CE measures to climate targets in these sectors and value chains will be a strong argument to integrate these measures in the climate plans in future. So, on the basis of the hot spot analysis, use the climate change mitigation plans to single which key sectors need further action, and then explore what the mitigation potential of CE could be for these sectors. In addition to waste management, these are often the construction sector or energy- and material-intensive industries. Here, it is important to identify those measures that, in addition to a reduction in the use of primary raw materials or a reduction in waste flows, can also have significant GHG reduction potential, e.g., by less energy consumption or reduced process-related emissions.
In a second step, the **sectors**, **value chains** and **industries** should be included in the analysis that show a relevant reduction potential either from the perspective of the CE or climate change mitigation. In particular, measures that address the consumption and use phase of products (e.g., concerning the CE strategy refuse, rethink, reduce, repair) should be considered, as they are rather underrepresented compared to the end-of-life phase, as our analysis shows.

Define the scope

As described, climate policy and climate reporting are in most cases following a territorial perspective (with few exceptions like the new Carbon Boarder Adjustment Mechanism (CBAM)), whereas CE effects are often broader (non-territorial) in their reductions and therefore reported following an environmental footprint perspective. In addition, there are different legislation to manage climate change mitigation in parts of the economy, including the Emission Trading system (ETS), the Effort Sharing Reporting (ESR) as well as NECPs and NDCs. Also, it is possible that a target or at least a reporting scheme for carbon or greenhouse gas footprints is already in place. Therefore, it is first **important to clearly define which emissions or which system boundaries are to be considered** when analysing the decarbonization potential of CE measures under discussion. Even if there are no official statistics or reporting on greenhouse gas emissions from a consumer (i.e., footprint) perspective, it may be of interest to look at emissions outside one's own territory in terms of climate change mitigation and to become aware of the potential for reducing consumption-related emissions, e.g. through CE as a big share of our impact (in terms of footprint) is due to the products we consume and there are methods and models that allow to monitor this (see the example of Flanders or Switzerland).

Choose the appropriate methodological approach

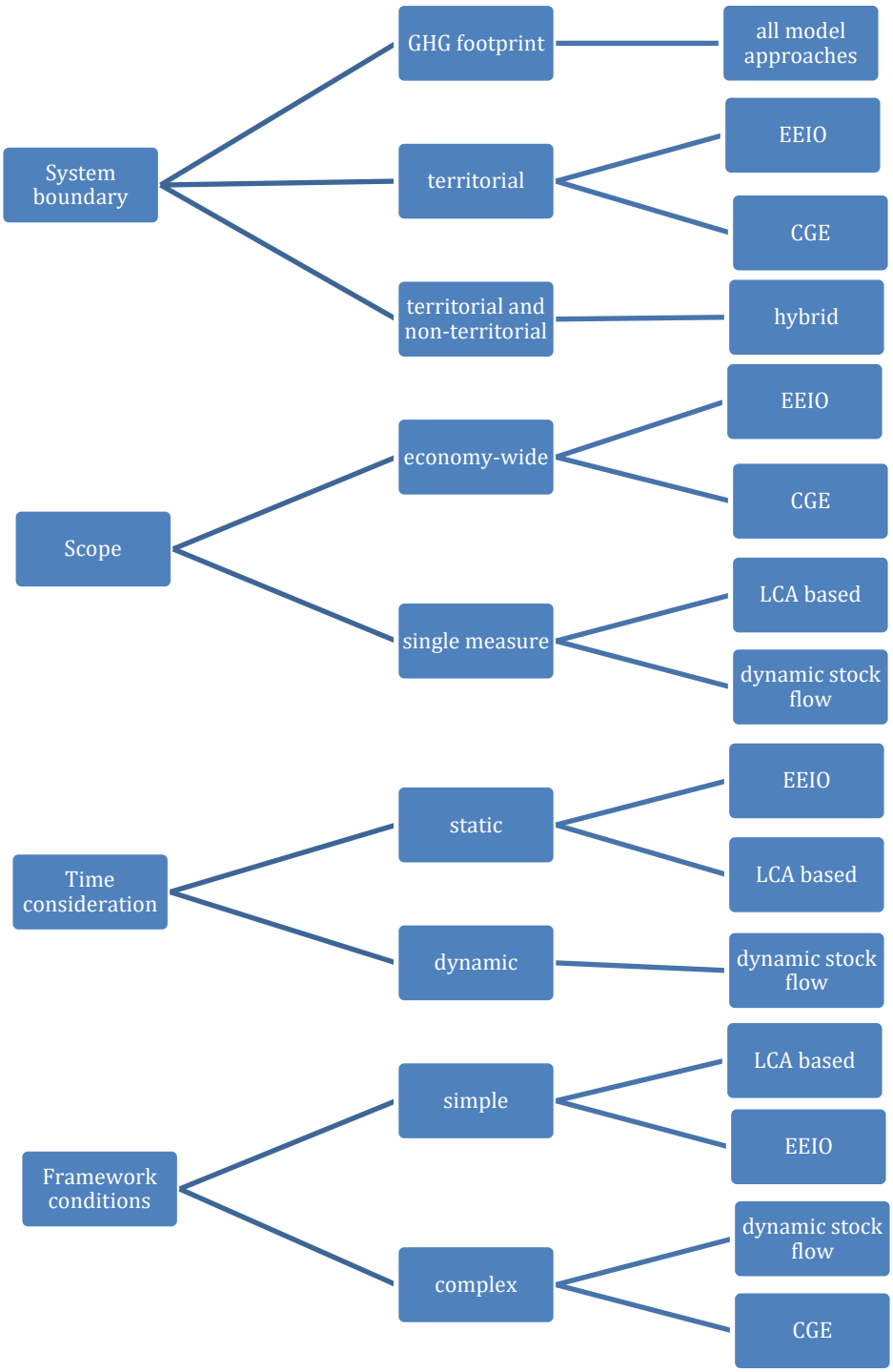
When selecting the methodological approach(s), the following aspects and key questions should be considered (Figure 5.2). Depending on the answers and preferences different modelling approaches can be used. Each of these methods has strengths and weaknesses that need to be considered in the selection process. Also, depending on the question, different methodological approaches are more or less suitable. Our analysis provides initial indications in this regard.
In addition, country-specific characteristics, e.g. with regard to data availability, must be considered. The current focus of the climate and resource protection policies of the country under consideration should also be considered. For example, some countries currently focus on waste management and recycling in the area of resource protection, while others focus on waste prevention or consumption. All these should be reflected when looking for the appropriate modelling approach as no one size fits all approach is feasible (see Table 3.5).

Which system boundaries should the model consider? Is it intended to look at both territorial and non-territorial emissions (GHG footprints) or only on one of the two?

The modelling approaches evaluated in the analysis conducted in Chapter 3 can all estimate the reduction of GHG emissions as carbon GHG footprint emissions. Specifically, for the use in climate reporting, it is helpful to estimate the effects on territorial emissions and emissions abroad separately. Therefore, if only territorial emissions are to be considered, **input-output models** are suitable, which allow to distinguish

savings that take place in the context of domestic linkages from emissions resulting from imports in a well comprehensible way. If both GHG footprints and territorial emissions are to be considered, **hybrid approaches**, such as those used by Wiprächtiger et al. (2023), are particularly suitable in addition to input-output models.

Figure 5.2 Overview of relevant aspects for the selection of model approaches



Source: ETC/CE

Is the focus on the reduction potential of individual circular economy measures or should the effects of the measures in the entire economy also be mapped?

When considering individual measures or a set of measures without considering the economy-wide effects, e.g., on other sectors, or by considering rebound effects, the so-called bottom-up approaches offer good possibilities. Single measures or simple What-if scenarios can be performed well with **LCA based approaches**. **Dynamic Flow-Stock models** are well suited to represent entire material flow systems and are therefore well suited to represent material-specific impacts of different CE measures. They represent the different life cycle phases of products and can also anticipate dynamic changes over time by considering the use phases.
If the upstream and downstream or the economy-wide effects of CE measures in different sectors are to be considered, **environmentally extended input-output (EEIO) models** provide a suitable approach. If CE measures are to be assessed not only in terms of their effectiveness on reducing environmental impacts, but also in terms of other macroeconomic indicators or their social impacts, **macroeconomic equilibrium models** are recommended.

Should the analysis of the measures take a more static view or should some dynamization be considered?

While **LCA approaches** and **EEIO models** require the framework to be set at a specific point in time, the analysis of measures can also only take place within that framework and is therefore static. However, it is certainly possible to compare different framework conditions or different points in time within the framework of scenario analyses. In contrast, **dynamic flow-stock models** can also anticipate dynamic changes over time.

Should scenarios with different framework conditions be described in comparison or just "simple" what if scenarios?

While **LCA-based approaches** as well as **EEIO models** are well suited to investigate so-called 'what if' scenarios, **dynamic flow-stock models** offer the possibility to perform complex scenario analyses allowing the modelling of several intervention points. If the focus is rather on the analysis of the effect of a multitude of measures without the necessity to determine the contribution of individual measures, **macroeconomic equilibrium models** can also be applied for scenario analyses.

Assessment of emission reduction potential
Once there is clarity about the system boundaries and the appropriate methodological approaches, the actual assessment must be carried out. The first step is to define and calculate a baseline or business as usual scenario which reflect the current situation of the economy or the sector. Against this baseline the effects of CE measures can be modelled. Doing so, it is necessary to make appropriate determinations and assumptions about the baseline. For example, it is necessary to decide whether a business-as-usual scenario, which represents the current status quo, should be used as the baseline, or whether legislation that has already been passed but not yet implemented and/or expected should be included in the baseline. After that, the analysis of the CE measures or the scenarios can take place with the aim of identifying those measures and instruments that can make a significant contribution to reducing GHG emissions.

5.2.3 Step 3 – Integrate CE measures and the quantified resulting emission reduction targets in national climate reporting

The work done in the previous step already provides relevant information to integrate CE measures and their GHG reduction potential into national climate reporting and policies. Thus, knowledge is already available on the overlap of the respective CE and climate change mitigation strategies and policies, which can act as direct entry points.

Box 5.1 Relevant information required as part of reporting PaMs

Key characteristics

- Is the PaM reported within the NECPs?
  If so ensure to report the number of the PaM here, to allow comparability.
- Is the PaM "single" or also part of a "group"?
  A group of PaMs can be used to allow quantifications to be reported where a single PaM has not / cannot be evaluated on its own.
- Does the PaM link to multiple dimensions of the Energy Union (i.e., beyond "decarbonisation: GHG emissions and removals")?
  If so further coordination with relevant energy experts will be required to finalise reporting.
- Relevant GHG emissions and removal information will be required: including how the PaM contributes to objectives/targets (qualitative and quantitative), which GHGs the PaM affects, and under which of the country's GHG projections scenarios the PaM's impacts are connected to? Does the PaM link to a country achieving its Long-Term Strategy (LTS) to reach climate neutrality?
- What is the geographic coverage of the PaM (international, national, regional, local)?
  Which public entities are responsible for implementing the PaM?
- What sectors are effected and which sector objectives does the PaM address?
- What indicators are used to monitor progress of a PaMs objectives and targets?

GHG impacts

- Which policy instrument can emission reductions or removals be categorized under?
  Effort Sharing Regulation (ESR) emissions, EU Emission Tradition Scheme (ETS) emissions, Land Use, Land Use Change and Forestry (LULUCF) emissions and reductions? Can be one or multiple.
- What are ex ante (expected) emissions of the PaM, by year in intervals of 5 years (from reporting until NECP target year – i.e., currently 2030)?
- What are ex post (achieved) emissions of the PaM? This is to be reported by year for any number of years in which the PaM was initiated and data is available.
- What are the costs and benefits (expected / achieved) of the PaM – i.e., cost per tonne of CO2 equivalent reduced / sequestered.

Related reporting on energy efficiency, air quality and financing

PaMs reporting now includes a large range of additional elements, which must further be reported if relevant. Therefore they should be considered prior to including a PaM in the reporting. Additional elements include:

- Energy efficiency (information regarding energy efficiency obligation scheme PaMs, how PaMs help achieve milestones on building stock quality, how PaMs support ensuring public buildings are role models in energy efficiency),
- Progress towards financing PaMs (investment assumed, implemented and remaining – by national funding, EU funding, and private stakeholder contributions leveraged).
- How a PaM contributes towards improving air quality (by affected pollutants, quantitative and qualitative impacts expected, and details on the methodology used).

At the same time, based on the analyses, concrete information on the reduction potential of already existing measures in relevant sectors and policy areas is available, which allows them to be included in climate reporting (NECP and NDC) with reasonable effort (See Diaz-Bone et al. (2021) for integrating CE specifically in NDCs.).

To include information in the reporting it is already useful for CE experts to be aware what key facets of reporting are required so they can ensure to link this into their evaluation(s) and outputs. This sharing of information can be effectively and transparently coordinated via the national system and should link to the reporting obligations, as required under the Governance Regulation 2018/1999 (Articles 17 and 18), and implemented in Reportnet 3[36]. Box 5.1 provides an overview of some key aspects to bear in mind. For further comprehensive details on reporting requirements, please see the reporting guidelines[37].

5.2.4 Step 4 - Analyse if further legislative proposals are needed

While measures already included in strategies, action plans, or legislation can be included in climate reporting almost immediately after the GHG reduction potential has been identified, the analysis of effective measures may also lead to the conclusion that further legislative action is needed first.
On the one hand, this can consist of adapting previously voluntary measures so that they become binding. In addition, it may also be possible to develop and implement new instruments and laws. For both steps, it can be helpful to draw on the experience of and in other countries in the sense of an exchange of knowledge. A first starting point could be the summarized analysis of the country profiles of the EEA member countries (ETC/CE, 2022).

5.2.5 Step 5 – Monitor the progress

The application of the methodological approaches and models presented in this report allows the determination of theoretical savings potentials or an ex-ante consideration of expected GHG reductions through CE measures. Thus, they allow the identification and assessment of particularly relevant sectors (hot spots) and appropriate measures. For the assessment of savings actually achieved and thus an evaluation of the successful implementation of policy measures, these may only be suitable to a limited extent. Therefore, it is necessary to identify or develop indicators that allow monitoring of GHG reductions through CE measures in the sense of an ex-post consideration.

As a first step, indicators on the development of GHG emissions from consumption and production could be used here. The EU monitoring framework[38] offers a good start here with the indicators "GHG emissions from production activities" and the Climate change sub-indicator of the Consumption Footprint (Sala et al., 2019b) . Distance-to-target indicators, for example, in which model-based theoretical savings, e.g., in sectors, are compared with the actual reductions achieved, are also a conceivable approach.

5.2.6 Step 6 - Institutionalize and continue to develop method

After a successful start of the implementation of CE measures in climate reporting and climate policy, the goal should be a continuation and institutionalization. It is also important to redevelop and further develop methodological approaches as needed in order to be able to feed well-founded findings into policy-making.

Conceivable measures would be the transition from a lean to a comprehensive approach, e.g. by continuously broadening and deepening the scope of the analyses and carrying out own model-based calculations. It may also be useful to introduce mandatory environmental impact assessments in the ex-ante/ex-post evaluation of measures if the initial assessment reveals significant environmental impacts. Of particular importance in terms of permanence is also the promotion of education and training in higher education to strengthen national know-how and expertise.

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36 https://reportnet.europa.eu/

37 https://www.eionet.europa.eu/reportnet/docs/govreg/policies-and-measures/reporting-guidelines-dataflow-9-to-14-policies-and-measures.pdf/view

38 https://ec.europa.eu/eurostat/web/circular-economy/monitoring-framework

6 Conclusions

As our analysis shows, the positive interactions between the CE and climate change mitigation are increasingly being seen and incorporated into national policies (chapter Circular Economy and Climate Policy. It becomes clear that the decarbonisation potential of the CE is increasingly mentioned in corresponding strategies and programmes as about 20 countries link one or more components of their CE policy to climate and climate policy. Overall, the link between CE and climate policies is most often established in waste management plans. CE measureshave also already been taken up in the PaMs reporting corresponding to the NECP. CE-related PaMs account for 5% of the total number of policies and measures stored in this EEA database. Despite it is clear that reducing material consumption results in a lower demand for (raw) materials and thus in a reduction of GHG emissions related to raw material sourcing and processing, PaMs in the field of **resource efficiency** are less prominent in the GHG PaMs database. Decreasing the use of unsustainable resources or increasing resource efficiency, resource productivity or raw material productivity, are only mentioned 3 times in the database.
Although an increasing consideration of the interactions is clearly recognizable, it must be noted that neither in the CE-plans, nor in the PaMs reporting there seems to be a consistent way of assessing the impacts of CE measures on climate change mitigation. Therefore, it is evident that so far hardly any consistent and comprehensive consideration of the GHG reduction potential of CE measures has been carried out. This may be due, among other things, to a lack of knowledge among relevant stakeholders about the significance of the interactions or to a lack of overarching control and coordination.

Further, our findings and also discussions with national experts show that, the partially high complexity of the interactions, combined with open methodological questions and the need for suitable models, are perceived as main challenges to consider the GHG reduction potential of CE. Therefore, we provide an overview analysis of modelling approaches based on a literature review to be able to show the advantages and disadvantages of different approaches with regard to the evaluation of GHG reduction potentials in a condensed form (chapter Model approaches for calculating the decarbonisation potential of the Circular Economy. Our analysis includes bottom-up assessments, in which the individual contributions of the measures to the reduction of greenhouse gases are usually calculated with the help of LCA data and Dynamic Flow-Stock models, which are more complex bottom-up approaches based on MFA (Material Flow Analysis). To consider upstream and downstream effects with regard to demand, scenarios should be modelled with environmentally extended input-output (EEIO) models. If CE measures are to be assessed not only in terms of their effectiveness in reducing GHG emissions, but also in terms of other macroeconomic indicators or their social impacts, macroeconomic equilibrium models are recommended. Another result of the literature analysis is the identification of relevant hot spots, which include construction, heavy industry, and food systems, and also some materials incl. cement, steel, aluminium and plastics. In general, the CE measures described in the analysed studies aim to increase the efficiency of the use of carbon-intensive materials (e.g., less production waste) or aim to fundamentally reduce the sectoral demand of carbon-intensive materials through material substitution. However, more work is needed to sustain these results and further develop the knowledge with finer grained and locally applicable results.

Based on our conclusion, that there seems to be a need for further guidance and harmonization of calculation models and methods for the assessment of the climate change mitigation potential of CE-related PaMs, so that the knowledge base can be strengthened, we developed, together with the Eionet network and the project Advisory Group for this ETC report, a guideline for countries to include CE into climate reporting and policy making. Our six-step guidance approach focuses mainly on the aspects of awareness raising and the systematic evaluation of the interactions between CE and climate change mitigation. Using GHG footprint as a target indicator for CE policy may raise awareness for climate benefits of the CE and could support its acceptance, as e.g. material-based targets can be criticized as unspecific as mass based indicators often do not correlate with environmental impacts (see e.g. Giegrich et al., 2012; Voet et al., 2004). In general, approaches to calculate GHG and other environmental footprints are important tools for fact-based policy making and making sure that CE measures reduce environmental

impacts. Furthermore, GHG footprints offer the advantage that emissions over the whole life cycle are covered, i.e. both territorial emissions and also emissions from the upstream chains of production. CE measures unfold their potential of emission reduction along the whole value chain, within borders and abroad. Their emission reduction potential is thus covered by the footprint perspective. This also allows the development and optimisation of corresponding mitigation strategies. On the other hand, official reporting on climate change mitigation, however, focuses on territorial emissions. So far, in the analysed studies, effects on territorial and emissions abroad have not been presented separately. It would be important in the context of climate reporting that study designs allow for this distinction in the future.

As a result of the previously stated, it is clear that open, overarching issues still need to be addressed before the reporting frameworks for the two policy areas or the corresponding data sources can be harmonized. However, this is becoming increasingly important as more is known about the interactions and the GHG reduction potential of CE measures and is incorporated into relevant policies and strategies. While progress towards an internationally harmonised calculation is advancing in terms of methodology, there is still a need for harmonisation with regard to the respective database. Furthermore, for the use in climate reporting, it is important that all GHG are covered in footprint calculations, and not only CO_2, which is currently the case for some multi regional Input-Output tables MRIOT. With regard to the contribution of CE measures to climate change mitigation, there is also a need for further harmonisation and improvement in the standardisation of reporting. Therefore, there is a need for further research in this area to go further into the direction of developing a methodology for the inclusion of CE in NECPs.

The evaluation of existing studies and analyses as well as the presentation of some country examples have shown that different methodological approaches can be used to assess the decarbonisation potential of CE measures. General advantages and disadvantages of the respective model families could be worked out for such an analysis. In addition, there is also a need for harmonisation with regard to the model approaches and questions of data availability and data quality that could not be addressed in the analysis and thus require further research.

Furthermore, this report only considers the GHG reduction potential aspect of CE measures. However, as the example presented from Germany shows, there is at least one other relevant interrelationship between climate change mitigation and resource conservation. The expected temporary increase in demand for raw materials due to the implementation of climate change mitigation and adaption measures, e.g., the transformation of the energy system, makes the sustainable and efficient use of raw materials indispensable. The CE can thus help the climate agenda to reduce dependencies on raw materials and foster the strategic autonomy of the EU. This aspect of the interaction should also be analysed in more detail. However, as several different approaches, databases and tools are already available to calculate national GHG footprints and assess the emission reduction potential of CE measures. Based on this, it is possible to integrate CE into NECPs as well as NDCs.

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Annex 1: CE targets and objectives in EU policy (strategic documents) and legislation, for 2020-2050

Resource efficiency		
Reference	*Target/objective and deadline*	*Rep. requirements*
2020 CEAP, COM(2020)98 final	Reduce the EU consumption footprint (**2030**)	
2020 CEAP, COM(2020)98 final	Double the EU CMUR (**2030**)	
Product making		
Reference	*Target/objective and deadline*	*Rep. requirements*
EU Plastic Strategy, COM(2018)28 final	All plastics packaging is either reusable or can be recycled in a cost-effective manner (**2020**)	
Directive 94/62/EC on packaging and packaging waste	Reduction in the consumption of lightweight plastic carrier bags (2018 – **2025**)[39]	Every year (Art. 12)
SUP Directive, EU 2019/904	Member States shall ensure that, from **2025**, beverage PET bottles listed in part F (beverage bottles with a capacity up to 3 litres) of the Annex contain at least 25% recycled plastic, calculated as an average for all PET bottles placed on the market on the territory of that Member State.	Every year (Art. 13)
SUP Directive, EU 2019/904	Member States shall take the necessary measures[40] to achieve an ambitious and sustained reduction in the consumption of the single-use plastic products listed by part A of the Annex (cups for beverages and food containers used to contain food intended for immediate consumption) **2026** compared to 2022.	Every year (Art. 13)
Strategy for sustainable and circular textiles, COM(2022)141 final	Textiles are long-lived and recyclable, to a great extent made of recycled fibres, free of hazardous substances (**2030**)	
SUP Directive, EU 2019/904	Member States shall ensure that, from **2030**, beverage bottles listed in part F (beverage bottles with a capacity up to 3 litres) of the Annex contain at least 30% recycled plastic, calculated as an average for all PET bottles placed on the market on the territory of that Member State.	Every year (Art. 13)
Consumption		
Reference	*Target/objective and deadline*	*Rep. requirements*
Strategy for sustainable and circular textiles, COM(2022)141 final	Wide availability of reuse and repair services for textiles (**2030**)	
Waste generation		
Reference	*Target/objective and deadline*	*Rep. requirements*
2020 CEAP, COM(2020)98 final and Zero Pollution Action Plan, COM(2021)400 final	Significantly reduce total waste generation by **2030**	
'Farm to Fork' Strategy, COM(2020)361 final	Halve per capita food waste at retail and consumer levels by **2030** (SDG Target 12.3)	
Waste collection		
Reference	*Target/objective and deadline*	*Rep. requirements*
Directive 2008/98/EC, Waste Framework Directive	Bio-waste shall be either separated and recycled at source, or is collected separately and is not mixed with other types of waste (**2023** – end)	Report by 31.12.2021 (Art. 10)

[39] The measures taken by Member States shall include either or both of the following:

a) the adoption of measures ensuring that the annual consumption level does not exceed 90 lightweight plastic carrier bags per person by 31 December 2019 and 40 lightweight plastic carrier bags per person by 31 December 2025, or equivalent targets set in weight. Very lightweight plastic carrier bags may be excluded from national consumption objectives;

b) the adoption of instruments ensuring that, by 31 December 2018, lightweight plastic carrier bags are not provided free of charge at the point of sale of goods or products, unless equally effective instruments are implemented. Very lightweight plastic carrier bags may be excluded from these measures.

[40] The measures may include national consumption reduction targets, measures ensuring that re-usable alternatives to the single-use plastic products listed in Part A of the Annex are made available at the point of sale to the final consumer, economic instruments such as instruments ensuring that those single-use plastic products are not provided free of charge at the point of sale to the final consumer and agreements as referred to in Article 17(3).

SUP Directive, EU 2019/904	Member States shall take the necessary measures to ensure the separate collection for recycling by **2025**, of an amount of waste single-use plastic products listed in Part F of the Annex (beverage bottles with a capacity up to 3 litres) equal to 77% of such single-use plastic products placed on the market in a given year by weight. INT	Every year (Art. 13)
Directive 2008/98/EC, Waste Framework Directive	Member States shall set up separate collection for textiles (**2025**)	
SUP Directive, EU 2019/904	Member States shall take the necessary measures to ensure the separate collection for recycling by **2029**, of an amount of waste single-use plastic products listed in Part F of the Annex (beverage bottles with a capacity up to 3 litres) equal to 90% of such single-use plastic products placed on the market in a given year by weight. FIN	Every year (Art. 13)
Waste reuse, recycling and recovery		
Reference	*Target/objective and deadline*	*Rep. requirements*
Directive 2008/98/EC, Waste Framework Directive	Recycling and reuse of 70% by weight of non-hazardous construction and demolition waste (**2020**)	Every year (Art. 37)
Directive 2008/98/EC, Waste Framework Directive	Recycling and reuse of 50% by weight of paper, plastic, glass and metal from households (**2020**)	Every year (Art. 37)
Directive 2008/98/EC, Waste Framework Directive	Increase the reuse and recycling of municipal waste to a minimum of 55% (**2025**) INT	Every year (Art. 37)
Packaging Waste Directive 94/62/EC	Increase the recycling rate of packaging waste to 65% (**2025**) INT	Every year (Art. 12)
Packaging Waste Directive 94/62/EC	Achieve minimum targets by weight for recycling regarding specific materials contained in packaging waste: (i) 50 % of plastic; (ii) 25% of wood; (iii) 70% of ferrous metal; (iv) 50% of aluminium; (v) 70% of glass; (vi) 75% of paper and cardboard (**2025**) INT	Every year (Art. 12)
EU Plastic Strategy, COM(2018)28 final	More than half of plastics waste generated in Europe is recycled (**2030**)	
EU Plastic Strategy, COM(2018)28 final	Sorting and recycling capacity of plastics has increased fourfold since 2015 (**2030**)	
Strategy for sustainable and circular textiles, COM(2022)141 final	Development of capacities for innovative fibre-to -fibre recycling (**2030**)	
Directive 2008/98/EC, Waste Framework Directive	Increase the reuse and recycling of municipal waste to a minimum of 60% (**2030**) INT	Every year (Art. 37)
Packaging Waste Directive 94/62/EC	Increase the recycling rate of packaging waste to 70% (**2030**) FIN	Every year (Art. 12)
Packaging Waste Directive 94/62/EC	Achieve minimum targets by weight for recycling regarding specific materials contained in packaging waste: (i) 55 % of plastic; (ii) 30% of wood; (iii) 80% of ferrous metal; (iv) 60% of aluminium; (v) 75% of glass; (vi) 85% of paper and cardboard (**2030**) FIN	Every year (Art. 12)
Directive 2008/98/EC, Waste Framework Directive	Increase the reuse and recycling of municipal waste to a minimum of 65% (**2035**) FIN	Every year (Art. 37)
Waste incineration and landfilling		
Reference	*Target/objective and deadline*	*Rep. requirements*
Landfill Directive 1999/31/EC	Member States shall endeavour to ensure that as of **2030**, all waste suitable for recycling or other recovery, in particular in municipal waste, shall not be accepted in a landfill, with the exception of waste for which landfilling delivers the best environmental outcome.	
2020 CEAP, COM(2020)98 final and Zero Pollution Action Plan, COM(2021)400 final	Halve the amount of residual (non-recycled) municipal waste by **2030** (reference year to be established)	
Strategy for sustainable and circular textiles, COM(2022)141 final	The incineration and landfilling of textiles is reduced to the minimum (**2030**)	
Landfill Directive 1999/31/EC	Ensure that the amount of municipal waste landfilled is reduced to 10% of the total amount of municipal waste generated (**2035**)	Every year (Art. 15)
Other		
Reference	*Target/objective and deadline*	*Rep. Requirements*

Zero Pollution Action Plan, COM(2021)400 final	Reduce by 50% plastic litter at sea and by 30% microplastics released into the environment (**2030**)	

Note: targets (red cells) and objectives (blue cells) are listed in chronological order of the deadlines for implementation. When provided with the same deadline for implementation, objectives are listed first, followed by targets. In case of staged objectives/targets,[41] interim ('INT') and final ('FIN') targets/objectives are distinguished.
Source: own elaboration.

[41] Within the category of staged targets/objectives, the following is included: 1) targets/objectives that are identical but show an increasing level (e.g. percentages) of application over time; 2) targets/objectives that are explicitly staged by legislation, e.g. by indicating different implementation phases.

Annex 2: CE targets set by EU legislation in force with a deadline before 2020

Product making		
Reference	*Target/objective and deadline*	*Rep. Requirements*
Directive 2000/53/EC, ELV Directive	MS shall ensure that materials and components of vehicles put on the market after 1 July 2003 do not contain lead, mercury, cadmium or hexavalent chromium other than in specified cases (**2003**)	
Directive 2011/65/EU on the restriction of the use of certain hazardous substances in EEE	No heavy metals (Pb, Hg, Cd, hexavalent Cr, PBB and PBDE) in monitoring and control devices and medical devices (**2014**)	
Directive 2011/65/EU on the restriction of the use of certain hazardous substances in EEE	No heavy metals (Pb, Hg, Cd, hexavalent Cr, PBB and PBDE) in vitro medical devices (**2016**)	
Directive 2011/65/EU on the restriction of the use of certain hazardous substances in EEE	No heavy metals (Pb, Hg, Cd, hexavalent Cr, PBB and PBDE) in industrial monitoring and control instruments (**2017**)	
Directive 2011/65/EU on the restriction of the use of certain hazardous substances in EEE	No heavy metals (Pb, Hg, Cd, hexavalent Cr, PBB and PBDE) in all electrical and electronic equipment not covered by the previous Directive 2002/95/EC (**2019**)	
Waste collection		
Reference	*Target/objective and deadline*	*Rep. Requirements*
Directive 2008/98/EC, Waste Framework Directive	Separate collection for glass, plastic, metal, paper (**2015**)	
Directive 2006/66/EC on waste batteries and accumulators	Collection target for batteries: 45% (**2016**) FIN	Every year (Art. 10)
Directive 2012/19/EU, WEEE Directive	Collection target for WEEE: – 65% of the average weight of EEE placed on the market in the Member State in the three preceding years or – 85% of WEEE generated in the Member State. (**2019**) FIN	Every year (Art. 16)
Waste reuse, recycling and recovery		
Reference	*Target/objective and deadline*	*Rep. requirements*
Directive 94/62/EC on packaging and packaging waste	At least 60% by weight of packaging waste to be recovered or incinerated at waste incineration plants with energy recovery (**2008**)	Every year (Art. 12)
Directive 94/62/EC on packaging and packaging waste	Between 55% and 80% by weight of packaging waste to be recycled (**2008**)	Every year (Art. 12)
Directive 94/62/EC on packaging and packaging waste	Recycling targets for materials contained in packaging waste must be attained: - 60% for glass, paper and board; - 50% for metals; - 22.5% for plastics and; - 15% for wood (**2008**)	Every year (Art. 12)
Directive 2006/66/EC on waste batteries and accumulators	Producers provide for the treatment and recycling of waste batteries and accumulators, based on BAT (**2009**)	
Directive 2006/66/EC on waste batteries and accumulators	Recycling targets for batteries by average weight: 65% of lead acid batteries, 75% of nickel cadmium batteries, 50% of other batteries (**2011**)	Every year (Art. 12)
Directive 2000/53/EC, ELV Directive	Targets for end-of-life vehicles (by average weight per vehicle per year): reuse and recovery: 95%; reuse and recycling: 85% (**2015**) FIN	Every year (Art. 9)
Directive 2012/19/EU, WEEE Directive	WEEE, with reference to Annex IIII categories: - cat. 1 or 4: 85% recovery and 80% reuse and recycling - cat. 2: 80% recovery and 70% reuse and recycling - cat. 5 or 6: 75% recovery and 55% reuse and recycling - cat. 3: 80% recycling (**2018**) FIN	Every year (Art. 16)
Waste incineration and landfilling		
Reference	*Target/objective and deadline*	*Rep. requirements*
Directive 96/59/EC on PCB & PCT	Decontamination or disposal of equipment with PCB volumes > 5 dm^3 (**2010**)	

Directive 1999/31/EC on landfills	Disposal of biodegradable municipal waste: reduction to 35% of total 1995 biodegradable municipal waste (**2016**) FIN	Every year (Art. 15)

Note: targets (red cells) and objectives (blue cells) are listed in chronological order of the deadlines for implementation. When provided with the same deadline for implementation, objectives are listed first, followed by targets. In case of staged objectives/targets,[42] interim ('INT') and final ('FIN') targets/objectives are distinguished.
Source: own elaboration.

[42] Within the category of staged targets/objectives, the following is included: 1) targets/objectives that are identical but show an increasing level (e.g. percentages) of application over time; 2) targets/objectives that are explicitly staged by legislation, e.g. by indicating different implementation phases.

Annex 3: Types and categories of national CE goals additional to EU ones: overview (2020-2050)

Category	Type	Countries setting only non-binding objectives		Countries setting at least a binding target		Total number of countries
		Countries	*Number*	*Countries*	*Number*	
Resource efficiency	Material footprint or RMC	AT, BE, FI	3		0	3
	Domestic material consumption (DMC)	AT, BE	2		0	2
	Households material consumption	AT	1		0	1
	Direct material input (or remand) (DMI)	BE	1		0	1
	Resource efficiency, resource productivity, raw material productivity or material intensity	AT, BE; DE, EE, ES, FI, HU, LV, PT, SI	10	FR	1	11
	Water intensity/efficiency	ES, HU	2		0	2
	Circular material use rate -CMUR	AT, BG, EE, FI, IE, LV, LT	7		0	7
	Decrease in use/replacement of fossil, non-renewable, abiotic or unsustainably extracted resources	NL	1		0	1
	Decoupling economic growth (GDP) from waste production	BG, EE, IT, PT, RO	5	FR	1	6
Product making	Ban on products containing microplastics		0	ES, IT	2	2
	Ban/reduction of (selected) plastic items placed on the market or consumed		0	AT, BG, CY, DE, EL, ES, FR, HR, HU, LU, MT, PT, RO, SE	14	14
	Obligation/targets to place on the market reusable packaging (including SUP)	AT, SE	2	ES, FR, RO	3	5
	Targets for distributors on reusable/refillable packaging (including SUP)		0	AT, BE, DE, EE, ES, LV, LU, NL, PT, SK	10	10
	Recyclable plastic/packaging	FI	1	ES, FR	2	3
	Recycled content – General (incorporation of waste in the economy)	PT	1		0	1
	Recycled content - Plastic (in packaging or other items)	FI	1	SE	1	2
	Recycled content - Paper		0	FR	1	1
	Recycled content - C&D waste (or waste fractions) in new construction products or materials	MT	1		0	1
	Eco-design of (new/renovated) buildings	BE	1		0	1
Consumption	Prohibition to destruct unsold products		0	FR	1	1
	GPP targets/obligations (broad in scope or directly CE-specific/relevant)	BE, DK, EL	3	EE, FR, IT, LT, PT, SK, SI	7	10
	Market share of eco-labelled products	DE	1		0	1

Category	Type	Countries setting only non-binding objectives		Countries setting at least a binding target		Total number of countries
		Countries	*Number*	*Countries*	*Number*	
	Repair targets for WEEE	BE	1		0	1
	Increase the use of rechargeable batteries	BE	1		0	1
Waste generation	Reduction of waste	NL, PT	2	ES	1	3
	Reduction of municipal/ household waste	BE, BG, HR, HU, IE, LV, PT, RO, SK	9	FR	1	10
	Reduction of biowaste	BE, SK	2		0	2
	Reduction of food losses/waste	BE, ES, PT, SE, CH	5	EL, FR	2	7
	Reduction of WEEE	BE	1		0	1
	Waste generation – Reduction of packaging waste/plastic waste	BE, NL	2		0	2
	Reduction of bulky waste	BE, LU	2		0	2
	Reduction of industrial waste	BE	1		0	1
	Reduction of hazardous waste	BE, LV	2		0	2
Waste collection	Separate collection of glass, plastic, metal, paper	CY, HR, PT, SE	4	ES	1	5
	Separate collection of biowaste	CY, HR	2	BE, ES	2	4
	Separate collection of food waste	BE, SE	2		0	2
	Separate collection of furniture	LT	1		0	1
	Separate collection of bulky waste		0	ES	1	1
	Separate collection of C&D waste	HR	1		0	1
Reuse, Recycle, Recovery	RU - Amount of reused goods (per capita)	BE	1		0	1
	RU - Municipal waste		0	ES	1	1
	RU - Packaging waste	LT	1	FR, PT	2	3
	RU - Plastic waste	FI	1		0	1
	Waste reuse + recycling	LV, NL	2		0	2
	RY+RU of municipal, household waste	DE, DK	2	FR	1	3
	RY+RU of packaging waste (overall and material-specific)	BE, FI, HU, LT, PT	5	CZ, DE, FR, SE, CH	5	10
	RU+RY of plastic waste		0	FR	1	1
	RY of non hazardous waste		0	FR	1	1
	RY of hazardous waste	LV	1		0	1
	RY of metal waste	SK	1		0	1

Category	Type	Countries setting only non-binding objectives		Countries setting at least a binding target		Total number of countries
		Countries	*Number*	*Countries*	*Number*	
	RU+RY+RE of C&D waste (or fractions)	BE, EE, MT, NL	4		0	4
	RY and RE of biowaste	BE, EE, FI, SK	4		0	4
	RE of ELVs	BE	1		0	1
Incineration and landfill	Reduction of waste incineration	BE	1		0	1
	Reduction of incineration of plastic waste	DK	1		0	1
	Reduction of waste landfilled (particularly municipal and non hazardous waste)	BE, HR, LV, LT, NL, PT	6	EL, FR	2	8
	Reduction of biodegradable municipal waste landfilled	EE	1		0	1
	Landfill ban - Recoverable municipal waste		0	CZ	1	1
	Landfill ban - C&D waste		0	FI	1	1
Other	Number of CE-related jobs	BE	1		0	1
	Number of companies with CE practices	BE	1		0	1
	Number of regional strategies incorporating CE aspects	PL	1		0	1
	Targets related to land take	DE	1		0	1
	Targets to reduce littering	BE	1	SE	1	2

Source: own elaboration

Notes:

- *When a 'type' is addressed, at the national level by more than one target/objective, the table reports the most stringent one.*
- *For Austria and Spain, a few targets set in draft legislation were included.*

With regard to Kosovo, seven non-binding objectives related to waste collection and management have been identified. They are shown in the Table below, as they cannot be considered additional to EU ones.

CE objectives of Kosovo:

CE objectives	*Baseline*	*Deadline*	*Source*
Increase the share of waste being separately collected for recycling from 0% to 50% by 2020		2020	Integrated Waste Management Strategy (2013-2022) and Action Plan (ETC/WMGE, 2021)
Reduce the share of waste being landfilled from 90% to 60% by 2020		2020	Integrated Waste Management Strategy (2013-2022) and Action Plan (ETC/WMGE, 2021)
Reduce the share of biodegradable waste disposed of with municipal waste from 95% to 40% by 2020		2020	Integrated Waste Management Strategy (2013-2022) and Action Plan (ETC/WMGE, 2021)
The percentage of total population with access to adequate and regular municipal waste collection services is 80% in 2020 and 100% in 2022		2020 and 2022	Integrated Waste Management Strategy (2019- 2028) and Action Plan (2019- 2021)
The percentage of total generated municipal solid waste being managed in controlled facilities (ie. including sanitary landfill, and/or thermal and/or biological and materials recovery/recycling facilities) is 60% in 2020, 80% in 2025 and 100% in 2028		2020, 2025, and 2028	Integrated Waste Management Strategy (2019- 2028) and Action Plan (2019- 2021)
Treatment facilities with sufficient capacity to meet national needs are installed for C&D waste, animal byproducts waste and health care waste.		2028	Integrated Waste Management Strategy (2019- 2028) and Action Plan (2019- 2021)
Extended producer responsibility mechanisms are applied to four products/waste streams (packaging, WEEE, ELVs and batteries; none currently existing)		2022	Integrated Waste Management Strategy (2019- 2028) and Action Plan (2019- 2021)

Sources: ETC/WMGE (2021)[43]; Integrated Waste Management Strategy (2019- 2028) and Action Plan (2019- 2021).[44]

[43] https://www.eea.europa.eu/themes/waste/waste-management/municipal-waste-management-country/kosovo-municipal-waste-factsheet-2021

[44] http://kepweb.org/wp-content/uploads/2020/04/F_KEP_D0.00.20-Draft_Waste_Management_Strategy-2019-2028.pdf

Annex 4: Key words and corresponding search terms used to select CE related PaMs from the "GHG Policies and Measures"-database

Key word	Search term (ENG/FR)
Circular / Circularity	"circular/circulai"
Product / Production	"product/produi"
Consumption / Consumer	"consum/consom"
Waste	"waste/déchet"
(Secondary Raw / Recycled) Material	"material/matéri"
(Secondary) Resource	"resource/ressour"
Innovation / Innovative	"innovat"
Reduce / Reduction	"reduc/rédui"
Reuse	"reuse/réutil"
Recycle / Recycling / Recycled	"recyc"
Recover / Recovery / Recovered	"recover/récup"
Sustainable / Sustainability	"sustainab/durab"
Environmental	"environm/environnem"
Economy / Economic	"econom/économ"
Just transition	"just transition/juste"
Residue	"residue/résidu"
Sharing	"sharing/partag"
Repair	"repair/répar"
Durable / Durability	"durab"

A circular economy is an economic system that is based on business models which "replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations." (Kirchherr et al., 2017)

Annex 5: CE PaMs included in the EEA database on GHG policies and measures in Europe

N°	Country	Name of policy or measure	Description	Objective(s)
1	**Austria**	Modal shift to environmentally friendly transport modes	The programme 'klimaaktiv mobil' for mobility management and awareness raising is an essential tool to promote environmentally friendly transport modes like public transport, cycling and walking. The cornerstones of 'klimaaktiv mobil' are the funding programme for businesses, communities and associations, target group-oriented counselling programmes, awareness-raising initiatives, partnerships, and training and certification initiatives. With respect to freight transport, investment support for corporate feeder lines aims at shifting transport activities from road to rail.	Transport: Modal shift to public transport or non-motorized transport
2	**Austria**	Further modal shift to environmentally friendly transport modes	Expansion of public transport through additional offers, both in local and long-distance traffic; Simplification of the tariff system; Promotion of intermodal freight transport and rail-bound freight transport through investments in infrastructure expansion	Transport: Improved transport infrastructure, Transport: Modal shift to public transport or non-motorized transport
3	**Austria**	Emission reduction through livestock and feeding management	This measure includes: * climate friendly breeding and feeding; * Reduction of nitrogen excretion; * Promotion of grazing	Agriculture: Activities improving grazing land or grassland management, Agriculture: Improved livestock management, Agriculture: Reduction of fertilizer/manure use on cropland
4	**Austria**	Sustainable N management	Within this measure, the use of mineral fertilizers will be further reduced by improving the overall farm nitrogen management or by paying a premium for the reduced use. Some effective ÖPUL measures already exist for this purpose, which will be further developed or expanded accordingly. ÖPUL = the Austrian Agri-Environmental Programme	Agriculture: Improved animal waste management systems, Agriculture: Other activities improving cropland management, Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
5	**Austria**	Reduce emissions from waste treatment	To reduce emissions from waste treatment, deposition of untreated bio-degradable waste has been banned completely (Austrian Landfill Ordinance). Methane emissions from mass landfills are reduced by the mandatory collection and use of landfill gas. The carbon content of waste is reduced by incineration or mechanical-biological treatment before deposition (pre-treatment options). Biogas plants, treating biogenic waste, gas-tight coverage of storage facilities are required, in order to avoid unintentional leakages. In order to minimise the generation of waste, awareness raising campaigns and networks have been established to minimise especially food waste and to intensify the re-use of waste.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling, Waste: Waste incineration with energy use
6	**Belgium**	Reform fiscal framework to promote sustainable mobility	Reform (Para)fiscal framework to promote sustainable mobility and intermodality.	Transport: Demand management/reduction, Transport: Modal shift to public transport or non-motorized transport
7	**Belgium**	Federal roadmap circular economy	Updating and implementation of the federal circular economy roadmap	Other Sectors: New objective(s)
8	**Belgium**	More sustainable freight transport	Making freight transport more sustainable: Stimulate modal shift to waterway and rail (among others through more investments in infrastructure) and an emission-free urban distribution	Transport: Improved transport infrastructure, Transport: Modal shift to public transport or non-motorized transport
9	**Belgium**	Actions to keep more recyclable waste out of residual waste	The separate collection and recycling of waste streams from households and companies is being pushed up to reduce CO_2 emissions from incineration and primary plastic production. This is coupled with more cooperation with the federal government to make recyclable or reusable packaging more interesting through product policy or financial incentives.	Waste: Demand management/reduction, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
10	**Belgium**	Long-term waste treatment strategy	The realization of an effective reduction of the waste supply must lead to capacity being systematically reduced- starting with the least efficient capacity or with the highest emissions. An investigation will be started in collaboration with the sector into which instruments can be used to ensure that we actually reduce the least efficient capacity. The combustion capacity that we maintain in the meantime must have the highest possible energy efficiency and lowest possible emissions.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Improved treatment technologies
11	**Belgium**	Reducing emissions from fertilisers	Substitute more emissive forms of fertiliser (urea and nitrogen solution) with less emissive forms (ammonium nitrate).	Agriculture: Reduction of fertilizer/manure use on cropland
12	**Belgium**	Food Local productions	Promote local productions and short circuits	Agriculture: Other activities improving cropland management, Agriculture: Other agriculture, Agriculture: Reduction of fertilizer/manure use on cropland
13	**Belgium**	Consumer behaviour and improved sustainability of the entire food chain	Various plans and strategies focus on consumer behaviour - which can have a major- indirect impact on the climate by making particular choices for food - and on improving the sustainability of the entire food chain. These include the Short Supply Chain Strategic Plan- the Organic Agriculture Strategic Plan- the Good Food strategy- awareness-raising for a more sustainable diet and various projects designed to counter food loss and waste- and to maximise the use of biowaste and organic by-products. This strategy has been extended by the Brussels NPEC	Agriculture: Other agriculture
14	**Belgium**	Production of local food	Support to new urban farmers and non-professional farmers (including land purchase) -Creation of a Brussels food belt in cooperation with Flemish and Walloon Regions -deployment of an integrated logistic offer -set up of a scientific reference center focused on urban agriculture -Support to the deployment of a sustainable food offer in school canteens and other canteens managed by public authorities	Agriculture: Other agriculture

N°	Country	Name of policy or measure	Description	Objective(s)
15	**Belgium**	Waste refrigerating fluids recuperation and management	Reducing F-gas emissions by means of certification requirements for refrigeration companies and their personnel and inspection campaigns.	Industrial Processes: Improved control of manufacturing, fugitive and disposal emissions of fluorinated gases
16	**Belgium**	Promotion of car-pooling and car-sharing	Changing the rules of the road- allowing road managers to open a road lane reserved for buses- cars occupied by several people- vehicles used for the transportation company (journey to work).	Transport: Improved behaviour
17	**Belgium**	Meeting on sustainable mobility needs campaign	Raise awareness of citizens to satisfy their mobility needs in a sustainable way	Transport: Modal shift to public transport or non-motorized transport
18	**Belgium**	Mobility plan for civil servants of different administrative organisations sharing a common office building	Increasing the use of mobility plans for civil servants of different administrative organisations sharing a common office building to show good practice by public administrations	Transport: Demand management/reduction, Transport: Electric road transport, Transport: Modal shift to public transport or non-motorized transport
19	**Belgium**	Optimize incineration of wastes	Establish a long-term calendar for the adaptation of the regional incinerator- considering the progressive reduction of the flows intended for incineration- while maintaining the autonomy of the Brussels Region -Capital in the management of its own waste. The study that will frame this adaptation will be conducted in 2020 and will focus on reducing emissions- on upgrading residual waste streams by energy production- on waste imported into Brussels regions and on socio-economic and environmental effects of this transformation (energy production- indirect impacts linked to changes in collection- etc.). The Government will carry out a phasing out study of this incinerator- a phasing out that is desirable in order to meet the region's greenhouse gas emission obligations.	Waste: Demand management/reduction

N°	Country	Name of policy or measure	Description	Objective(s)
20	**Bulgaria**	Transport: REDUCTION OF THE RELATIVE SHARE OF TRIPS WITH PRIVATE MOTOR VEHICLES THROUGH IMPROVEMENT AND DEVELOPMENT OF URBAN PUBLIC TRANSPORT AND DEVELOPMENT OF NON-MOTORIZED TRANSPORT	Improving the urban public transport and non-motorized transport development. With the implementation of projects the following measures will be achieved:- Renovation and development of transport infrastructure and the ability to maintain a sustainable transport system; - Priority development of urban mass transport with fundamental development of the transport function of the subway;- Redirecting of the transit the automobile flows outside the city through construction of bypass routes; - Improving accessibility and connectivity between structural zones; development of bicycle and pedestrian infrastructure;- Improvement of traffic conditions and parking.	Transport: Modal shift to public transport or non-motorized transport
21	**Bulgaria**	Agriculture: Improving fertilization practices Elaboration of irrigation technologies aiming at water use reduction	During the last years fertilization was conducted in an uncontrolled manner. The amounts of nitrous fertilizers applied to soils often exceeded the recommended ones. The requirements for quality of production and lower prime costs grew strict due to expanded import of agricultural goods from the neighbouring countries. These products compete successfully with some local productions both for their quality and price. The appropriate fertilization and irrigation are preconditions for competitiveness of local agricultural production and reduction of N_2O emissions.	Agriculture: Other activities improving cropland management

N°	Country	Name of policy or measure	Description	Objective(s)
22	**Croatia**	MTR-9: Promotion of sustainable intermodal transport at national level	The measure follows the general and specific objectives defined in the Transport Development Strategy of the Republic of Croatia for the period from 2017 to 2030 (OG 84/17) in the context of energy efficiency of rail, road, maritime transport, inland waterway transport and urban, suburban and regional traffic. Development of rail and generally multimodal infrastructure fall behind in comparison to highway infrastructure in terms of quality and connectivity. Investments are planned to develop a sustainable, integrated trans-European climate-resilient transport network. In maritime and inland waterway transport, the possibilities of introducing appropriate mechanisms to ensure the transition to low-carbon solutions will be analysed, especially in terms of the application of alternative energy sources for navigation. In this context, an action plan for shipping will be defined, which will, among other things, define appropriate emission standards for the coming period. Also, in air transport, the Republic of Croatia will define a plan and develop detailed guidelines for achieving a significant reduction in greenhouse gas emissions.	Transport: Improved transport infrastructure, Transport: Low carbon fuels, Transport: Modal shift to public transport or non-motorized transport

N°	Country	Name of policy or measure	Description	Objective(s)
23	**Croatia**	MWM-1: Preventing the generation and reducing the amount of solid waste	Waste prevention is achieved through the process of reuse and the use of by-products and the repealing of waste status, which will directly affect the reduction of the total amount of waste. The implementation of waste prevention measures is defined by the Waste Prevention Plan and the Plan for the Prevention and Reduction of Food Waste in the Republic of Croatia 2019 - 2022 (OG 61/19). The most important measures in terms of waste prevention are the establishment of Centres for reuse and provision of the necessary equipment for home composting as well educational activities. This measure is achieved by cleaner production, education, economic instruments and enforcement of regulations in waste management, and by investing in modern technologies that enable material recovery and chemical recycling of waste. According to the Act, quantitative targets and deadlines for reducing the total amount of waste disposed to non-compliant landfills were defined. Disposal of waste to non-compliant landfills in Croatia was prohibited after 31 December 2017.	Waste: Demand management/reduction, Waste: Reduced landfilling
24	**Croatia**	MWM-2: Increasing the amount of separately collected and recycled solid waste	Beside the Sustainable Waste Management Act, the Waste Management Plan of the Republic of Croatia for the period 2017 – 2022 (OG 3/17) also defines the quantitative targets and deadlines for increasing the amount of separately collected and recycled waste. Waste management objectives are prescribed to encourage the transition to a European circular economy with a high level of resource efficiency, in which the value of products, materials and resources is maintained for as long as possible, and waste generation is reduced to a minimum.	Waste: Demand management/reduction, Waste: Improved treatment technologies, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
25	**Croatia**	MWM-4: Reducing the amount of disposed biodegradable waste	The aim of this measure is to reduce the amount of biodegradable fraction of waste disposed at landfills, thus reducing methane emissions resulting from anaerobic decomposition of waste. Pursuant to the Sustainable Waste Management Act, quantitative targets that relate to the reduction of biodegradable municipal waste disposed to landfills were established. Thus, by the end of 2020, the share of biodegradable municipal waste disposed of in landfills had to be reduced to 35% weight of biodegradable municipal waste generated in 1997, that is 264,661 tons of waste was allowed to dispose. To prevent the disposal of biowaste at landfills and contribute to the achievement of other goals of waste management, it is necessary to encourage citizens to compost. The goal is to achieve that households separate biowaste from other municipal waste by disposing of it in biowaste containers. This measure will cover rural areas, i.e. suburbs of urban areas with a larger number of independent housing units with infield. In the territory of the Republic of Croatia, by implementing this measure, it is possible to reduce up to 90,000 tons of biowaste per year.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling
26	**Croatia**	MEN-36: General consumption (WEM)	Incorporates estimated mitigation potential of measures in the general consumption sector in WEM scenario. Description is given for each measure separately.	
27	**Croatia**	MEN-37: General consumption (WAM)	Incorporates estimated mitigation potential of measures in the general consumption sector in WAM scenario. Description is given for each measure separately.	
28	**Croatia**	MWM-6: Waste	Incorporates estimated mitigation potential of measures in the waste sector. WEM scenario is the same as WAM scenario. Description is given for each measure separately.	

N°	Country	Name of policy or measure	Description	Objective(s)
29	**Cyprus**	Implemented & adopted policies and measures for proper recovery system for Fluorinated greenhouse gases in equipment	Preparation of the proper recovery system for F-gases in equipment; This is an obligation according to EU and national legislation. It is however still not properly implemented. This policy considers that the necessary implementing measures will be taken so that in 2020 proper recovery of F-gases in old equipment is performed. A financial support scheme is under preparation by the Department of Environment to provide an award for the recovery of the gases. It is anticipated that the first supporting scheme will be in place in 2021.	
30	**Cyprus**	Promotion of mitigation actions in the sector of waste	A series of policies and measures are implemented in the waste sector to reduce greenhouse gas emissions such as reduction of the amount of waste that are sent to solid waste disposal sites, reduction of the amount of organics going to landfills, promotion of alternatives for the treatment of the organic fraction of solid waste (anaerobic digestion) and biogas recovery from old landfills.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling
31	**Cyprus**	Promotion of additional mitigation actions in the sector of waste	A series of policies and measures are implemented in the waste sector to reduce greenhouse gas emissions such as reduction of the amount of waste that are sent to solid waste disposal sites, reduction of the amount of organics going to landfills, promotion of alternatives for the treatment of the organic fraction of solid waste (anaerobic digestion) and further biogas recovery from old landfills.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling
32	**Czechia**	Waste management plan 2015-2024	This is a document governs whole waste management in the country. Sets preferences for management practice. Offers prognosis for waste development. This plan focuses on waste prevention, aims at a higher share of recycling (50% for paper, plastic, glass and metal wastes), compulsory separation of biologically degradable communal waste to reach the limit of maximal 35% going to landfill from the total biologically degradable communal waste.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Improved wastewater management systems, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
33	**Czechia**	Circular Economy Package (CEP)	European Commission describes the CEP (EC 2018) as the revised legislative proposals on waste setting targets for reduction of waste and establishing a long-term path for waste management and recycling (EC 2018).	Waste: Enhanced recycling, Waste: Reduced landfilling, Waste: Waste incineration with energy use
34	**Denmark**	7-AG-01(expired): Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture	The action plans contain several measures e.g. with the objective to increase the area with winter green fields and better utilisation of manure.	Agriculture: Reduction of fertilizer/manure use on cropland
35	**Denmark**	7-AG-02(expired): Action Plan for the Aquatic Environment III	The plan contain several measures, where the most import in relation to greenhouse gas emissions are: ? Establishment of 4000 ha wetlands in 2004 and 2005. ? Making the rules on catch crops more rigorous. ? Making the rules on exploitation of N in animal manure more rigorous. ? Additional environmentally friendly measures in crop farming.	Agriculture: Reduction of fertilizer/manure use on cropland
36	**Denmark**	9-WA-01: A ban of landfill of combustible waste.	In 1996 the Statutory Order on Waste was amended to introduce an obligation for municipalities to assign combustible waste to incineration (corresponding to a stop for disposal of combustible waste at landfills) from 1 January 1997. As a result of this, large quantities of combustible waste that used to be disposed of at landfills are now either recycled or used as fuel in Danish incineration plants.	Waste: Reduced landfilling, Waste: Waste incineration with energy use
37	**Denmark**	9-WA-02: The waste tax	A tax is imposed on waste for incineration or landfilling. The taxes are DKK 475 per tonne for landfilling and DKK 60,9/GJ for incineration.	Waste: Reduced landfilling
38	**Denmark**	9-WA-12: Requirements for the possibility of direct recycling at municipal recycling stations	All municipal recycling stations are obliged to make a designated spot available where citizens can hand in objects with the purpose of direct reuse of the objects. The objects should be made available first to private agents such as voluntary organisations and citizens.	Waste: Demand management/reduction, Waste: Enhanced recycling
39	**Denmark**	9-WA-13: Streamlining the sorting and collection of business household-like waste	The guidelines and criteria for the sorting and collecting of household-like waste from businesses are streamlined nationally and made mandatory. The national guidelines, including the usage of similar waste pictograms, must be implemented and followed by no later than the end of 2022.	Waste: Demand management/reduction, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
40	**Denmark**	9-WA-14: Streamlining and mandatory collection schemes for household waste	The guidelines and criteria for the sorting and collecting of household waste are streamlined nationally and made mandatory. The national guidelines, including the usage of similar waste pictograms, must be implemented and followed across all municipalities. The following waste fractions are made mandatory: Food, paper, cardboard, metal, glass, plastic, textiles (as of 2022), carton packaging, hazardous waste, and general waste.	Waste: Demand management/reduction, Waste: Enhanced recycling
41	**Denmark**	9-WA-15: Streamlining with mandatory collection scheme for household textile waste	As of 2022, it will be mandatory for the municipalities to include textile waste as a separate waste fraction in the provided waste collections scheme. Regarding the implementation of the waste collection of textile waste it is important that voluntary organisations have easy access to textiles able to be reused.	Waste: Demand management/reduction, Waste: Enhanced recycling
42	**Denmark**	9-WA-16: Waste sorting in the public space	Waste sorting in the public space will be improved, especially in the public spaces with most people and most waste. A scheme for the collection of plastic waste in the public space will be implemented. The new and improved sorting and collection of waste in public areas will be implemented no later than January 1st 2025 as part of the forthcoming extended producers' responsibility on packaging. It will be analysed whether or not part of the waste managing in public spaces can be funded through waste fees.	Waste: Demand management/reduction, Waste: Enhanced recycling
43	**Denmark**	9-WA-17: Requirements for the municipalities on tenders for bulky waste schemes with re-sorting with regard to higher real recycling and reuse	Municipalities are required to specify in the tender for bulky waste schemes that a sorting must be carried out in order to achieve a high level of real recycling and preparation for reuse. The sorting will ensure that a lesser part of the bulky waste is incinerated.	Waste: Demand management/reduction, Waste: Enhanced recycling
44	**Denmark**	9-WA-18: Demand for smaller losses in recycling plastic	The Executive Order on Waste stipulates that the municipalities must, as of 1 January 2022, set a requirement of 60 per cent actual recycling of the collected plastic waste when the waste is offered for treatment. The municipalities must ensure a high level of real recycling of all recyclable waste types.	Waste: Demand management/reduction, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
45	**Denmark**	9-WA-19: Target of 50% reduction of certain plastic takeaway packaging by 2026	A target of 50 percent reduction of certain plastic take-away packaging in 2026 is set. The goal must initially be sought to be achieved through a binding agreement and collaboration with the restaurant industry. If the goal is not reached by binding agreement, further regulation must be implemented.	Waste: Demand management/reduction, Waste: Enhanced recycling
46	**Denmark**	9-WA-21: Target of 50% sorting of plastic for recycling in the agricultural sector	As an initiative in the Danish climate agreement of June 2020 for a green waste sector and circular economy a sectoral cooperation with the agricultural sector has been established. The goal of the cooperation is to sort out 50% of plastic waste for reuse in 2025 from the agricultural sector and 80% of plastic waste for reuse in 2030 from the agricultural sector. As of 2020, approximately 25% of plastic waste from the agricultural sector is reused. If the sectoral cooperation cannot document the necessary progress by the end of respectively 2023 and 2027 to achieve the goals, new initiatives will be implemented.	Waste: Demand management/reduction, Waste: Enhanced recycling
47	**Denmark**	9-WA-22: Target of 50% sorting of plastic for recycling in the construction sector	As an initiative in the Danish climate agreement of June 2020 for a green waste sector and circular economy a sectoral cooperation with the construction sector will be established. The goal of the cooperation is to sort out 25% of plastic waste for reuse in 2025 from the construction sector and 75% of plastic waste for reuse in 2030 from the construction sector. If the sectoral cooperation cannot document the necessary progress by the end of respectively 2023 and 2027 to achieve the goals, new initiatives will be implemented.	Waste: Demand management/reduction, Waste: Enhanced recycling
48	**Denmark**	9-WA-23: New model for waste management to ensure increased recycling	The new and improved Danish waste inspection will be targeted at the companies where there is the greatest risk that the rules will not be complied with, and where the environmental risk of not complying with the waste rules is the greatest. Concrete tools, methods and a professional basis must be analysed developed for in order to fulfil a strengthened and risk-based waste supervision. On the basis of this analysis, a decision on the new model for waste inspection till be made in 2021.	Waste: Demand management/reduction, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
49	**Denmark**	9-WA-24: Productivity gain on increased recycling of plastics through the synergy effect between a clear framework for the sector, the market gaining access to both household and acquired waste and the increase and streamlining of waste streams	As a result of the Danish climate agreement of June 2020 for a green waste sector and circular economy a productivity gain on the increased recycling of plastics is expected. This is due to an expected synergy effect of the several initiatives in the agreement. This includes a clear framework for the sector, the market gaining access to both household and acquired waste and the increase and streamlining of waste streams.	Waste: Demand management/reduction, Waste: Enhanced recycling
50	**Estonia**	Facilitating the supply and use of renewable sources of energy, by-products, wastes, residues and other non-food raw material for purposes of the bio-economy	The main requirement underlined within this priority is to support the production of heat and electricity from biogas. The objectives are furthered by activities of article 17 in the Estonian Rural Development Plan 2014-2020 which include activity type "Investments into improved performance of agricultural holdings" within the framework of which investments are endorsed to produce electricity, heat, liquid fuels or gas out of biomass.	Agriculture: Other agriculture, Energy Supply: Increase in renewable energy in the heating and cooling sector, Energy Supply: Increase in renewable energy sources in the electricity sector, Energy Supply: Switch to less carbon-intensive fuels
51	**Estonia**	Organic production	The objectives of the measure are to develop organic production, increase the competitiveness of organic production, preserve and improve biodiversity and landscape diversity, preserve and enhance soil fertility and water quality and develop animal well-being. The measure helps to reduce GHG emissions by using organic fertilizers instead of mineral fertilizers. Additionally, emission per one hectare is lower compared to the conventional production.	Agriculture: Activities improving grazing land or grassland management, Agriculture: Improved livestock management, Agriculture: Reduction of fertilizer/manure use on cropland
52	**Estonia**	Agri-environment-climate measures (including seven sub-measures)	To achieve the objects, the measure consists of the following seven sub-measures: Support for environmentally friendly management (also LULUCF), Regional water protection support, Regional soil protection support (also LULUCF), Support for environment-friendly horticulture, Support for growing local plant varieties, Support for keeping animals of endangered breeds, Support for maintaining semi-natural habitats (also LULUCF). The description of the sub-measures can be found in the Estonian Rural Development Plan 2014-2020.	Agriculture: Activities improving grazing land or grassland management, Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Improved management of organic soils, Agriculture: Other activities improving cropland management, Agriculture: Reduction of fertilizer/manure use on cropland, Land use, land use change and forestry: Other land use, land-use change and forestry

N°	Country	Name of policy or measure	Description	Objective(s)
53	**Estonia**	Limiting the percentage of biodegradable waste going to landfill and increasing the preparing for reuse and recycling of waste materials	The focus of the measure is to increase the volume of recycling of municipal waste, including increasing recycling of biodegradable waste and reducing the share of biodegradable waste in landfilling, also developing a nationwide waste collection network with a more efficient reporting information system. Consistent guidance on recycling and preparation for re-use of waste and an expanding and simple waste management system will help increase the amount of waste collected separately and reduce the proportion of biodegradable waste in landfills. The establishment of a national biodegradable waste collection and treatment network is particularly important for reducing GHG emissions from solid waste disposal.	Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Reduced landfilling
54	**Estonia**	Reducing landfilling waste	Landfilling will be reduced by 30% by 2030 and the risk from waste will be significantly reduced.	Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Reduced landfilling
55	**Estonia**	Promoting the prevention and reduction of waste generated, including reducing the hazard of waste	General objective of the measure is to improve the resource efficiency of the Estonian economy and to promote waste prevention in order to reduce the negative effects on the environment and human health. The state supports waste prevention by disseminating information. Various initiatives will be used to implement the measure, environmental management measures will be implemented, additional studies will be carried out, investments will be made and the necessary legislation will be supplemented.	Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
56	**Finland**	Government decision on packaging and packaging waste 962/1997, 1025/2000, 987/2004, 817/2005, 2014/518	The Decision is regulatory by specifying the criteria and markings on packaging waste. It is basically regulatory, but also economic in nature by specifying the system for the economic handling of waste obligations in terms the conditions for handling packaging waste. The key actor is the Finnish Packaging Recycling RINKI Ltd, which is a non-profit service company, operating in conjunction with producer organisations in the packaging sector. Rinki Ltd provides companies with effective and sustainable solutions concerning the execution of producer responsibility for packaging.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling, Waste: Waste incineration with energy use
57	**Finland**	Government decree on landfills (861/1997, revised 2006), Biowaste strategy (2004)	Regulation on biodegradable waste	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Reduced landfilling
58	**Finland**	General reform of waste legislation; Act on Waste (646/2011); Decree on Waste (179/2012); Waste Tax Act (1126/2010)	The general reform of the waste tax has entered into force. The reform provides the basis for more effective waste management with respect to recycling, reduced land filling of organic waste, enhanced collection of CH_4 and better regulated incineration, all contributing to reduced greenhouse gas emissions. The reform combines all different types of policy instruments from planning (mandatory waste plans) to regulation (basis for restrictions on landfills) and economic instruments (waste tax). It applies to all forms of waste production and waste management.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling, Waste: Waste incineration with energy use
59	**Finland**	Aggregated all PAMs/WASTE	The total combination of measures directed to improve waste management and reduce GHG emissions from waste.	
60	**Finland**	National Waste Plan 2030	Waste plan lays down the objectives and measures for waste management and prevention in Finland to 2023.	Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Other waste

N°	Country	Name of policy or measure	Description	Objective(s)
61	**Finland**	Ongoing general reform of waste legislation; Following legislation are under reform: Waste Act (646/2011); Decree on Waste (179/2012); Government Decree on Landfills (331/2013); Government Decree on Packaging and Packaging Waste (518/2014)	The general reform of the waste legislation in ongoing and will be in force in July 2021. The reform provides the basis for more effective waste management with respect to recycling, reduced landfilling of organic waste, enhanced collection of CH_4 and better regulated incineration, all contributing to reduced greenhouse gas emissions. . It applies to all forms of waste production and waste management.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Improved wastewater management systems, Waste: Reduced landfilling, Waste: Waste incineration with energy use
62	**France**	Obligation d'une part minimale de produits de qualité et bio dans les repas de la restauration collective	L'approvisionnement de la restauration collective devra comprendre, en 2022, 50% (en valeur) de produits bio, sous autres signes de qualité ou locaux, dont 20% de produits issus de l'agriculture biologique. A partir de 2020, les usagers devront être informés de la part de produits de qualité entrant dans la composition des repas.	Agriculture: Reduction of fertilizer/manure use on cropland
63	**France**	Plan semences et agriculture durable	Plan semences et agriculture durable contribue à la limitation des émissions de N_2O en appuyant la sélection de plantes économes en azote ainsi qu'en améliorant les ressources en semences de légumineuses.	Agriculture: Reduction of fertilizer/manure use on cropland
64	**France**	Volet agricole de la feuille de route économie circulaire	Le volet agricole de la feuille de route économie circulaire vise à mobiliser les matières fertilisantes issues du recyclage pour substituer en partie les engrais minéraux issus de ressources non renouvelables et contribuer à lapport de matières organiques, et donc de carbone, dans les sols.	Agriculture: Improved animal waste management systems, Agriculture: Improved management of organic soils, Waste: Enhanced CH_4 collection and use
65	**France**	Observatoire national des ressources en biomasse	L'Observatoire national des ressources en biomasse fournit une évaluation des ressources en biomasse et de leurs usages, notamment énergétiques, afin notamment d'anticiper d'éventuels conflits d'usage.	Agriculture: Other agriculture, Energy Supply: Increase in renewable energy in the heating and cooling sector, Energy Supply: Increase in renewable energy sources in the electricity sector, Land use, land use change and forestry: Substitution of GHG intensive feedstocks and materials with harvested wood products, Waste: Other waste

N°	Country	Name of policy or measure	Description	Objective(s)
66	**France**	Le renforcement de la réglementation relative à la récupération des déchets de fluides fluorés et à l'encadrement des équipements préchargés en HFC	Le décret n° 2015-1790 relatif à certains fluides frigorigènes et aux gaz à effet de serre fluorés renforce la réglementation française en matière de récupération des déchets de fluides ainsi que l'encadrement des ventes au public des équipements préchargés en HFC, complétant au niveau national les dispositions du règlement européen F-Gas II.	Industrial Processes: Improved control of manufacturing, fugitive and disposal emissions of fluorinated gases
67	**France**	Renforcement des transports collectifs et partagés (loi d'orientation des mobilités 2019)	La loi d'orientation des mobilités prévoit un renforcement des transports collectifs et partagés : une augmentation de 40 % des investissements en transports entre la période 2014-2018 et 2019-2023 pour notamment améliorer les transports du quotidien ; une meilleure information multimodale (100 % des informations de mobilité accessibles pour un trajet en un seul clic) ; un cadre et des outils pour favoriser le développement des alternatives à la voiture individuelle notamment dans les territoires ruraux (covoiturage, services à la demande, mise à disposition de véhicules en autopartage).	Transport: Modal shift to public transport or non-motorized transport
68	**France**	Le forfait mobilités durables vélo et covoiturage	Depuis 2020, tous les employeurs privés et publics peuvent contribuer aux frais de déplacement domicile-travail en covoiturage ou en vélo de leurs salariés. Ce forfait peut s'élever jusqu'à 500 €/an en franchise d'impôt et de cotisations sociales. La mise en œuvre du forfait au sein de chaque entreprise est facultative. L'Etat a mis en place le forfait à hauteur de 200€/an.	Transport: Modal shift to public transport or non-motorized transport

N°	Country	Name of policy or measure	Description	Objective(s)
69	**France**	Filières à responsabilité élargie du producteur	Les filières à responsabilité élargie des producteurs (REP) sont des dispositifs d'organisation de la prévention et de la gestion de déchets qui concernent certains types de produits. Ces dispositifs reposent sur le principe selon lequel les producteurs, c'est-à-dire les personnes responsables de la mise sur le marché de certains produits, sont rendus responsables de financer ou d'organiser la gestion des déchets issus de ces produits en fin de vie. Il existe actuellement en France 15 filières qui sont soumises à ce principe, mises en place de manière progressive depuis 1992. Un tel dispositif permet l'intégration par le producteur du coût de gestion des déchets dans le coût du produit et encourage l'écoconception de son produit pour les réduire.	Waste: Demand management/reduction, Waste: Enhanced recycling
70	**France**	Obligation de tri des déchets des activités économiques (pour les matériaux papier, carton, plastique, métaux, bois, verre)	Depuis le 1er juillet 2016, les activités économiques (entreprises et administrations) ont une obligation de tri de leurs déchets papier, carton, plastique, métaux, bois et verre, en vue d'une valorisation matière ou énergétique.	Waste: Enhanced recycling
71	**France**	Collecte séparée des déchets ménagers	Les collectivités locales organisent la collecte sélective des déchets selon des modalités qui varient d'une collectivité à l'autre ; les déchets de carton, papier, métal, verre sont collectés de manière séparée.	Waste: Enhanced recycling
72	**France**	Obligation de tri des biodéchets	Une obligation de tri des biodéchets est applicable aux gros producteurs de biodéchets depuis 2012. Le tri à la source des biodéchets sera généralisé pour les ménages d'ici 2025 : chaque Français disposera dune solution de tri de ses déchets de cuisine et de table, afin que ceux-ci puissent être valorisés.	Waste: Enhanced recycling, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
73	**France**	Le fonds déchets	Le fonds déchets géré par l'ADEME vise à soutenir l'ensemble des opérations qui concourent à mettre en œuvre la politique déchets et l'économie circulaire. Le niveau de ce fonds (163 M€ en 2018) permet à l'ADEME d'offrir des soutiens à la plupart des opérations concourant à cette politique, selon des modalités dépendant de la nature des opérations (études, animation, sensibilisation, investissements...) et de leur objectif (prévention, recyclage, valorisation, etc.).	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Improved wastewater management systems, Waste: Reduced landfilling, Waste: Waste incineration with energy use
74	**France**	Plans régionaux de prévention et de gestion des déchets	Le plan régional de prévention et de gestion des déchets est un outil de planification à l'échelle régionale de la prévention et de la gestion de l'ensemble des déchets produits sur le territoire, qu'ils soient ménagers ou issus des activités économiques. Il a pour rôle de mettre en place au niveau régional les conditions d'atteinte des objectifs nationaux de réduction des déchets à la source en priorité, d'amélioration des taux de tri et de valorisation des déchets en second lieu.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling, Waste: Waste incineration with energy use
75	**France**	Déploiement de la tarification incitative pour l'enlèvement des déchets ménagers et assimilés	La tarification incitative consiste à introduire une part variable en fonction de la quantité de déchets produite dans la taxe ou la redevance d'enlèvement des ordures ménagères prélevée par les collectivités pour financer le service public de prévention et de gestion des déchets. La loi de transition énergétique pour la croissance verte d'août 2015 a fixé l'objectif de l'étendre à 15 millions d'habitants en 2020 et 25 millions en 2025 (contre 5 millions en 2015).	Waste: Demand management/reduction, Waste: Enhanced recycling

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76	**France**	Composante déchets de la taxe générale sur les activités polluantes	La composante déchets de la taxe générale sur les activités polluantes (TGAP) est due par tout exploitant d'une décharge ou d'un incinérateur soumis à autorisation. Le fait générateur de la taxe est la réception de déchets par l'exploitant de l'installation. Les taux de la TGAP déchets ont été augmentés progressivement depuis 2009, afin de surenchérir le coût de ces modes de traitement pour en limiter l'utilisation et inciter à la prévention de la production de déchets et au développement du recyclage, en cohérence avec la hiérarchie des modes de traitement des déchets. Par ailleurs, le taux de la TGAP déchets non dangereux est modulé en fonction de critères environnementaux et énergétiques des décharges et incinérateurs, afin d'inciter à l'exploitation des installations présentant les performances environnementales et de valorisation les plus élevées.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling, Waste: Waste incineration with energy use
77	**France**	Feuille de route économie circulaire	La feuille de route sur l'économie circulaire, publiée en avril 2018, vise à mieux produire (éco-conception, incorporation de matières recyclées), mieux consommer (développement du réemploi et de la réparation, allongement de la durée de vie des produits), mieux gérer les déchets (optimisation du tri des déchets, développement du recyclage et de la valorisation) et mobiliser tous les acteurs. La feuille de route propose 50 mesures en faveur de l'économie circulaire. Un projet de loi sur l'économie circulaire et une meilleure gestion des déchets est en préparation pour 2019.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling
78	**France**	La loi anti-gaspillage pour une économie circulaire	La loi anti-gaspillage pour une économie circulaire vise à mettre en place un ensemble de mesures articulées autour de quatre grandes orientations : mettre fin au gaspillage pour préserver les ressources naturelles, mobiliser les industriels pour transformer les modes de production, renforcer l'information du consommateur et améliorer la collecte des déchets et lutter contre les dépôts sauvages	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling
79	**Germany**	Reduction of nitrogen balance surplus through the mass flow balance ordinance	Reduction of farm N surplus	Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
80	**Germany**	separate collection of biological waste (Kreislaufwirtschaftsgesetz)	separate collection of biological waste (Kreislaufwirtschaftsgesetz)	Waste: Other waste
81	**Germany**	avoidance of food waste	Reduction of bio-waste through less food waste	Waste: Other waste
82	**Germany**	Reduction of peat as substrate in gardening	Voluntary agreements with substrate industry and retailers, research in peat substitutes. See https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzprogramm_2030_en_bf.pdf, chapter 3.4.7.3 Conserving peatland, including curbing peat use in growing media	Land use, land use change and forestry: Prevention of drainage or rewetting of wetlands
83	**Greece**	Recovery of organic waste	Reduction of the quantities of biodegradable wastes landfilled through the installation of solid waste treatment facilities. Acc. to national JMD 90439/1846/2021 (transposition act of Directive (EU) 2018/850 amending Directive 1999/31/EC) on the landfill of waste, it is targeted only the 10% of generated municipal solid waste to be landfilled by 2030.Promotion of measures for separate collection of biowaste, recycling, energy recovery and use of sludge in agriculture as fertilizer/compost.	Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Reduced landfilling
84	**Greece**	Common Agricultural Policy (CAP) – Green Direct Payments: reduction of the rate of intensity of agricultural land use and improvement of management of animal waste.	The reduction of the rate of intensity of agricultural land use and the adoption of rules for the obligatory observance of cross compliance system relating to manure management contribute to the reduction of GHGs. Moreover, the disengagement of subsidies from the agricultural production has already enhanced indirectly the reduction of agricultural production and livestock population. In fact, the disengagement of subsidies from the agricultural production along with the enhanced urbanized way of life consist the main reasons for the reduction of agricultural production.	Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Other activities improving cropland management, Agriculture: Other agriculture
85	**Greece**	Common Agricultural Policy (CAP) – Green Direct Payments: Reduction in fertilizers use	Decrease of the use of synthetic nitrogen fertilizer and protection of the groundwater, resulting in a substantial decrease of ?2? emissions.	Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
86	**Hungary**	Act on waste	The National Waste Management Plan (OHT) includes the main waste management targets for the period 2014-2020. The NWMP defines actions related to specific waste flows, identifies objectives, areas of intervention, planned measures, and determines the resources necessary for their implementation. The objectives of the NWMP were defined consistently with the waste related objectives of the EU. Sustainable development is a basic element, while the implementation of a waste hierarchy is the main principle of the NWMP. The application of a waste hierarchy should be a priority in the waste regulations and policies of Member States: prevention of waste, its preparation for recycling, material recovery (reprocessing), other recycling and disposal in landfills. The NAP contains the National Prevention Programme (OMP) covering mainly agriculture, construction and infrastructure, manufacturing, sales, trade, transport, residential and public services. Types of waste concerned: biodegradable waste, construction and demolition waste, hazardous waste, municipal waste, packaging waste, waste from electrical and electronic equipment battery and accumulator waste, and other types of waste. The NPP defines 5 areas of intervention: reduction of construction & demolition waste; increase of recovery share; green public procurement; environmentally friendly production and economic operation; awareness raising. The New Plan for the period after 2020 is currently being prepared (2021-2027).	Waste: Enhanced recycling, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
87	**Hungary**	National Waste Management Plan	The National Waste Management Plan (NWMP) includes the main waste management targets for the period 2014-2020. It defines general and specific actions related to specific waste flows, identifies objectives, areas of intervention, planned measures, and determines the resources necessary for their implementation. The objectives of the NWMP were defined consistently with the EU waste goals. Sustainable development is a basic element, while the implementation of a waste hierarchy is the main principle of the NWMP. The NWMP contains the National Prevention Programme (NPP) covering mainly agriculture, construction and infrastructure, manufacturing, sales, trade, transport, residential and public services. Types of waste concerned: biodegradable waste, construction and demolition waste, hazardous waste, municipal waste, packaging waste, waste from electrical and electronic equipment, battery and accumulator waste, and other types of waste. The NPP defines 5 areas of intervention: reduction of construction and demolition waste, increase of recovery share, green public procurement, environmentally friendly production and economic operation, awareness raising. period. The New Plan for the period after 2020 is currently being prepared (2021-2027).	Waste: Enhanced recycling, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
88	**Hungary**	National Public Waste Management Plan	The National Waste Management Public Service Plan (OHKT), which is Decree No 2017/2003 on the National Waste Management Public Service Plan for 2017 (XII. (22) was promulgated as a Government Decision, describing the current state of the waste management public service in Hungary and listing the tasks of the waste management public service providers. The NPWMP also sets out various EU requirements concerning public waste management services, objectives relating to their fulfilment and additional directions of development. These directions: reduction of waste deposited in landfills, increase of the quantity of recoverable waste, assignment of a priority to using non-recyclable waste for energy purposes, infrastructure development in the field of biodegradable waste (composting). Each year the Government decides on approval of the NPWMP, which is published on the website of Nemzeti Hulladékgazdálkodási Koordináló és Vagyonkezelo Zrt.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Reduced landfilling
89	**Hungary**	Reduction of the share of landfilling in the management of municipal solid waste	The target for the management of municipal waste by 2030 shall be to reduce the landfilling rate to at least 30 %.	Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
90	**Hungary**	Sludge Treatment and Recovery Strategy	The Strategy sets out a 10-year (2014-2023) development plan concerning sludge management in Hungary. Its first stage (Sludge Treatment and Recycling Programme 2014-2017) mainly addresses the preparation of development tasks and treatment equipment. The second stage (2018-2023) involves the implementation of the above, and the preparation and implementation of additional development. The Strategy also provides a conceptual outlook until 2027. (1) capacity building/expansion according to sludge utilisation, application of more recent technologies on demonstration projects and then on a wider scale; (2) implementation of effective territorial organisation of sludge management; (3) encouraging the use of sewage sludge in agriculture by improving the tools available to farmers; (4) validate strategic planning in the use of re-cultivation areas; The progressive build-up of energy recovery capacity; Management and management tools.	Waste: Improved wastewater management systems

N°	Country	Name of policy or measure	Description	Objective(s)
91	**Iceland**	Improved feeding of livestock to reduce enteric fermentation	Reduced emissions from the enteric fermentation of ruminants will be achieved by improved feeding practices, which will be carefully monitored. Enteric fermentation is the process that causes methane emissions from the digestive system of livestock. It is the main source of GHG emissions from livestock and animal husbandry. When the livestock chew and process food they belch out methane. Research, that has been conducted abroad, indicates that it is possible to reduce methane production in the digestive system of livestock in various ways, such as through using substances made from algae. Whether it is possible to reduce emissions from enteric fermentation in Iceland through such means will be explored, and domestic research and development will be supported. The implementation of this policy is aligned with policy 401 on Climate-friendly agriculture and policy 404 on Carbon-neutral beef production, part of which is to assess the status and development of research on enteric fermentation. The project management team on the progress of climate action in agriculture will consequently be in charge of monitoring developments in this field and recommending measures that are suitable for Icelandic conditions when appropriate.	Agriculture: Improved livestock management

N°	Country	Name of policy or measure	Description	Objective(s)
92	**Iceland**	Carbon-neutral beef production	GHG emissions from cattle breeding will be reduced and carbon sequestration at cattle farms will be increased. Efforts will be made to reach the target of making cattle farming carbon neutral no later than 2040. An emphasis will be placed on both reducing GHG emissions and increasing carbon sequestration. To reach the target, research, counselling and education for farmers will be increased. First, cattle farmers' knowledge on carbon emissions and sequestration, improved feeding and manure management techniques, will be built up. The foundation will be knowing the possibilities of each plot of farmland and to build up a transparent and certified framework for the project. The preparation for this project is ongoing and a management group with representatives from the Ministry of Food, Agriculture and Fisheries, the Ministry of the Environment, Energy and Climate and the Farmers Association of Iceland (Bændasamtök Íslands) has proposed a variety of measures, in consultation with RML, The University of Agriculture, Matís (Icelandic Food and Biotech R&D) and more. The group handed in their recommendations in May 2020. It was proposed that part of the projects that will be undertaken now will, on one hand, improve the data that lays the foundation for the carbon inventory for cattle farming and, on the other hand, increase training and education for farmers on the possibilities to reduce their GHG emissions. The goal is for these projects to be concluded by the end of 2022. Proposals on direct measures in farms will be implemented in parallel, which will be useful when the agricultural contracts (búvörusamningar) are reviewed in 2023. The project management team on the agricultural contracts will follow through on the projects.	Agriculture: Other agriculture

N°	Country	Name of policy or measure	Description	Objective(s)
93	**Iceland**	Increased domestic vegetable production.	The aim of this measure is to increase vegetable production in Iceland and promote carbon neutrality in horticulture. Production of Icelandic vegetables will be increased by 25% in the next 3 years. Organic vegetable production will receive increased financial support and efforts will be made for Icelandic horticulture to become carbon neutral no later than 2040. This was agreed upon when the contract for the operation conditions of horticulture production (horticulture contract) was reviewed in May 2020. To support carbon neutrality in Icelandic horticulture by the year 2040, a part of the funding for the horticulture contract will be spent specifically on climate action. Knowledge on carbon emissions and sequestration will be increased, the treatment and use of resources and fertilisers will be improved, waste will be reduced, and an emphasis will be placed on effective agriculture, increased sustainability and other actions that support reaching the target of carbon neutral farming. A holistic approach will be undertaken, focusing on policy strategy in climate-, energy-, employment- and regional affairs, among other significant issues. Farmers' knowledge on climate issues, and possibilities to reduce carbon emissions and increase carbon sequestration, will be improved further. This will be achieved, partly by increasing farmers' access to direct council and education. The emphasis will be on knowing the possibilities of each individual horticultural farm directly, and to build up a transparent and certified framework for the project. At the end of 2020, the Ministry of Food, Agriculture and Fisheries and the Icelandic Association of Horticulture Producers (Samband garðyrkjubænda) decided to fund two specific projects that the Icelandic Association of Horticulture Producers will manage. The projects are vegetation in the city and carbon sequestration. They will focus on increasing knowledge, public interest and participation in cultivation in order to increase carbon sequestration.	Agriculture: Other agriculture

N°	Country	Name of policy or measure	Description	Objective(s)
94	**Iceland**	Ban on the landfilling of organic waste	Landfilling bio and biological waste will be banned in Iceland as a main rule, starting in the year 2021, according to a new legislative bill which was submitted to Parliament in 2020 , amending law nr 55 (2003) on the treatment of waste (Lög um meðhöndlun úrgangs). Provisions in the bill specify that a special collection of bio and biological waste shall be set afoot and that landfilling this waste will be prohibited. This is a change in the legislation and it the goal of the law is, among other things, to create conditions that support a circular economy. The provisions are meant to lead to the sorting of bio waste from other waste in the whole country and it being prepared for reuse or recycling, in line with the how the treatment of waste is prioritized. In the capital area bio waste will be diverted to the gas- and composting plant of Sorpa, at least in part, but in the countryside it is more likely that bio waste will be used for composting as a rule. The measure also includes banning the landfilling of biodegradable waste starting from the year 2023.	Waste: Improved landfill management, Waste: Reduced landfilling
95	**Iceland**	Reduction in food waste	Goal of this measure is to systematically reduce food waste by encouraging several short term and long term projects. In the past years, several projects have been undertaken by the government, NGOs and companies to reduce food waste in Iceland, such as the creation of various educational material, the organization of events to raise public awareness, school projects and discount systems in stores for food products that are nearing the expiration date, innovation in using by-products from food production, a defined government policy and courses on the better use of food products. The Minister for the Environment and Natural resources formed a project management team on food waste to form a holistic plan for the next years on effective measures against food waste. The team, which consists of representatives from consumers, the business sector, NGOs, young people and the government, submitted a report including 24 proposed food waste reduction measures in June 2020. Out of the propositions, the government will be responsible for implementing 14 of the measures and the business sector will be responsible for the rest. The goal is to reduce food waste, throughout the entire value chain, by 30% in 2025 and by 50% in 2030.	Waste: Demand management/reduction

N°	Country	Name of policy or measure	Description	Objective(s)
96	**Iceland**	No landfilling of organic waste	501 bans the landfilling of organic and biodegradable waste and measure 504 proposes the opening of a gas and composting plant accommodating partly the waste which cannot be landfilled anymore. Please find detailed information under 501 and 504.	
97	**Iceland**	Sustainable public procurement	Sustainability will be considered in all public procurement as a main rule. The Central Public Procurement developed a new public procurement policy on Sustainable procurement which was published in January 2021. The government procures goods and services for 117 billion ISK every year, which allows for many opportunities to form a clear environmental policy regarding procurement. Creating a demand for more environmentally friendly goods and services can have significant direct and indirect effects on the market and help pave the way for other businesses or organisations to do the same thing. The Icelandic government furthermore purchases food for approximately 3 billion ISK per year and can, as a big buyer, have a significant impact on food demand, support sustainable procurement, reduce the carbon footprint and support innovation. In the procurement policy for food for government agencies, which the Ministry of Industries and Innovation published in May 2019, an emphasis is placed on altering procurement processes so that cafeterias have access to package free food and that a public calculator for the carbon footprint of food will be designed. It has been declared that the goal is to keep the consumption of red meat in moderation. It has been ensured that the procurement policy for food and the policy on sustainable government purchasing will work together.	Other Sectors: New objective(s)
98	**Italy**	Sustainable Urban Mobility Incentive Program (PrIMUS)	The Sustainable Urban Mobility Incentive Program (PrIMUS) is aimed at municipalities with at least 50,000 inhabitants and provides 15 million euros for sustainable urban mobility actions on three themes: development of cycle infrastructure, sharing mobility and mobility management activities.	Transport: Other transport

N°	Country	Name of policy or measure	Description	Objective(s)
99	**Italy**	Nitrous oxide emissions reduction from manure management	The measure is related to interventions on animal feeding (considering low protein diets), animal housing, storage (including treatment of manure in anaerobic digestion plants for biogas production) and manure spreading for cattle, pig and poultry livestock categories.	Agriculture: Reduction of fertilizer/manure use on cropland
100	**Latvia**	Production of legumes	Support to use of legumes as green manure and fodder in crop rotation. Reduces GHG emissions in LULUCF and agriculture sector.	Land use, land use change and forestry: Other land use, land-use change and forestry
101	**Latvia**	Increase of waste preparation for treatment	Increase of waste preparation for treatment to reduce disposed waste amounts.	
102	**Latvia**	Increase biological waste preparation for treatment to 210 000 t per year	Increase biological waste preparation for treatment. Implementation of separate collection of biological waste. Waste management plan period 2021-2028.	Waste: Reduced landfilling
103	**Latvia**	Increase biological waste treatment to 110 000 t per year	Increase biological waste treatment capacity. Waste management plan period 2021-2028.	Waste: Reduced landfilling
104	**Latvia**	Support for evolving of precision agriculture technologies in crop growing farms to reduce nitrogen use	Measure is associated with promoting of nitrogen fertilizer use reduction and consequently with reduction of nitrogen amount in the run-off. This will reduce N_2O emissions from use of synthetic fertilizers and indirect N_2O emissions from soils. Voluntary/negotiated agreements, because financial support for farmers is available, if a farmer develop precision agriculture technologies in the farm with the aim to reduce GHG emissions.	Agriculture: Other activities improving cropland management

N°	Country	Name of policy or measure	Description	Objective(s)
105	**Lithuania**	Promotion of partial change of the composition of animal feed by reducing methane and nitrogen emissions	To inform farmers about the impact of certain changes in the composition of feed on GHG emissions while maintaining productivity: changes in the feeding of pigs, limited changes to the composition of feed for cattle; to reduce methane emissions from cattle, to inform cattle farmers on the potential for diversification of the composition of animal feed, improving the quality of feed and, at the same time, cattle productivity (e.g. by conversion of conventional wheat and barley straw into maize, sorghum, etc.), reducing the number of carbohydrates and replacing them by unsaturated fats in feed; to introduce nitrogen additives with slowly digestible compounds of nitrogen into feed, to reduce the protein content in feed for dairy cows and to avoid overfeeding.	Agriculture: Improved livestock management
106	**Lithuania**	Promoting environment-friendly and sustainable farming practices	To publicise good practices in environment-friendly and sustainable farming. To make farmers aware of the implementation of eco-schemes based on direct support measures under the CAP Strategic Plan and other policy instruments. It is planned to organise field days and information campaigns on soil-friendly technologies; to fertilise based on actual plant needs, postponing spring fertilisation; to carry out local (targeted) fertilisation and the opportunities and benefits of reducing mineral fertiliser use.	Agriculture: Reduction of fertilizer/manure use on cropland
107	**Lithuania**	To reduce waste quantity in landfills	To reduce municipal waste recycling for at least 65% of the total waste by 2020. Municipal biodegradable waste disposed of in landfills should not exceed 35% of municipal biodegradable waste compared to 2000. To use methane (CH_4) gas from landfills for energy generation. To incinerate waste in CHP plants	Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
108	**Lithuania**	Creating financial incentives to promote repair activities	Establishment of financial incentives to encourage repairing of bicycles, shoes, leather goods, clothing, furniture, etc. by considering the possibilities of alleviating the tax burden in order to encourage not discarding and re-use of old items. The measure will reduce waste landfilling by 0.5% per year.	Waste: Enhanced recycling, Waste: Reduced landfilling
109	**Lithuania**	Prevention of food waste	Raising public awareness and promoting behavioural change through social campaigns using the media, social networks, online and other information channels on food waste problem and can be avoided (consumption patterns, sorting of food waste, separate collection, recovery, etc). Creation and promotion of a mobile application about food nearing its best-before date but safe and suitable for consumption. Food waste will be reduced by 21%.	Waste: Reduced landfilling
110	**Lithuania**	Improvement of residents' waste sorting skills	Raising public awareness of the possibilities, benefits, different waste disposal sites and sorted waste through various information channels and instruments. Development, regular updating and promotion of a mobile interactive application to encouraging waste sorting among the public (involving all municipalities). The quantities of sorted and recycled waste are expected to increase as the residents' waste sorting skills and the conditions for sorting improve. Due to the presentation of new information, the amount of municipal waste recycled will rise by 15% of the amount of municipal waste generated. The information covers both theoretical information on the benefits and environmental impacts of recycling and practical information on where and how residents can sort waste.	Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
111	**Lithuania**	Improvement of the skills of specialists consulting on dangerous waste and training of company representatives on identification of dangerous waste	Development of a common methodology for the identification of hazardous waste for environmental authorities and economic operators. Providing training for environment professionals on the identification and classification of hazardous waste and company consulting. The organisation of training for business representatives on the identification and classification of hazardous waste.	Waste: Other waste
112	**Luxembourg**	Agriculture - Rural Development Programme - practices to reduce GHG emissions and ammonia	This PaM covers priority 5.D.3. of the Rural Development Programme, i.e. livestock management practices to reduce GHG emissions and ammonia. Reduced tillage reduces overall fuel consumption and thus reduces CO_2 emissions. Modern slurry spreading techniques can significantly reduce ammonia losses. Reduction of nitrogen fertilization helps to reduce NO2 emissions. It is therefore a question of promoting methods that help to limit the emission of GHG.	Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Improved management of organic soils, Agriculture: Reduction of fertilizer/manure use on cropland
113	**Luxembourg**	Transport - mobility - promotion of car-pooling and car-sharing	Setting up of a national car-pooling portal in order to promote this alternative form of transportation and to increase the car occupancy rate, which is as of now at 1.2 passengers per car. Setting up of car-sharing facilities in order to reduce the number of cars per household. It is evaluated that one shared car through a car-sharing scheme and infrastructure could replace 7 to 10 private cars. Car-sharing would also allow to promote the use of public transport by offering flexibility when reaching a journey destination.	Transport: Demand management/reduction, Transport: Improved behaviour

N°	Country	Name of policy or measure	Description	Objective(s)
114	**Luxembourg**	Waste - overall management - National Waste & Resources Management Plan	According to Article 36 of the law of 21 March 2012 concerning the management of waste, the next national waste management plan is currently being elaborated. Luxembourg's national waste plan is a fundamental instrument which drives the waste management policy. Except for radioactive waste and waste from extractive operations, it covers all waste types (municipal solid waste, food and organic waste, packaging waste, electrical and electronic equipment/batteries) and has the goal to promote measures related to prevention and management of waste. The national waste plan does not include any quantitative targets.	
115	**Luxembourg**	Waste - overall management - polluter pays principle	In application of Art. 17(3) of the law of 21 March 2012, municipal charges must cover all costs incurred by municipalities in relation with waste management. The taxes charged to the various households and, where applicable, of establishments, must consider the quantities of waste actually produced. For these purposes, the taxes must include at least one variable component calculated as a function of the weight and / or the volume of the residual household waste in a mixture actually produced as well as a variable component calculated according to the weight and / or volume of bulky waste actually produced.	Waste: Demand management/reduction
116	**Luxembourg**	Waste - overall management - reduced consumption of plastic bags	Reducing the consumption of (lightweight) plastic carrier bags.	Waste: Demand management/reduction
117	**Luxembourg**	Waste - landfills - overall management - advanced waste collection system	According to the Grand-Ducal Regulation of 1 December 1993 concerning the collective management of waste, it is mandatory to separately collect waste categories for which different treatment is required. Hence, an advanced waste collection system has been implemented, often with waste collection charges, allowing the evaluation of annual quantities of municipal waste.	Waste: Demand management/reduction, Waste: Improved landfill management, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
118	**Luxembourg**	Waste - landfills - overall management - reduced landfilling of municipal solid waste	The modern requirements for disposal sites of the Landfill Directive 1999/31/EC aiming at preventing or reducing environmental damage by landfilling waste have been transposed into national legislation through the Grand-Ducal Regulation of 24 February 2003, subsequently amended and rectified by the Grand-Ducal Regulation of 17 February 2006. In order to reduce methane generation, Luxembourg has decided to minimise quantities of waste dumped into landfills as much as possible.	Waste: Reduced landfilling
119	**Luxembourg**	Waste - recycling - packaging waste	Pursuant to Directive 2015/720/UE, Art. 6. of the law of 21 March 2017 on packaging waste defines that packaging managers are required to achieve, on an individual or collective basis, the following minimum targets for recovery and recycling: (1) 65% by weight of packaging waste shall be recovered or incinerated in incineration plants of waste with energy recovery; (2) 60% by weight of packaging waste shall be recycled with the following minimum recycling for the materials contained in the packaging waste: 60 per cent by weight for glass, 60 per cent by weight for paper and cardboard, 50 per cent by weight for metals, 22.5 per cent by weight for plastics, considering exclusively materials that are recycled as plastics and 15 percent by weight for wood.	Waste: Enhanced recycling
120	**Luxembourg**	Waste - overall management - bio-waste	According to Art. 25 of the modified law of 21 March 2012, (1) bio-waste must be separately collected in order to subject it to a composting operation or digestion or, if due to the nature of the material this is not possible, to any other recovery operation and (2) the treatment of bio-waste must be carried out in a manner compatible with a high level of environmental protection. The use of materials produced from bio-waste must be carried out without risk to the environment and human health.	Waste: Demand management/reduction, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
121	**Malta**	Agriculture Waste Management in the Maltese Islands (2015-2030)	To cater for the management of agricultural waste in Malta and to safeguard the competitiveness of the livestock sector whereby in spite of restructuring, significant imbalances between number of heads and resources for manure/slurry management persist.	Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Other activities improving cropland management, Agriculture: Reduction of fertilizer/manure use on cropland
122	**Malta**	Waste Management Plan for the Maltese Islands	The plan is focused towards implementing Malta's EU obligations and targets set in the various EU directives and regulations pertaining to Waste Management. The plan's scope can be summarised in terms of changes to the waste management systems and waste management behaviour as follows: - Move up the Waste hierarchy for a many waste streams as possible- Reduce Waste Generation- Increase waste separation at source- Increase recycling- Avoid landfilling of wastes otherwise treatable or with a Degradable organic component	Waste: Other waste
123	**Netherlands**	Government-wide Programme for a Circular Economy [entitled 'A Circular Economy in the Netherlands by 2050']	To ensure that in 2050 everyone has enough to eat and can buy the goods they need, like clothing and electrical devices, the economy needs to become circular, with basically no waste. To achieve this, the Government-wide Programme for a Circular Economy, entitled 'A Circular Economy in the Netherlands by 2050', was presented to parliament in September 2016. The programme sets out what we need to do in order to utilise raw materials, products, and services in more efficient and smarter ways, thus enabling to realise the ambition - the Netherlands circular by 2050. In this transition, many parties participate: companies, governments, knowledge institutes, NGOs and many more. The government has selected 5 economic sectors and value chains that will be the first to switch to a circular economy. The agreement has further been worked out in 5 transition agenda and an implementation programme. The 5 economic sectors are: biomass and food, plastics, manufacturing industry, construction sector and consumer goods. Many links and overlaps exist with climate policy.	Agriculture: Other agriculture, Industrial Processes: Other industrial processes, Transport: Other transport, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
124	**Netherlands**	Green Deal 225 Car sharing II	The Green Deal on Car sharing II (a follow up of an earlier first deal on car sharing) is an agreement between a broad coalition of providers of car sharing, leasing companies, insurance companies, municipalities, businesses, interest groups as well as the national government, to join forces with the aim to expand the car sharing concept and implementation. The ambition was to increase and extent the network up to some 100 000 cars in 2021 and some 700 000 users. The goal of 700.000 users was reached in 2020. In 2019/2020 extra communication support was planned by the government as response also to the Urgenda court ruling. There is also a similar agreement (City Deal) specifically on the sharing of electric cars.	Transport: Demand management/reduction, Transport: Improved behaviour
125	**Netherlands**	National Programme Agricultural Soils (NPL) (Sustainable management of agricultural soils)	Through smart and sustainable management of agricultural soils, CO_2 capture may be enhanced. The government together with other parties develop measures toward a sustainable management of all agricultural soils by 2030 a.o. through a national programme	Agriculture: Improved management of organic soils
126	**Netherlands**	Subsidy scheme Circular Economy Projects (substance chain)	An innovation-oriented subsidy scheme for entrepreneurs that in cooperation want to develop new products, processes, services or business models to make a substance/product chain more circular and use less natural resources and/or less CO_2 emissions. After the project the new product/service/etc. is to be introduced on the market	Industrial Processes: Other industrial processes, Waste: Enhanced recycling

N°	Country	Name of policy or measure	Description	Objective(s)
127	**Netherlands**	Conversion programme livestock farming & the circular agriculture approach	In its vision on "Agriculture, nature and food: valuable and connected“ the ministry describes its longer term vision on developments towards more circular agricultural practices. In such a circular system, arable farming, livestock farming and horticulture primarily use raw materials from each other’s supply chains and waste flows from the food industry. Circular chains may be within a company, at local level, within the Netherlands or across national borders. This will contribute towards improving biodiversity as well as circular economy and climate policies. Given the urgent need to decrease nitrous oxide depositions, for the short term a conversion programme for livestock farmers is being set up (with intended start of the first schemes in 2021) to accelerate extensification of the subsector also by offering demonstration/pilot projects as well as subsidy schemes for farmers that want to change to less intensive and more sustainable practices.	Agriculture: Reduction of fertilizer/manure use on cropland
128	**Norway**	Regional agri-environmental programme	The regional agri-environmental programmes are support schemes directed at environmental challenges in different parts of the country. Each county (region) uses schemes/measures taken from a national “menu”, according to the priorities of the regional environmental programme. These involve area-based payments for farming practices to achieve various agri-environmental targets, such as reducing run-off and emissions. Few measures are directed primarily to abate GHG emissions, but several of the supported measures may have co-benefits for GHG emissions and/or increased carbon sequestration. Such supported measures include no/delayed tillage (no-autumn tillage), cover crops and environmentally friendly spreading of manure. For more information, see BR4 chapter 4.2.9.1.	Agriculture: Improved animal waste management systems, Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
129	**Norway**	Support scheme for Special Environmental Measures in Agriculture	The support scheme for Special Environmental Measures in Agriculture support investments towards environmentally friendly practices. From 2017 this scheme has been expanded to support better storage of manure, to control emissions of CH_4 and N_2O. For more information see BR4, chapter 4.2.9.3.	Agriculture: Improved animal waste management systems
130	**Norway**	Prohibition of depositing biodegradable waste	Landfilling of easy degradable organic waste was prohibited in 2002 and was replaced by the wider prohibition of depositing from 2009 that applies to all biodegradable waste.	Waste: Improved landfill management, Waste: Reduced landfilling
131	**Norway**	Agreement with industry to minimise waste	Agreements primarily to ensure that waste is collected and sent to approved treatment. it is correct to also cover CO_2 and N_2O since the PaMs can influence the amounts of waste combusted.	Waste: Enhanced recycling
132	**Norway**	Measures to increase waste recycling	Waste regulations for a number of waste fractions and a tax on beverage packaging. It is correct to also cover CO_2 and N_2O since the PaMs can influence the amounts of waste combusted.	Waste: Enhanced recycling
133	**Norway**	Tax on final disposal of waste	Tax on incineration up to 2010 and for landfills up to 2015. Tax on incineration from 2021.	Waste: Demand management/reduction, Waste: Enhanced recycling
134	**Poland**	Agri-environmental measures	Measures to restore, preserve and enhance ecosystems related to agriculture and, at the same time, to implement the objectives of rural development which include, among others, climate change mitigation and adaptation.	Agriculture: Activities improving grazing land or grassland management, Agriculture: Other activities improving cropland management, Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
135	**Poland**	Research and scientific and educational projects in the scope of rational and low-emission agricultural production	Research measures to develop rational and low-emission agricultural production and to improve the knowledge of low-emission farming in rural areas.	Agriculture: Activities improving grazing land or grassland management, Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Improved management of organic soils, Agriculture: Other activities improving cropland management, Agriculture: Reduction of fertilizer/manure use on cropland
136	**Poland**	Rational waste management	Measures to implement the objectives of the National Waste Management Plan – to implement the principles of waste management, in particular, the waste management hierarchy by preventing waste generation, reducing the quantity of municipal waste landfilled, establishing and maintaining general systems for separate waste collection, maintaining in the country an integrated and adequate network of waste management installations, building or modernising the existing installations.	Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Reduced landfilling
137	**Portugal**	To promote the transition to a circular economy.	With a view to decarbonising the economy, it is intended to increase the levels of material use circularity, to lead to a substantial adaptation of (new) business models that replace the provisioning of goods with the provision of services and property by use, and the proximity between production and consumption and reduce consumption by turning waste into (new) resources. Pursue the vision and actions of circular economy that contribute to the reduction of GHG emissions provided for in the Circular Economy Action Plan, by promoting material recirculation, material efficiency of products and streamlining circular business models. Strengthening the outlook for the circular economy, efficient, zero-emission solutions over the next 30 years. Promoting the circular economy in industry, it is possible to develop innovation, develop low-carbon products designed for multiple life cycles, new business models and reduce energy and materials consumption, contributing to the fight against climate change.	Industrial Processes: Other industrial processes, Transport: Modal shift to public transport or non-motorized transport, Transport: Other transport, Waste: Enhanced recycling, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
138	**Portugal**	Reduction of waste production and of landfill disposal and promotion of recycling.	Prevent waste production and hazardousness, increase preparation for reuse, recycling, improve the quality of recyclables and reduce landfilling. Consolidate and optimize the waste management network and promote power generation at waste management facilities.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Reduced landfilling
139	**Portugal**	Reducing the use of nitrogen fertilisers.	Reduced use of synthetic fertilizers and their replacement with organic compost, based on the Good Agricultural Practices and the EU Fertilizer Regulation (which will replace the current EC Fertilizers Regulation 2003/2003), greater efficiency in the use of fertilizers and the replacement of the synthetic fertilizers for organic compost.	Agriculture: Reduction of fertilizer/manure use on cropland
140	**Romania**	Order no. 344/708/2004 approving the technical rules on environment protection, particularly soil protection, when using sludge in agriculture	Establishes the concentration of heavy metals in soil to which sludge is applied, concentration of the heavy metals in sludge, the maximum annual concentration of heavy metals which may be introduced into cultivated soils and the criteria for evaluation of soil suitability in sludge application. Promoting the use of sewage sludge on agricultural land reduce the level of applied synthetic fertilisers.	Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Other activities improving cropland management
141	**Romania**	Law no. 211/2011 regarding waste management, with subsequent amendments	Establishes requirements for preventing and reducing the adverse impact of the generation and management of waste. Starting with 2012, the public local authorities shall assure the separate collection for at least paper, metal, plastic and glass. Also, till 2020, the produces and the local public authorities shall achieve a preparation level for reuse and recycling (at least 50% of the total waste mass - paper, metal, plastic, glass from municipal waste) and a preparation level for reuse, recycling and other recovery operation (at least 70 % of the non-hazardous waste mass from construction and demolition activities).	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Improved wastewater management systems, Waste: Reduced landfilling, Waste: Waste incineration with energy use

N°	Country	Name of policy or measure	Description	Objective(s)
142	**Romania**	GD no. 870/2013 approving the National Strategy on Waste Management	Establishes the strategic policy and objectives of Romania in the short (2015) and medium term (2020) waste management area.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved treatment technologies, Waste: Improved wastewater management systems, Waste: Reduced landfilling, Waste: Waste incineration with energy use
143	**Romania**	GD no. 942/2017 approving the National Waste Management Plan	Includes clear and coherent measures to achieve the objectives of preparation for reuse and recycling of waste by 2020	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling
144	**Romania**	GD no. 621/2005 on the management of packaging and packaging waste, amended and supplemented by GD no. 1872/2006 and GD no. 247/2011.	Establishes rules for the packaging and packaging waste management and objectives concerning the recovery or incineration at waste incineration plants with energy recovery and, respectively, concerning the recycling of packaging waste, in line with transition period.	Waste: Enhanced recycling, Waste: Reduced landfilling, Waste: Waste incineration with energy use
145	**Romania**	Law no. 621/2005 on the management of packaging and packaging waste, with subsequent amendments	Establishes measures to prevent the production of packaging waste, the re-use of packaging, recycling and other forms of recovery of packaging waste and, consequently, the reduction of the final waste disposal.	Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Waste incineration with energy use
146	**Romania**	GD no. 1037/2010 regarding waste from electric and electronic equipment/ Implementing Eu policy Directive 2002/96/EC	Establishes requirements for preventing of waste electrical and electronic equipment (WEEE) and promote reuse, recycling and other forms of recover. The executive authorities of administrative-territorial units shall ensure the existence and operation at least one point for separate collection of WEEE from private households to 50,000 inhabitants, but no more than a collection point in each village. Till 31 December 2015, the EEE producers shall organize the collection of WEEE from private householders in order to ensure the average rate of separate collection at the national level at least 4 kg /capita/year.	Waste: Enhanced recycling, Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
147	**Romania**	GEO no. 5/2015 regarding waste from electric and electronic equipment	Establish measures to protect the environment and public health by preventing or reducing the negative effects of the generation and management of waste electrical and electronic equipment, by reducing the overall effects of the use of resources and by improving the efficiency of the use of these resources,	Waste: Enhanced recycling, Waste: Reduced landfilling
148	**Romania**	GD no. 349/2005 on landfill of waste, amended and supplemented by GD no. 201/2007 and GD no. 1292/2010	Establishes the national targets concerning the reduction of the quantities of biodegradable waste landfilled, comparing to the year 1995, in line with transition period. Also, establishes the compliance calendar for the existing landfills (41 non-compliant municipal landfills in operation between 2013-2017, shall stop operating by 2017).	Waste: Enhanced recycling, Waste: Reduced landfilling
149	**Romania**	Improving solid waste management	The future provisions of the new County Waste Management Plans were considered that will include clear and consistent measures for achieving the reuse and recycle targets by 2025 and 2040.	Waste: Enhanced recycling, Waste: Reduced landfilling
150	**Romania**	WEM Scenario - Waste	WEM Scenario - Reduction of GHG emissions for Waste sector	
151	**Romania**	WAM Scenario - Waste Sector	WAM Scenario - Reduction of GHG emissions for Waste sector	
152	**Slovakia**	Collection of biodegradable municipal waste	By amending the Waste Act, municipalities and cities are obliged to ensure the sorting of municipal biological waste. The main goal of this change is to reduce, ideally remove kitchen organic waste from mixed municipal waste. In practice, this means that in addition to the current coloured containers and containers for separate waste collection, there will be additional container for food residues from the kitchen. The aim of this measure is to reduce the amount of biodegradable municipal waste that is disposed to landfill by collecting the biodegradable municipal waste. The measure reduces methane emissions produced by waste decomposing in landfills.	Waste: Reduced landfilling

N°	Country	Name of policy or measure	Description	Objective(s)
153	**Slovakia**	Reduction of inorganic nitrogen fertilisers use	The measure objective is reduction of nitrous oxide emissions through reduction of inorganic nitrogen fertilisers use, alongside with other improvements in fertiliser management that lead to decreased losses of nitrogen to air and water. The goal of reducing the consumption of nitrogen fertilisers by 20% by 2030 was implemented in WAM scenario, the measure aims to reduce the consumption of inorganic nitrogen fertilizers. There is a transitional period implemented in the emission projections. It is expected that the Slovak Republic will negotiate its own percentage reduction in fertiliser consumption and will claim a transitional period, which will also be enshrined in legislation. It will be necessary to adjust the emission projections in line with the future valid national strategy and legislation. This measure has been included in the list of measures based on the adopted Farm to fork strategy. The mechanism of the measure is not yet precisely defined, but the measure is in synergy with other reported measures number 24 and number 21. As part of the preparation of the future Common Agricultural Policy Strategic Plan, the plan will follow the rules of good agricultural practice and precision farming. One of the planned measures is the so-called Nutrient management plan, which is currently being prepared and will be introduced into agricultural practice after its elaboration and approval.	Agriculture: Reduction of fertilizer/manure use on cropland
154	**Slovenia**	Reduction of amount of generated waste and promotion of reuse and recycling	Waste prevention programme which was accepted by the government in 2016 and contains more than 30 measures targeted to decrease generation of waste in different sectors (construction, companies, public sector, households, etc.). Main measure is awareness raising, information campaigns and educational activities. Other measures are: green public procurement, record of generated waste in public sector, increase the number of companies included in environmental performance schemes, etc.	Waste: Demand management/reduction

N°	Country	Name of policy or measure	Description	Objective(s)
154	**Slovenia**	Changes in environmental taxation of waste management	Increase in taxation for deposition of waste on landfills and other changes in environmental taxation for waste management to enforce new waste management hierarchy (prevention, preparing for re-use, recycling, recovery, disposal)	Waste: Reduced landfilling
155	**Slovenia**	Improving the system of packaging waste collection	The Packaging waste collection system was improved by implementing extended producer responsibility to prevent any environmental impact by packaging waste. Part of this measure is also better reporting of companies that are dealing with packaging waste. This has been implemented and companies also have to inform final consumers.	Waste: Enhanced recycling
156	**Slovenia**	Reduction of landfilled biodegradable waste	Reduction of landfilled biodegradable waste will be achieved through decrease of landfilled waste and decrease in share of biodegradable waste in landfilled waste. Decrease in landfilled waste will be achieved by: implementation of pay as you throw concept, improving the system for collection of packaging waste and change in taxes for waste landfilling to promote other types of waste management. To increase interest in collection and treatment of biodegradable waste changes in criteria for use of compost or digestate are foreseen. By 2016 on all operating landfills technology for enhanced treatment of municipal waste has been operational, including biodegradable waste stabilisation.	
157	**Slovenia**	Promoting a sustainable choice of transport in the context of the calculation of compensation for transport costs to work	Establishment of suitable sustainable solution for the costs returned for transport to work with the goal of increasing use of public passenger transport and other sustainable modes of transport	Transport: Improved behaviour, Transport: Modal shift to public transport or non-motorized transport
158	**Slovenia**	Incentives for the implementation of above-standard farming methods that contribute to the reduction of nitrous oxide emissions	Intensify measures contributing to reduction of nitrous oxide emissions in the frame of the Strategic plan of Common Agricultural Policy (low-ammonia fertilization techniques, cover crops, fertilization based on Nmin, manure incorporation, …)	Agriculture: Activities improving grazing land or grassland management, Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Reduction of fertilizer/manure use on cropland

N°	Country	Name of policy or measure	Description	Objective(s)
159	**Spain**	LAW 22/2011, ON WASTE AND CONTAMINATED SOILS	Legislación básica que emana de la Directiva marco de residuos. En ella se enmarcan los diferentes planes en materia de prevención y gestión de residuos. Establece la jerarquía de residuos y los objetivos a 2020. Se complementa con normativa nacional y regional.	
160	**Spain**	Promotion of collective transport for employees: Royal Decree-Law 6/2010, of 9 April, on measures to boost economic recovery and employment. - Transport voucher	El Real Decreto Ley establece una desgravación del Impuesto de la Renta de Personas Físicas por pagos a trabajadores para uso de medios de transporte colectivo. Se denomina Vale transporte	Transport: Modal shift to public transport or non-motorized transport
161	**Spain**	National Waste Prevention Program 2014-2020	El Programa de Prevención incluye medidas para reducir la generación de residuos en todos sus ámbitos, en línea con lo que establece el artículo 9 de la directiva marco de residuos. Involucra a todos los agentes implicados, a través de 4 líneas estratégicas: reducir la cantidad, reducir la peligrosidad, fomentar la reutilización, y reducir los impactos ambientales.	Waste: Demand management/reduction, Waste: Enhanced recycling
162	**Spain**	More food less waste Strategy 2017-2020	Esta estrategia busca la prevención y reducción del desperdicio alimentario a través de un cambio de actitudes, sistemas de trabajo y sistemas de gestión, implicando a todos los agentes de la cadena alimentaria. Se integra en el Plan Estatal de Prevención de Residuos (medida 80)	Waste: Demand management/reduction
163	**Spain**	National Waste Management Framework Plan 2016-2022	Sus medidas se ajustan a la jerarquía de gestión de residuos. Marca objetivos de reducción de vertido y de incremento de la recogida separada y del reciclado. Es de aplicación a todos los residuos en el ámbito de la ley 22/2011 de Residuos y Suelos contaminados.	Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Reduced landfilling, Waste: Waste incineration with energy use
164	**Spain**	Spanish Circular Economy Strategy. SPAIN 2030	Impulsa la eficiencia en el uso de los recursos en el marco del Paquete de Economía Circular de la Unión Europea y su Plan de Acción. Se articula a través de programas de trabajo trienales, el primero 2021-2023 incluye las priemeras medidas a poner en marcha, en los siguientes ámbitos: Producción, materias primas secundarias, consumo, gestión de residuos, reutilización del agua, Investigación, desarrollo e innovación (I+D+i), participación y sensibilización, y empleo y formación.	Industrial Processes: Installation of abatement technologies, Industrial Processes: Other industrial processes, Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Improved treatment technologies, Waste: Improved wastewater management systems

N°	Country	Name of policy or measure	Description	Objective(s)
165	**Spain**	Emissions reduction in waste management sector (Measure 1.22 NECP)	Incluye medidas destinadas a la prevención en la generación de residuos, el compostaje doméstico, la recogida separada de materia orgánica para su tratamiento biológico, y la recogida separada de otras fracciones como el papel, aceite de cocina y textiles de cara a su reciclado, y la promoción del uso de gases renovables. Este conjunto de medidas, incluidas en el Plan Nacional Integrado de Energía y Clima, se alinea con el cumplimiento de los objetivos de las nuevas directivas europeas en esta materia.	Waste: Demand management/reduction, Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling
166	**Spain**	Green direct payment (or "greening"): support for farmers who adopt or maintain farming practices that help meet environmental and climate goals.	Consiste en un pago al agricultor por la realización de prácticas agrícolas beneficiosas para el clima y el medio ambiente, tales como la diversificación de cultivos, el mantenimiento de pastos permanentes y contar con superficies de interés ecológico en las explotaciones. Se trata de un componente de ecologización obligatorio de los pagos directos en el contexto de la Política Agrícola Común (PAC 2015-2020), cuyo objetivo es la mejora del comportamiento medioambiental de ésta. Se encuentra regulado a nivel europeo por el Reglamento 1307/2013 por el que se establecen normas aplicables a los pagos directos a los agricultores en virtud de los regímenes de ayuda incluidos en el marco de la PAC. A nivel nacional está regulado en el Real Decreto 1075/2014, de 19 de diciembre de 2014, sobre la aplicación a partir de 2015 de los pagos directos a la agricultura y a la ganadería y otros regímenes de ayuda, así como sobre la gestión y control de los pagos directos y de los pagos al desarrollo rural.	Agriculture: Activities improving grazing land or grassland management, Agriculture: Other activities improving cropland management, Agriculture: Other agriculture, Land use, land use change and forestry: Other land use, land-use change and forestry

N°	Country	Name of policy or measure	Description	Objective(s)
167	**Spain**	2018-2020 Organic production Strategy	Da continuidad a las Estrategias de producción ecológica anteriores del Ministerio de Agricultura, Pesca y Alimentación y tiene como objetivos: Fomentar el consumo interno y mejorar la comercialización de productos ecológicos; Contribuir a una mejor vertebración sectorial de la producción ecológica; Apoyar el crecimiento y consolidación de la producción ecológica, con especial atención a la ganadería ecológica y al sector industrial; Estudiar el papel de la producción ecológica en la política de medio ambiente y adaptación al cambio climático.	Agriculture: Other activities improving cropland management
168	**Sweden**	Urban Environment Agreements	Urban environment agreements is a scheme for investments in public transport and cycling infrastructure at the regional and local level in Sweden. The scheme commenced in 2015. The aim of the scheme is to promote sustainable urban environments and the measures should lead to energy-efficient solutions with low greenhouse gas emissions and contribute to achieving the environmental quality goal Good built environment. In the national plan for the transport system 2018-2029, SEK 1 billion per year is allocated to the urban environmental agreements. Municipalities are eligible to apply for grants to cover part of the investment costs for public transport infrastructure. The investment should be coupled with other actions aiming at increasing the long-term sustainability of urban areas and the transport system. These actions can include increased accessibility through public transport, urban planning for housing or increased cycling and walking, lower vehicle speeds, parking policies and pricing. The scheme is administered by the Swedish Transport Administration. The Government decided in December 2020 on a temporary strengthening of the urban environment agreements with a special focus on cycling. The proposal includes a budget of SEK 550 million during 2022-2023	Transport: Improved behaviour, Transport: Improved transport infrastructure, Transport: Modal shift to public transport or non-motorized transport

N°	Country	Name of policy or measure	Description	Objective(s)
169	**Sweden**	Ban on landfilling combustible and organic materials and methane collection	Under the Swedish Ordinance on the Landfill of Waste (SFS 2001:512), a ban on landfilling combustible materials was introduced in 2002 and a similar ban was imposed for organic material in 2005. The ordinance also regulates the collection and disposal of methane gas from landfills. The ordinance is intended to prevent and reduce adverse effects on human health and the environment from landfilling.	Waste: Enhanced CH_4 collection and use, Waste: Enhanced recycling, Waste: Improved landfill management, Waste: Improved wastewater management systems, Waste: Reduced landfilling
170	**Sweden**	Municipal waste planning requirement	Since 1991, there has been a requirement that all the municipalities in Sweden must have their own municipal waste plan. A Swedish EPA regulation (NFS 2006:6) sets out the minimum requirements of what each municipality must include in its waste plan, such as a description of the current situation, recycling plants and landfills, environmental assessment, measures and monitoring. Both the national waste plan and the national prevention program act as guidance for the municipalities in developing their local plans and deciding on prioritized actions.	Waste: Demand management/reduction, Waste: Enhanced recycling, Waste: Improved treatment technologies
171	**Switzerland**	Resource programme (subsidies for a more efficient use of natural resources)	Subsidising measures for more efficient use of natural resources such as nitrogen, phosphorous and energy, protection and sustainable use of soils, and biodiversity. To qualify for subsidies, measures must go beyond legal requirements or the criteria for other funding programmes.	Agriculture: Improved animal waste management systems, Agriculture: Improved livestock management, Agriculture: Reduction of fertilizer/manure use on cropland
172	**Switzerland**	Ban on landfilling of combustible waste	Prohibition on landfilling of combustible waste.	Waste: Reduced landfilling
173	**Switzerland**	Ordinance on the Avoidance and Management of Waste	Mandatory minimal energy recovery rate.	Waste: Other waste

Annex 6: Types and categories of CE-related PaMs in EEA database on GHG policies and measures in Europe

Category	Type	Quantified goal	Countries	Without quantified goal	Countries	Total number
Resource efficiency	Decrease in use/replacement of fossil, non-renewable, abiotic or unsustainably extracted resources	1	EE	0		1
	Resource efficiency, resource productivity, raw material productivity or material intensity	0		2	FR, CH	2
Product making	Livestock and animal feed management	1	IS	5	AT, LT, LU, NL	6
	Local food production	1	IS	3	BE, IT	4
	Nutrient cycle: manage C-sinks in soils	2	EE, NL	3	FR, PL, ES	5
	Nutrient cycle: reduce N-losses	3	EE, NO, SK	19	AT, BE, BG, DK, FR, DE, EL, LV, LT, MT, PL, PT, RO, SI, ES	22
	Recycled content plastic	0		1	DK	1
Consumption	General consumption	0		3	HR, DE	3
	GPP targets/obligations	0		1	IS	1
	Locally produced food	0		1	BE	1
	Market share of eco-labelled products	0		1	FR	1
	Modal shift	1	BG	6	AT, BE, HR, FR	7
	Repair targets	1	LT	0		1
	Shared mobility	1	NL	7	BE, FR, LU, SI	8
Waste generation	Reduction of food waste	3	DE, IS, LT	1	ES	4
	Reduction of plastic waste	2	DK, LU	0		2
	Reduction of solid waste	1	HR	4	EE, LU, NO, SI	5
Waste collection	Extended Producer Responsibility schemes	0		2	FR, SI	2
	Raising public awareness and sorting skills	1	LT	0		1
	Separate collection of biowaste	0		4	FR, DE, LU, SK	4
	Separate collection of non-specified recyclable waste	1	HR	6	BE, DK, FR	7
	Separate collection of textile waste	0		1	DK	1
Reuse, Recycling, Recovery	Compost and biogas recovery	1	BG	0		1

Category	Type	Quantified goal	Countries	Without quantified goal	Countries	Total number
	Packaging waste recycling	1	LU	3	FI, RO	4
	Plastic recycling in construction sector	1	DK	0		1
	Plastic recycling in agricultural sector	1	DK	0		1
	Promote reuse	0		1	DK	1
	Promotion of recycling	0		2	NO, PT	2
	Recovery of organic waste	2	LV	1	EL	3
	Recovery of sludge	0		1	HU	1
	Reduce losses in plastic recycling	0		1	DK	1
	Refridgerating fluids recovery	0		2	BE, CY	2
	Sorting bulky waste	0		1	DK	1
	Tarifs and taxes	1	FR	2	SI	3
	Waste Management Strategy	9	CZ, FI, ES	18	BE, HR, CY, DK, HU, LU, MT, PL, RO, SE	27
	Waste preparation for treatment	1	LV	0		1
	WEEE reuse, recovery and recycling	0		2	RO	2
Incineration and landfill	Landfill ban on combustible waste	0		3	DK, SE, CH	3
	Reduction of biodegradable municipal waste landfilled	2	HR, IS	7	AT, EI, FI, NO, RO, SI	9
	Reduction of waste incineration	0		2	BE, CH	2
	Reduction of waste landfilled	1	EI	7	CY, DK, HU, LT, LU, NO	8
Other	Awareness campaigns	0		1	LT	1
	CE Roadmap	3	FR, NL, ES	2	BE, PT	5
	Funding/Investment mechanisms	0		3	FR, NL, SE	3
	Mobility programme	0		1	IT	1
	Waste management plan	0		2	FR	2

Annex 7 – Ex-ante estimation of GHG emission reductions for CE-related PaMs in the EEA GHG PaMs Database

Type	Country	Quantified objective (for the CE-measure)	Total GHG emissions reductions in 2025 (kt CO_2eq/y)	Total GHG emissions reductions in 2030 (kt CO_2eq/y)	Total GHG emissions reductions in 2035 (kt CO_2eq/y)	Total GHG emissions reductions in 2040 (kt CO_2eq/y)
Waste Management Strategy[45]	Belgium		132	330	557	824
General consumption	Croatia		-491	-6366	-236	9888
General consumption	Croatia		15998	26054	46414	6842
Waste Management Strategy	Croatia		2635	61898	8818	106664
Waste Management Strategy	Czechia	yes	330	330	330	
Waste Management Strategy	Finland	yes	3166	3361	3497	
Separate collection of non-specified recyclable waste	France		3600	4000	4200	
Nutrient cycle: reduce nitrogen losses	Germany		0	880	880	880
Separate collection of biowaste	Germany		0	0	0	0
Reduction of food waste	Germany	yes	70	110	110	110
General consumption	Germany		909	1229	1633	2036
Recovery of organic waste	Greece		800	1100		
Nutrient cycle: reduce nitrogen losses	Greece		550	750		
Nutrient cycle: reduce nitrogen losses	Greece		150	200		
Nutrient cycle: reduce nitrogen losses	Latvia		66	66		
Waste preparation for treatment	Latvia	yes		4	4	
Recovery of organic waste	Latvia	yes		2	2	
Recovery of organic waste	Latvia	yes		2	2	
Repair targets	Lithuania	yes	3	3		
Reduction of food waste	Lithuania	yes	22			
Raising public awareness and sorting skills	Lithuania	yes	176	175		
Reduction of waste landfilled (particularly municipal and non-hazardous waste)	Luxembourg		7875	8975	905	

[45] Impact of the waste management strategy of Flanders (difference between WEM and WAM scenario) on the territorial emissions of waste incineration in Flanders

Separate collection of biowaste	Luxembourg		318	318	318	
Type	**Country**	**Quantified objective (for the CE-measure)**	**Total GHG emissions reductions in 2025 (kt CO_2eq/y)**	**Total GHG emissions reductions in 2030 (kt CO_2eq/y)**	**Total GHG emissions reductions in 2035 (kt CO_2eq/y)**	**Total GHG emissions reductions in 2040 (kt CO_2eq/y)**
Waste Management Strategy	Malta		141	2873		
Nutrient cycle: reduce nitrogen losses	Norway	yes		10		
Reduction of biodegradable municipal waste landfilled	Norway			620		
Waste Management Strategy	Poland		3545	3995	4313	4545
Waste Management Strategy	Romania		428346	597892	664456	735829
Waste Management Strategy	Romania		63399	8986	12503	15456
Reduction of biodegradable municipal waste landfilled	Slovenia		237	448	607	716
Shared mobility (car sharing, carpooling)	Spain		14	20		
Waste Management Strategy	Spain	yes	54529	17251	281829	358662

Annex 8: List of evaluated literature (Chapter 3)

Author	Title	Publication Year
1. **Ramboll/Fraunhofer ISI/Ecologic**	The decarbonisation benefits of sectoral circular economy actions	2020
2. **Metabolic**	Modelling the Renovation of Buildings in Europe from a Circular Economy and Climate Perspective	2022
3. **Deloitte/BDI**	Zirkuläre Wirtschaft - Herausforderungen und Chancen für den Industriestandort Deutschland	2021
4. **Günther et al.**	Resource-Efficient Pathways towards Greenhouse-Gas- Neutrality – RESCUE	2019
5. **Material Economics**	Industrial Transformation 2050)	2019
6. **Ellen MacArthur Foundation and Material Economics**	Completing the picture: How the circular economy tackles climate change	2019
7. **Serrano et al.**	Contribution of circular economy strategies to climate change mitigation: Generic assessment methodology with focus on developing countries	2021
8. **Circle Economy**	The circularity gap report 2023	2023
9. **International Resource Panel**	Resource efficiency and climate change: material efficiency strategies for a low-carbon future	2020
10. **Hailmariam/Erdiam-Kwasie**	Towards a circular economy: Implications for emission reduction and environmental sustainability	2023
11. **Bherwani et al.**	Application of circular economy framework for reducing the impacts of climate change: A case study from India on the evaluation of carbon and materials footprint nexus	2022
12. **ICF and Fraunhofer ISI**	Role of the circular economy as a contributor to industry decarbonisation beyond 2030	2022
13. **Walz et al.**	Wider economic and social implications of sustainable economy approaches: Some insights from a scenario exercise	2019
14. **Wiprächtiger et al.**	Combining industrial ecology tools to assess potential greenhouse gas reductions of a circular economy: Method development and application to Switzerland	2023
15. **Raes et al.**	Circulaire economie en klimaat - voeding en textiel	2019
16. **Raes et al.**	Milieuwinst Recyclage en Hergebruik Textiel	2018

17. OVAM	De klimaatvoetafdruk van een duurzaam tegenover een fast fashion T-shirt	2022
18. Christis and Vercalsteren	Impact of Circular Economy on achieving the climate targets: case mobility	2019
19. Borms et al.	Het aandeel van materiaal- en niet- materiaalgerelateerde emissies in vlaanderen	2021a
20. Borms et al.	Effect van circulaire economie scenario's op Vlaamse en globale broeikasgasemissies en materiaalgebruik	2021b
21. Breemersch et al.	Impact of circular economy on achieving the climate targets: case housing	2020
22. Donati et al.	Modeling the circular economy in environmentally extended input-output tables: Methods, software and case study	2020

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