

Policy framework analysis – Technical supporting material to the report “Circular Economy and Biodiversity”



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Layout: ETC CE

Publication Date 9 June 2023

EEA activity Biodiversity and ecosystems, circular economy and resource use

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ETC-CE coordinator: Vlaamse Instelling voor Technologisch Onderzoek (VITO)

ETC-CE partners: Banson Editorial and Communications Ltd, česká informační agentura životního prostředí (CENIA), Collaborating Centre on Sustainable Consumption and Production (CSCP), Istituto Di Ricerca Sulla Crescita Economica Sostenibile, Istituto Superiore per la Protezione e Ricerca Ambientale, IVL Swedish Environmental Research Institute, PlanMiljø, Università Degli Studi Di Ferrara (SEEDS), Federal Environment Agency (UBA), Teknologian Tutkimuskeskus VTT oy, Wuppertal Institut für Klima, Umwelt, Energie gGmbH, World Resources Forum Association.

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Acknowledgements

This report has been produced within the task on 'Circular Economy and biodiversity' of the 2022 ETC/CE work program. Tobias Nielsen (EEA) has been the project leader and Jens Günther (ETC/CE) has been the task leader. The report was finalised and published under the 2023 work program of the ETC/CE.

The authors are grateful to the following experts and organisations for their comments that substantially improved the quality of the report: Natacha Carvalho; Gorm Dige; Frank Wugt Larsen; Lars Mortensen; Almut Reichel; Jan-Erik Petersen; Dario Piselli; Caroline Whalley (all EEA), Saskia Manshoven (VITO), Gregory Fuchs (Ecologic Institute), Aurélien Carré (French Muséum national d'Histoire naturelle), Rikke Fischer-Bogason (PlanMiljø).

Summary

The world is facing a triple planetary crisis consisting of climate change, biodiversity loss, and pollution, which pose a major challenge to human health, well-being and prosperity for present and future generations. One of the main reasons for this is our current production and consumption system. Consequently, the entire production and consumption system and the entire value chain of products and services must be considered to minimise those unsustainable levels.

Circular economy aims to transform our economy from the current mostly linear take-make-waste model towards a closed-loop model. In doing so, a circular economy can minimise the use of materials and energy, while reducing environmental pressures.

In the last decades, the EU has developed several strategies addressing resource efficiency/circular economy (CE), biodiversity and climate change and with the European Green Deal the EU Commission has significantly broken down the separation of policy domains, in which climate protection, circular economy and the protection of natural resources were addressed together as core objectives.

This report provides an overview of the EU policy frameworks on circular economy, biodiversity and climate change. Building on this overview, the report provides a qualitative analysis of the interconnections between the three policy domains. In particular, it investigates whether and how CE policy measures (regulatory, economic and voluntary tools both in place and to be developed according to the EGD) are expected to alleviate pressures on biodiversity and on climate change.

The report acts as a technical background document for the "Circular Economy and biodiversity" report which analyses how circular economy can contribute to halting biodiversity loss and highlight the positive effects of circular economy measures on biodiversity in practice.

1 Introduction

In the last decades, the EU has developed several strategies addressing resource efficiency/circular economy (CE), biodiversity and climate change. In 2011, the Commission adopted the Roadmap to a resource efficient Europe (EC, 2011c), which was part of the Resource Efficiency Flagship under the Europe 2020 Strategy and outlined how the Europe's economy could be transformed into a sustainable one by 2050. It was followed by the 2015 Circular Economy Action Plan (CEAP; EC, 2015a), which shaped 54 actions to promote the transition to an economy 'where the value of products, materials and resources is maintained ... for as long as possible, and the generation of waste minimised'. The Action Plan was also instrumental to achieving the 2030 Sustainable Development Goals, in particular Goal 12 'ensuring sustainable consumption and development patterns'. Based on the 2015 CEAP, the Commission issued the EU Plastic Strategy (European Commission, 2018), proposing concrete measures to move towards a more circular plastic economy.

The EU Biodiversity Strategy (BDS) to 2020 (EC, 2011a), adopted in 2011, was aimed at halting the loss of biodiversity and ecosystem services in the EU by 2020. It was built on the 2006 EU Biodiversity Action Plan (EC, 2006) and reflected the commitments taken by the EU in 2010, within the international Convention on Biological Diversity (so-called Aichi targets; CBD, 2010). The Strategy listed six mutually supportive and inter-dependent targets addressing the main drivers of biodiversity loss.¹

In the policy area of climate change, the Roadmap to a low carbon economy was presented by the European Commission in 2011 (EC, 2011b). In 2014, following the 2020 climate and energy package set in 2007, the European Council agreed on a new target framework for 2030, using the same threefold approach as for 2020 applying to greenhouse gas emissions (GHG), renewable energy and energy efficiency (Council of the European Union, 2007; European Council, 2014). In 2018, the Commission shaped its vision for a climate-neutral EU (EC, 2018b), looking at all the key economic sectors and exploring pathways for the transition, in line with the Paris Agreement objective to keep the global temperature increase to 'well below 2°C'. In 2019, based on Commission proposals (so-called 'Clean Energy For All Europeans'; EC, 2016), a new energy policy package was adopted to move away from fossil fuels towards cleaner energy.

CE, biodiversity and climate change have traditionally been conceived as separate domains at the policy level, although the related policies (objectives, priorities, implementation measures) overlap and interact in many respects. For instance, with regard to the CE-biodiversity nexus, the 2015 CEAP (EC, 2015a) identified food waste, biomass and bio-based products as key action areas and the EU BDS to 2020 (EC, 2011a, p. 3) recognised that 'by conserving and enhancing its natural resource base and using its resources sustainably, the EU can improve the resource efficiency of its economy'. The strong interlinkages between CE and biodiversity policies have also been highlighted by the two EU Bioeconomy Strategies (EC, 2018a, 2012). In particular, the 2018 Strategy states that, in order to be successful, bioeconomy, which covers all sectors and systems that rely on biological resources, needs to 'have sustainability and circularity at its hearth' (EC, 2018a, p. 1).

With the European Green Deal (EGD; European Commission, 2019), published in 2019, the EU Commission has significantly broken down this separation of policy domains, in which climate protection, circular economy and the protection of natural resources were addressed together as core objectives.

In the following, the technical report presents an overview of the EU policy frameworks on CE (chapter 2.1), biodiversity (chapter 2.2), and climate change (chapter 2.3)², focusing on the related objectives, priority areas

¹ 1) Full implementation of the EU nature legislation; 2) better protection and restoration of ecosystems and the services they provide, and greater use of green infrastructure; 3) more sustainable agriculture and forestry; 4) better management of EU fish stocks and more sustainable fisheries; 5) tighter controls on invasive alien species; and 6) greater EU contribution to averting global biodiversity loss.

² As the main focus of this Report is on the link between CE and biodiversity, chapter 2.3 provides a very short overview of the EU climate policy framework.

of intervention and main implementing measures. Building on this overview, chapter 3 provides a qualitative analysis of the interconnections between the three policy domains. In particular, it investigates whether and how CE policy measures (regulatory, economic and voluntary tools both in place and to be developed according to the EGD) are expected to alleviate pressures on biodiversity and on climate change. Eventual trade-off between the three policy areas are also highlighted. Chapter 4 briefly outlines the enabling framework shaped by the EGD to foster sustainable investments and financing the green transition, paying particular attention to the Multiannual Financial Framework 2021-2027 and the EU Taxonomy Regulation (EU, 2020). Chapter 5 provides some conclusion based on the analysis done.

2 The European Green Deal policy framework

With the European Green Deal (EGD; European Commission, 2019), the Commission has made a significant effort to overcome the abovementioned ‘silo approach’, by shaping a comprehensive and integrated growth strategy to transform the EU into a climate neutral and resource efficient economy, while protecting, conserving and enhancing the EU's natural capital. Climate neutrality cannot be achieved without substantial progress in meeting the other fundamental EGD policy goals, i.e. supplying clean, secure and affordable energy; promoting sustainable mobility; encouraging the transition to a CE; creating a toxic-free environment; preserving Europe’s natural capital; and designing a fair, healthy and environmentally-friendly food system. More detailed environmental objectives and implementation measures have been scheduled by a wide range of strategic documents that have been issued by the Commission based on the EGD (this framework is continuously evolving).³

2.1 Circular Economy

A new Circular Economy Action Plan was adopted in 2020 (2020 CEAP; European Commission, 2020), in the context of the EGD. Both the 2015 and 2020 CEAPs do not provide a definition of CE, even if they list several characteristics of a CE system which suggest that CE applies to the whole life-cycle of products (i.e. to design/production, consumption and the end-of-life phase), as well as to services and business models. In the EC Communication ‘Towards a CE, a zero waste programme for Europe’ (European Commission, 2014), which paved the way for the adoption of the 2015 CEAP, ‘circular economy’ is opposed to ‘take-make-consume and dispose’ patterns of growth (i.e. linear models) and circular economic systems are described as those that ‘keep the added value in products for as long as possible and eliminate waste’ (p. 1). Similarly, the EU Taxonomy Regulation defines CE as ‘an economic system whereby the value of products, materials and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their use, minimising waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy’ (EU, 2020, Art. 2.9).

The main strategic objectives of the 2020 CEAP are to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries, reduce the consumption footprint, and double the circular material use rate in the coming decade. The Commission has not planned to translate these objectives into binding legislative targets. However, the European Parliament has called on the Commission to introduce new targets for 2030 to significantly reduce the EU material and consumption footprints, bringing them within planet boundaries by 2050 (European Parliament, 2021).

The current EU legislation on waste and chemicals already sets several binding targets and requirements that support CE (Paleari, 2019). For instance, collection, reuse and recycling targets apply to different waste streams;⁴ extended producer responsibility (EPR) makes producers responsible for the management of waste generated by selected products;⁵ certain products/materials that have negative impacts on human health and the environment shall not be placed on the EU market (as in the case of oxodegradable plastic) or their consumption shall be progressively reduced (as in the case of lightweight plastic carrier bags); the use of several hazardous substances/chemicals in product making is prohibited or restricted,⁶ etc. Based on the 2020 CEAP, some of these requirements will be extended or made more stringent and new ones will be shaped.

³ As this framework is continuously evolving, the cut-off date of this analysis is 30 June 2022.

⁴ Packaging waste, waste electrical and electronic equipment, end-of-life vehicles, waste batteries and accumulators, construction and demolition waste, etc.

⁵ Packaging waste, waste electrical and electronic equipment, end-of-life vehicles, waste batteries and accumulators, selected single-use plastic items.

⁶ This is provided, e.g., by the Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals and the Directive on the restriction of *hazardous substances in electrical and electronic equipment* (EU, 2006, 2011a).

The 2020 CEAP schedules several actions that address the different phases of the product life-cycle (production, consumption, and waste management), while other initiatives focus on the sustainability challenge posed by selected value chains (electronics and ICT; batteries and vehicles; textiles; packaging; plastics; construction and buildings; food, water and nutrients). Moreover, a section of the Action Plan is aimed at stepping up the synergies between CE and climate mitigation. Some CEAP measures are referred to in other EGD strategic documents.

The way a product is designed determines up to 80% of its environmental impacts, but the EU has not currently a comprehensive approach to promote eco-design, as it mainly relies on sectoral legislation (EU, 2009a) and voluntary tools (EU ecolabel and green public procurement). The 2020 CEAP planned, therefore, a sustainable product policy legislative initiative, to ensure that all products placed on the EU market become increasingly sustainable and stand the test of circularity. This will also result in the minimisation of waste and pollution (EC, 2021f). The new proposed Regulation (EC, 2022e) widens the scope of the Eco-design Directive (EU, 2009a) beyond energy-related products and, through EC delegated acts, will introduce eco-design requirements for products not already (adequately) covered by the EU legislation. Priority will be given to products identified by the 2020 CEAP (electronics, ICT and textiles), but also to furniture and high impact intermediary products, such as steel, cement and chemicals. According to the Commission proposal, eco-design requirements should address key issues such as products durability, reusability, reparability; the presence of substances of concern; resource efficiency; recycled content; the possibility of recycling; etc. They include both performance and information requirements. The proposed Regulation also shapes a general obligation of transparency for economic operators (excluding SMEs) who discard unsold consumer products and provides for the possible setting, via EC delegated acts, of green public procurement (GPP) requirements applicable to public contracts.

The transition towards safer materials and products (which is a fundamental component of eco-design) is also supported by the Chemicals Strategy for Sustainability (EC, 2020c), with a specific focus on product categories that affect vulnerable populations and on those with the highest potential for circularity (e.g. packaging, ICT, furniture, etc.). This will be achieved, *inter alia*, by moving to safe and sustainable-by-design chemicals, including sustainable bio-based chemicals.

In production processes, circularity will be further promoted in the context of the review of the Industrial Emissions Directive (IED; EU, 2010; EC, 2022c), through the integration of CE practices in upcoming Best Available Techniques reference documents (BREFs). Moreover, the 2020 CEAP plans to use digital technologies for a better tracking, tracing and mapping of resources. The Commission intends to support a sustainable and circular bio-based sector through the implementation of the Bioeconomy Action Plan (EC, 2018a). The deployment of a circular bioeconomy, which remains within the boundaries of sustainability, is conceived as a key enabler for moving towards a sustainable food system (EC, 2020e) and a sustainable management of forests (EC, 2021i).

Another key priority of the 2020 CEAP is to strengthen the role of consumers and public buyers in the green transition. In particular, the EU consumer law is being revised (EC, 2022d) to ensure that consumers receive trustworthy and relevant information on products at the point of sale and address misleading commercial practices related to the sustainability of products. The Commission will also work towards establishing a new 'right to repair' to extend products lifetime and on an initiative to require companies to substantiate claims they make about the environmental footprint of their products/services. Minimum mandatory GPP criteria and targets will be set, as part of the proposed Regulation on eco-design (EC, 2022e).

With regard to the end-of-life phase, the 2020 CEAP aims at creating a well-functioning EU market for secondary raw materials (SRMs). The present state of these markets is, indeed, rather diverse and uneven, with some of them that are already working well and others that suffer from still limited developments.⁷ In order to improve the quality of SRMs, the Commission will co-operate with industry to progressively create harmonised systems to track and manage information on relevant chemicals substances and identify those substances in waste. Methodologies to minimise the presence of substances that pose problems to health or

⁷ This diversity is highlighted in the 2021 unpublished research report 'Overcoming barriers to step up SRMs markets' (prepared by zu Castell-Rudenhause M., Nelen D., Paleari S., Wahlström M., Wilts H., and Zoboli R.), ETC-WMGE.

the environment in recycled materials and articles will be developed and the role of standardisation enhanced. The EU rules on waste shipment are being revised to facilitate the shipments of waste for reuse and recycling in the EU; ensure that the EU does not export its waste challenges to third countries; and tackle illegal waste shipments (EC, 2021x). Finally, requirements for recycled content in products will be established to address the mismatch between the supply and demand of SRMs.

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 National Energy and Climate Plans. Moreover, the Commission will shape a regulatory framework for certifying carbon removals, to incentivise increased circularity of carbon, in full respect of the biodiversity objectives. The latter measure is referred to by the Farm to Fork Strategy (EC, 2020e), as a complement to the new EU carbon farming initiative, which will provide farmers with a new source of income and help other sectors to decarbonise the food chain. It is also mentioned by the Energy System Integration Strategy (EC, 2020h) as a mean to support the market take-up of synthetic fuels, while correctly reflecting their carbon footprint.

Table 1 lists the most important actions planned by the Commission within the 2020 CEAP to address the environmental challenges posed by key value chains. Many of these actions are essential to achieve the EGD ambitions in other 'thematic areas', including biodiversity and climate change. The measures scheduled by the 2020 CEAP on batteries and ELVs are directly connected to the EU Strategy on Sustainable Mobility (EC, 2020i). Electric vehicles will play a crucial role in the transition towards a more sustainable road transport (according to the legislative targets that have already been proposed by the Commission, all new cars and vans shall be zero-emissions by 2035; EC, 2021r). Sustainability and end-of-life cycle requirements for batteries (concerning, e.g., carbon footprint and sustainable sourcing of raw materials), are, however, essential to reduce the environmental footprint of electric vehicles.

The 2020 CEAP measures addressing plastics complement those provided by the EU Plastic Strategy (European Commission, 2018), which is aimed at ensuring that by 2030, more than half of plastics waste generated in Europe is recycled (in 2020 only 35% of plastic waste was recycled in the EU27+3; PlasticsEurope, 2021).⁸ These initiatives are also essential to achieve the objectives, stated by the Zero Pollution Action Plan (EC, 2021f), of reducing by 50% plastic litter at sea and by 30% microplastics released into the environment by 2030. According to the CEAP, the Commission intends to develop a policy framework on bioplastics and biodegradable/compostable plastics, which are not currently exempted from the application of the Single-Use Plastic (SUP) Directive (EU, 2019). To this end, it will have to consider of the environmental impacts of these plastic materials throughout their whole life cycle. The framework will cover also plastic for uses in all types of agriculture and will therefore be highly relevant for organic farming (EC, 2021e).

The new EU Strategy for Sustainable and Circular Textiles (European Commission, 2022), issued in accordance with the 2020 CEAP, plans a set of new initiatives to support the green transition of the sector (to be accomplished by 2030). The main measures include: new eco-design requirements (EC, 2022e); new information requirements on circularity and other key environmental aspects of textiles (e.g. based on the digital product passport and revised eco-label criteria for textiles and footwear); actions addressing the unintentional release of microplastics (e.g. through eco-design, by targeting production processes, developing innovative materials, etc.); reuse/recycling targets and extension of Extended Producer Responsibility (EPR) to textiles (with eco-modulation of fees); possible introduction of bans on the destruction of unsold/returned textiles. These initiatives are relevant, *inter alia*, to ensure the achievement of the objectives of the Zero Pollution Action Plan (with regard, for instance, to waste and microplastics EC, 2021f) and of the EU Plastic Strategy (European Commission, 2018).

⁸ Norway, Switzerland and the UK.

Based on the 2020 CEAP, the Commission will adopt an EU Strategy for a Sustainable Built Environment, which is closely linked to the Renovation Wave Initiative, the Zero Pollution Action Plan, and the new Soil Strategy (EC, 2020g, 2020b, 2021h). The ‘Renovation Wave’ is the key EGD initiative to increase energy efficiency in the building sector. It is based on the full integration of the circularity principles across the value chain to reduce materials-related GHG emissions (e.g. by promoting the use of organic building materials, like wood, which can store carbon). The Zero Pollution Action Plan and the 2021 Soil Strategy, in synergy with the 2020 CEAP, shape a set of actions to incentivise a safe, sustainable and circular use of excavated soil⁹ and prioritise the circular use of land over greenfield development, in accordance with a new land take hierarchy. The EC has already proposed a revised Regulation on the marketing of construction products (EC, 2022f) which will improve the harmonised performance standards applicable to construction products and introduce the obligation for manufacturers to provide a declaration of conformity with specific environmental product requirements, as well as to deliver environmental information about the life-cycle of their products.

Table 1 Initiatives scheduled by the 2020 CEAP to address key value chains

Value chain	Planned initiatives
Electronics and ICT	<p>Circular Electronics Initiative to promote longer product lifetimes, including the following:</p> <ul style="list-style-type: none"> • Revision of the Ecodesign Directive (EC, 2022e) 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. • Shape regulatory measures on charges for mobile phones and similar devices (see EC, 2021q). • 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) and provision of guidance to improve its coherence with REACH (EU, 2006) and the Ecodesign Directive (EU, 2009a).
Batteries and vehicles	<p>New regulatory framework on batteries (EC, 2020k), including:</p> <ul style="list-style-type: none"> • Rules on recycled content and measures to improve collection/recycling of batteries. • Measures addressing non-rechargeable batteries. • Sustainability and transparency requirements for batteries. <p>Proposal to revise of the End-of-life vehicles (ELVs) Directive (EU, 2000), including:</p> <ul style="list-style-type: none"> • Link design issues to end-of-life treatment. • Consider rules on mandatory recycled content for certain materials. • Improve recycling efficiency. <p>Improved measures to ensure the collection and environmentally sound treatment of waste oils.</p>
Packaging	<ul style="list-style-type: none"> • Revision of the Packaging Waste Directive (EU, 1994) 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	<ul style="list-style-type: none"> • Proposal of mandatory requirements for recycled content and waste reduction measures for key product such as packaging, construction materials and vehicles. • Development a policy framework on 1) sourcing, labelling and use of bio-based plastics and 2) use of biodegradable or compostable plastics. • With regard to microplastics, introduction of: <ul style="list-style-type: none"> - Restriction of intentionally added microplastics (see ECHA, 2021). - Labelling, standardisation, certification and regulatory measures on unintentional release, including measures to increase the capture of microplastics at all relevant stages of products’ lifecycle. - Methods for measuring unintentionally released microplastics, especially from tyres and textiles. - Measures to improve scientific knowledge related to the risk and occurrence of microplastics in the environment, drinking water and foods.
Textiles	<p>New EU Strategy for Textiles (European Commission, 2022), including:</p> <ul style="list-style-type: none"> • Apply the new sustainable product framework to textiles (by developing eco-design measures and empowering business and private consumers to choose sustainable textiles).

⁹ For instance, the need/potential for legally binding provisions for a ‘passport for excavated soil’ will be assessed in the context of a new Health Soil Law.

	<ul style="list-style-type: none"> • Provide incentives and support to product as-service models, circular materials and production processes. • Provide guidance to achieve high levels of separate collection of textile waste, which Member States have to ensure by 2025. • Boost the sorting, re-use and recycling of textiles, including through innovation, encouraging industrial applications and regulatory measures such as extended producer responsibility (EPR).
Building and construction	<p>Comprehensive EU Strategy for Sustainable Built Environment, including:</p> <ul style="list-style-type: none"> • Revision of the Construction Product Regulation (including the introduction of recycled content requirements; EU, 2011b; EC, 2022f). • Promote measures to improve the durability and adaptability of built assets and develop digital logbooks¹⁰ for buildings. • Use Level(s)¹¹ 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 WFD (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.
Food, water and nutrients	<ul style="list-style-type: none"> • Revise the WFD (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). • Develop an Integrated Nutrient Management Plan (to stimulate markets for recovered nutrients) and consider reviewing Directives on wastewater treatment and sewage sludge (EEC, 1991; EU, 1986).

Source: EC (2020)

CE measures scheduled by the 2020 CEAP in the priority area of food, water and nutrients are referred to by several other EGD strategies. The Commission will propose legally binding targets to reduce food waste, as a part of the EU Farm to Fork Strategy (EC, 2020e) and in line with SDG 12.3 target ('halve per capita global food waste at the retail and consumer level and reduce food losses along production and supply chains by 2030'). Moreover, in order to move towards a more sustainable food system, action will be taken to scale-up sustainable and socially responsible production methods and circular business models in food processing and retail (e.g. the Commission will work on a legislative initiative on re-use in food services to substitute single-use food packaging and cutlery by re-usable products; revise the food contact materials legislation to improve food safety and public health; revise marketing standards to provide for the uptake and supply of sustainable agricultural, fisheries and aquaculture products; etc.). The implementation of circular practices is explicitly encouraged by the new Action Plan on organic production (e.g. through the promotion of a more efficient and sustainable use of water; EC, 2021g) and by the new Guidelines on aquaculture (e.g. through the use of renewable aquatic resources and waste management; EC, 2021j). Addressing water efficiency and reuse is also fundamental for climate resilience (EC, 2021b). The forthcoming Integrated Nutrient Management Plan, along with the review of the Urban Wastewater Treatment Directive (EEC, 1991) and the evaluation of the Sewage Sludge Directive (EU, 1986), will have to contribute to reducing the use of fertilisers by at least 20% by 2030, as provided by the 2030 BDS (EC, 2020d), the Farm to Fork Strategy (EC, 2020e), and the Zero Pollution Action Plan (EC, 2021f).

Finally, it has to be underlined that, beyond the 2020 CEAP, further CE objectives and measures are established by other EGD strategic documents. Some relevant examples are provided below.

- By 2030, the Zero Pollution Action Plan (EC, 2021f) aims at reducing significantly total waste generation and by 50% residual municipal waste, in accordance with a new zero pollution hierarchy that requires, that, first of all, pollution is prevented at the source.
- Based on CE principles, the new EU Forest Strategy (EC, 2021i) states that in all wood-based products priority should be on better using, reusing and recycling, as enhanced circularity offers a

¹⁰ A digital building logbook is a dynamic tool that allows a variety of data, information and documents to be recorded, accessed, enriched and organised under specific categories. It represents 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.

¹¹ Level(s) is an assessment and reporting tool, developed by the European Commission, for sustainability performance of buildings, firmly based on circularity.

possibility of maintaining all wood-based products longer in the economy for the multiple uses. Accordingly, the 2030 BDS (EC, 2020d) specifies that the use of whole trees for energy production,¹² whether from the EU or imported, should be minimised. The ongoing revision of the Renewable Energy Directive, by strengthening the sustainability criteria for bioenergy, will set out concrete and adequate safeguards with this regard (EC, 2021o).

- Under the EU Methane Strategy (EC, 2020j), the Commission will provide targeted support to accelerate the development of the market for biogas from sustainable sources, such as manure or organic waste and residues, via upcoming policy initiatives. Indeed, non-recyclable human and agricultural waste and residue streams, can be utilised in anaerobic digesters to produce biogas or in biorefineries to produce bio-materials (e.g. fertilisers) and intermediate bio-chemicals, thus preventing the formation of methane.
- The Communication on a new approach to a sustainable blue economy (EC, 2021d) promotes improved recycling solutions, for instance, by revising the Ship Recycling Regulation (EU, 2013) and the EU requirements for decommissioning offshore platforms and by developing standards for the circular design of fishing gears that facilitate re-use and recyclability.
- The Communication on carbon cycles establishes, as an aspirational objective that at least 20% of the carbon used in the chemical and plastic products should be from sustainable non-fossil sources by 2030. Currently only 1% of carbon used in the EU economy is from recycled origin. Therefore, in line with the climate neutrality goal, fossil carbon should be replaced by more sustainable streams of recycled carbon from waste, sustainable biomass and directly from the atmosphere (EC, 2021k).
- One of the key objectives of the Action Plan on critical raw materials (CRMs; EC, 2020f) is to reduce dependency on primary CRMs through circular use of resources (including sustainable product design). Access to CRMs is a strategic security question for Europe's ambition to deliver the Green Deal. For instance, for electric vehicle batteries and energy storage, the EU would need almost 60 times more lithium and 15 times more cobalt in 2050, compared to the current supply to the whole EU economy.
- As provided by the Strategy on Energy System Integration (EC, 2020h), as part of the revision of the Renewable Energy Directive and of the Energy Efficiency Directive (EC, 2021o, 2021p), the Commission will further facilitate the reuse of waste heat from industrial sites and data centres.

2.2 Biodiversity

The 2030 Biodiversity Strategy (EC, 2020d) aims to ensure that Europe's biodiversity is on the path to recovery by 2030 for the benefit of people, the planet, the climate and the economy, in line with the 2030 Agenda for Sustainable Development. To this end, it establishes a set of key commitments by 2030 and implementing actions (Table 2).

Several commitments of the 2030 BDS recall the objectives announced by the 2020 BDS (Aichi targets), which, in most cases, have not been fully met (EC, 2015b). Apart from the planned introduction of restoration targets, these objectives will not be translated into legally binding targets. The proposed Regulation on nature restoration (EC, 2022g) sets multiple binding restoration targets and obligations across a broad range of ecosystems (urban, agriculture, forests, marine, rivers ecosystems, etc.). These measures should cover at least 20% of the EU's land and sea areas by 2030 and all ecosystems in need of restoration by 2050. Restoration measures to meet the targets/obligations will be set by National Restoration Plans that will be adopted by Member States.

¹² It has to be underlined that RES are also needed to produce renewable hydrogen (according to the Hydrogen Strategy the EU should produce up to 10 million tonnes of renewable hydrogen by 2030; EC, 2020b) and that renewable hydrogen may also be produced through the reforming of biogas (instead of natural gas) or biochemical conversion of biomass, if in compliance with sustainability requirements.

Table 2 Key commitments established by the 2030 Biodiversity Strategy

Key commitments	Main implementing actions and/or strategies that have to plan implementing actions
PROTECTION OF NATURE	
Legally protect a minimum of 30% of the EU's land area and 30% of the EU's sea area.	Criteria and guidance for identifying and designating additional protected area. Further legislative action, if needed, following 2024 assessment by the EC. New EU Forest Strategy (EC, 2021i).
Strictly protect at least a third of the EU's protected areas, including all remaining EU primary and old-growth forests.	
Effectively manage all protected areas, defining clear conservation objectives and measures, and monitoring them appropriately.	
EU NATURE RESTORATION PLAN	
Significant areas of degraded and carbon-rich ecosystems are restored; habitats and species show no deterioration in conservation trends and status; and at least 30% reach favourable conservation status or at least show a positive trend.	Legally binding EU nature restoration targets (EC, 2022g), guidance on the selection of species and habitats.
The decline in pollinators is reversed.	Review and possible revision of the EU Pollinators initiative.
The risk and use of chemical pesticides is reduced by 50% and the use of more hazardous pesticides is reduced by 50%. No chemical pesticides are used in sensitive areas such as EU urban green areas.	Revision of the Sustainable Use of Pesticides Directive (EU, 2009b); Zero Pollution Action Plan (EC, 2021f); Chemicals Strategy for Sustainability (EC, 2020d); Farm to Fork Strategy (EC, 2020e).
The losses of nutrients from fertilisers are reduced by 50%, resulting in the reduction of the use of fertilisers by at least 20%.	Integrated Nutrient Management Action Plan; Zero Pollution Action Plan (EC, 2021f); Farm to Fork Strategy (EC, 2020e); 2020 CEAP (European Commission, 2020).
At least 10% of agricultural area is under high-diversity landscape features.	Measures to ensure that Member States' CAP Strategic Plans set explicit national values for relevant biodiversity targets. Farm to Fork Strategy (EC, 2020e).
At least 25% of agricultural land is under organic farming management, and the uptake of agro-ecological practices is significantly increased.	Action Plan for Organic Farming for 2021-2026 (EC, 2021g).
Three billion new trees are planted in the EU.	New EU Forest Strategy (EC, 2021i) including a roadmap for planting at least 3 billion additional trees; guidelines on biodiversity-friendly afforestation and reforestation; further development of the Forest Information System for Europe; new sustainability criteria on forest biomass energy through the revision of the RES Directive (EC, 2021o).
Significant progress has been made in the remediation of contaminated soil sites.	New Soil Strategy (EC, 2021h); Zero Pollution Action Plan (EC, 2021f); Strategy for a Sustainable Built Environment – 2020 CEAP (European Commission, 2020).
At least 25,000 km of free-flowing rivers are restored	Guidance and support to Member States: 1) to identify sites and help mobilise funding for the rivers restoration; 2) on their measures to review water abstraction and impoundment permits and to restore ecological flows.
There is a 50% reduction in the number of Red List species threatened by invasive alien species.	Full implementation of the Regulation on Invasive Alien Species (EU, 2014).
The negative impacts on sensitive species and habitats, including on the seabed through fishing and extraction activities, are substantially reduced to achieve good environmental status. The by-catch of species is eliminated or reduced to a level that allows species recovery and conservation.	New action plan to conserve fisheries resources and protect marine ecosystems.

Source: EC, (2020d)

The 2030 BDS mostly delegates to further EGD strategic documents the task of scheduling specific implementing measures. The Farm to Fork Strategy (EC, 2020e) and the Action Plan for organic farming (EC, 2021g) are expected to make a significant contribution to meeting the biodiversity objectives related to agriculture (including those addressing the use/risk of chemicals). Based on the Farm to Fork Strategy (EC, 2020e), the Commission will put forward a proposal for a legislative framework on sustainable food systems, to redesign them so that they have a positive or neutral environmental impact. Many initiatives have been

scheduled to promote plant health and animal welfare, reduce the use of pesticides and nutrient losses, tackle antimicrobial resistance (with the objective of reducing the overall EU sales of antimicrobials for farmed animals and in aquaculture by 50% by 2030), increase organic farming, and shift to sustainable fish and seafood production. The Action Plan on organic farming for 2021-2026 (EC, 2021g) is specifically aimed at supporting the conversion to organic farming, while expanding the accessibility of organic food. The sustainability of the EU aquaculture sector is addressed by the related Guidelines 2021-2030 (EC, 2021j) and the Farm to Fork Strategy also provides for a significant increase in organic aquaculture.

Extending the EU's sea area under protection and accelerating the transition towards a sustainable food systems are among the key objectives of the new EU approach for a sustainable blue economy in the EU (EC, 2021d). Within this context, the Commission has announced, for instance, the introduction of a proposal for legally binding EU targets to restore degraded ecosystems (in particular major fish spawning and nursery areas; EC, 2022g), revise marketing standards for seafood and support the digital transition of fisheries control.

The Zero Pollution Action Plan (EC, 2021f) develops an integrated framework to reduce air, water and soil pollution, by 2050, to levels no longer considered harmful to health and natural ecosystems and that respect planet boundaries. It sets key pollution reduction objectives by 2030, including those mentioned in the 2030 BDS (EC, 2020d) and the Farm to Fork Strategy (EC, 2020e) on chemical pesticides, nutrients and antimicrobials. Further commitments are about curbing waste generation, plastic litter at sea and EU ecosystems where air pollution threatens biodiversity. In order to meet these objectives, a wide range of initiatives have been planned by the Commission, such as the revision of relevant legislation (air quality legislation, environmental quality standards for surface water and groundwater, IED, etc.). The risks posed by chemical pesticides are also addressed by the Chemicals Strategy for Sustainability (EC, 2020c) and the new EU Soil Strategy for 2030 (EC, 2021h). The latter shapes concrete measures to protect soils and their biodiversity, combat desertification, restore degraded soils and remediate contaminated sites, prevent soil pollution, reach no land take, and ensure that soils are used sustainably. For instance, with regard to contaminated sites, the Commission will develop an EU priority list for contaminants that pose significant risks for soil quality and for which priority EU action is needed and revise the IED (EU, 2010; EC, 2022c) to address the definition of land damage and the role of financial security. Finally, the upcoming Strategy for a Sustainable Built Environment (provided by the CEAP; European Commission, 2020) will tackle soil sealing and support the rehabilitation of contaminated brownfields.

A roadmap for planting at least 3 billion additional trees in the EU has been issued by the Commission, as part of the new EU Forest Strategy (EC, 2021i). It will play a crucial role in reaching the ambitious net removal target for the Union of -310 million tonnes of carbon dioxide equivalents by 2030, as set out in the proposal for a revised Regulation on Land Use, Land Use Change and Forestry (EC, 2021s). More in general, the Strategy is expected to contribute to combating climate change and reversing biodiversity loss by implementing actions to improve the quantity/quality of forests, strengthen their protection/restoration (with a special focus on primary and old growth forests) and promote a sustainable (wood and non-wood) forest bioeconomy, in the full respect of biodiversity objectives. A legislative proposal has been put forward by the Commission to curb EU-driven deforestation and forest degradation within the EU and globally (EC, 2021w).

2.3 Climate change

The overall goal of the EGD is to achieve climate neutrality by 2050. This goal and its intermediate step (reducing net GHG emissions to at least 55% below 1990 levels by 2030) have been translated into binding targets by the new Climate Law (EU, 2021b). In order to achieve them, a wide range of economic and regulatory measures have been planned. The EU Emission Trading System (ETS) is being revised to cover shipping and reduce the number of allowances allocated free to airlines, while a separate ETS will be established for road transport and buildings from 2023-2026 (EC, 2021m, 2021n). In this way, the sectors covered by the revised ETS (including shipping, building and road transport) should be able to cut their GHG emissions by 61% compared to 2005 levels by 2030. To prevent the risk of carbon leakage, the Commission has proposed the adoption of a Carbon Border Adjustment Mechanism to put a carbon price on imports of a targeted selection of products (starting with cement, iron and steel, aluminium, fertilisers, and electricity;

EC, 2021t). The Land Use, Land Use Change and Forestry (LULUCF) Regulation, which is also currently under revision (EC, 2021s), will establish an overall EU target for carbon removals by natural sinks, equivalent to 310 million tonnes of CO₂ emissions by 2030 (national targets will be shaped as well). The Commission proposal aims to increase carbon sequestration in the LULUCF and agriculture sectors (including also agricultural non-CO₂ emissions, such as those from fertilizers use and livestock), without negative impacts on biodiversity and the environment, to ensure that they reach carbon neutrality by 2035. A specific strategy has been issued by the Commission to cut methane emissions from the energy sector, agriculture, and waste management, with the objective of reducing them by 35%-37% compared to 2005 (EC, 2020j).

To deliver on climate ambition, the EU energy system must undergo a deep transformation, driven by the higher renewable energy sources (RES) and energy efficiency objectives, which are being translated into binding targets (EC, 2021o, 2021p). According to the 'Fit for 55' (EC, 2021b), the RES target should have increased to 40% by 2030 (from current 32%) and the energy efficiency target to 36%-39% for final and primary energy consumption (from current 32.5% applying to overall energy efficiency). Following Russia's aggression to Ukraine, in order to rapidly reduce Europe's dependence on Russian fossil fuels, the REPowerEU plan (EC, 2022j) has put forward an additional set of actions, which includes the proposals to increase, by 2030, the RES target to 45% (through, inter alia, a new EU Solar Strategy to double solar photovoltaic capacity by 2025 and a Biomethane Action Plan to reach the target of 35 billion cubic meters of production by 2030; EC, 2022c) and the energy efficiency target from 9% to 13% (compared to 2020). With regard to RES, the Commission also plans to scale up renewable hydrogen and offshore renewable energy (EC, 2020b, 2020a) and specific legislation has been proposed to encourage the use of sustainable fuels in aviation and shipping (EC, 2021u, 2021v). The taxation of energy products and electricity is being aligned with climate policies, as it will be based on their energy content and environmental performance (instead of their volumes). Tax exemptions and incentives for the use of fossil fuels (e.g. in the EU aviation and maritime sectors) will be removed, while new ones will be introduced to promote green energy sources. Improved energy efficiency should mainly rely on buildings renovation, as provided by the Renovation Wave Initiative (EC, 2020g).

Transport is expected to significantly contribute to the climate transition. According to the Strategy for Sustainable Mobility (EC, 2020i), the sector will have to cut its GHG emissions by 90% by 2050 compared to 1990 levels. In particular, CO₂ emissions from new cars and new vans will have to be reduced by 55% and 50% respectively by 2030 and zero CO₂ emissions from new cars should be achieved by 2035. To meet these objectives, the EC has scheduled 82 actions to be implemented in 2021–2025, including the revision of regulations on CO₂ emissions performance standards for new passenger cars/light commercial vehicles (EC, 2021c) and for new heavy-duty vehicles.

Scaling up the circular economy from front-runners to the mainstream economic players is also considered as prerequisite for climate neutrality. The 2020 CEAP (European Commission, 2020) shapes a set of actions that are aimed at stepping up the synergies between circularity and reduction of GHG emissions (see chapter 2.1). One of the most important concerns the development of a regulatory framework for certification of carbon removals, based on robust and transparent carbon accounting.

The goal of the Strategy on adaptation to climate change (EC, 2021b) is to make adaptation to the unavoidable impacts of climate change smarter, faster, and more systemic, so that Europe becomes climate resilient by 2050. The Strategy will support the update and implementation of adaptation strategies and plans at all levels of governance with three cross-cutting priorities: integrating adaptation into macro-fiscal policy, deploying nature-based solutions for adaptation, and promoting local adaptation action.

3 The interaction between Circular Economy and biodiversity/climate change policy domains

In general, the most important objectives of the EU CE policy and legislative framework are to stimulate sustainable production (e.g. by encouraging eco-design and clean/circular production processes); promote sustainable consumption and extend the life of products/materials (e.g. through eco-label and GPP); and, once products/materials have been discarded, recycle them, while limiting energy recovery to non-recyclable residual waste and avoiding waste disposal as much as possible. Many of these objectives are closely interrelated (e.g. without fundamental redesign and innovation, about 30% of plastic packaging will never be reused or recycled; Ellen MacArthur Foundation, 2020).

Table 3 provides an overview of the EU CE policy measures (both in place and to be adopted, based on the 2020 CEAP; European Commission, 2020), grouped according to their main objective. For each group of measures, we have analysed its expected impacts on biodiversity and climate change, to highlight synergies and potential trade-offs. In particular, although CE policy measures do not generally directly support the achievement of the biodiversity objectives stated by the 2030 BDS, they contribute to meeting them, by addressing the five key drivers of biodiversity loss, namely, land and sea use change, overexploitation of natural resources, climate change, pollution, and invasive alien species (EC, 2020d). The 2020 CEAP (European Commission, 2020) explicitly recognises the connections between CE and BIO, as it states that ‘more than 90% of biodiversity loss and water stress come from resource extraction and processing’ (p. 1) and that ‘the CE can significantly reduce the negative impacts of resource extraction and use on the environment and contribute to restoring biodiversity and natural capital in Europe’ (p. 12).

CE can not only alleviate pressure on biodiversity/ecosystems, but it also supports both climate adaptation and mitigation (GHG emissions reductions and removals), by transforming the way in which goods are produced and used. As noted above (chapter 2.1 and 2.3), in the context of the EGD, CE is considered as prerequisite for climate neutrality and the 2020 CEAP (European Commission, 2020) shapes a set of specific actions that are aimed at enhancing synergies between circularity and climate mitigation. In this case (compared to the biodiversity policy area), a more direct link between CE measures and climate/energy strategic objectives can be identified, as the implementation of the former often directly results in reduced GHG emissions, improved energy efficiency and/or increased RES production.

3.1 Circular economy measures on eco-design

The first group of CE measures is aimed at stimulating eco-design. The promotion of eco-design in the EU mainly relies on: 1) the EU legislation on chemicals; 2) extended producer responsibility (EPR), which covers several waste streams;¹³ 3) technical requirements applying to specific products/materials; and 4) GPP and ecolabel criteria, which are voluntary instruments applying to selected product groups. The Commission has, however, recognized that currently ‘there is no comprehensive set of requirements to ensure that all products placed on the EU market become increasingly sustainable and stand the test of circularity’ (European Commission, 2020, p. 3) and has, therefore, proposed a Regulation establishing eco-design requirements for sustainable products (EC, 2022e).

Eco-design encompasses at least four dimensions: the selection of low impact materials (e.g. avoiding hazardous substances or using recycled resources), the reduction of material use (e.g. reducing overpackaging); the optimization of initial lifetime (e.g. increasing durability or re-use of components); and the optimization of end-of-life system (e.g. design for disassembly or producing mono-material goods; OECD, 2016). Eco-design measures may, therefore, contribute to tackling all the drivers of biodiversity loss. For instance, the legislation on chemicals reduces the risk that hazardous substances are used in products and contained in waste, which hinders waste recycling or results in low quality SRMs. The technical requirements

¹³ Packaging waste, waste batteries, end-of-life vehicles, waste electrical and electronic equipment, and selected single-use plastic items. The Commission has planned the extension of EPR to textiles (European Commission, 2020).

of the SUP Directive (EU, 2019) related to caps/lids of plastic beverage containers and the prohibition to place on the market products from oxodegradable plastic help to prevent plastic pollution/littering. Design for reuse extends the life of products, reducing waste generation and the negative impacts associated with the need to manufacture new products (e.g. exploitation of natural resources, change in land/sea use, pollution, climate change). Designing more recyclable products allows for the substitution of virgin materials with SRMs in production processes, while avoiding waste treatment options that are less preferable, according to the waste hierarchy. Eco-design is also particularly beneficial to climate, since, in the end, less waste is generated (with lower GHG emissions associated to waste management) and more waste is recycled. Recycling generally requires much less energy input than the production of virgin materials, resulting in net GHG savings (Turner et al., 2015).

The selection of 'low impact materials' is, however, a dimension of eco-design which deserves special attention. When considering climate change, bio-based materials/products¹⁴ are 'low impact', compared to fossil-based ones, because the former perform better than the latter in terms of GHG emissions. For instance, it has been estimated that the substitution of fossil-based by bio-based packaging materials can yield GHG emissions reductions by 40%–90% (Cantzler et al., 2020). But bio-based materials/products are not automatically more sustainable than fossil-based ones. Their use may cause greater pressure on biodiversity and ecosystems (e.g. overexploitation of natural resources, land/sea use change and increased pollution), which, in turn, may negatively affect nature's capacity to absorb/store carbon and to contribute to climate adaptation. This risk may be limited by defining sustainability criteria for biomaterials/bioproducts (similar to those applied to the production of renewable energy from biomass). The Commission is already working in this direction, as it emerges from the EGD package, adopting a case-by-case approach. For instance, with regard to bioplastics, the Commission has announced (European Commission, 2020) that it will assess where they lead to genuine environmental benefits along their whole life-cycle (and not only reduce the consumption of fossil resources) within a dedicated policy initiative. Similarly, in line with the Bioeconomy Strategy (EC, 2018a), the Chemicals Strategy for sustainability (EC, 2020c) considers bio-based chemicals as strategic for moving towards sustainable by-design chemicals, but it specifies that their environmental sustainability should be proven from a full life-cycle perspective. In the building sector, the Renovation Wave Initiative promotes the circular use of 'organic building materials that can store carbon', but it adds that the wood should be 'sustainably-sourced' (EC, 2020g, p. 3), as it has been also indicated by the Forest Strategy (EC, 2021i). It has to be noted that the potential impact of bio-based products/materials on biodiversity and ecosystems is undoubtedly reduced when, in accordance with CE principles, they are manufactured through the conversion of biological waste/residues. Recycled content obligations have been introduced by the SUP Directive (EU, 2019) for plastic bottles and their application will be probably extended, in the next future, to other key products (such as packaging and construction materials; EC, 2022f; European Commission, 2020; EC, 2022e).

3.2 Circular economy measures improving the sustainability of production processes

In the context of CE policies addressing production processes, the IED (EU, 2010) represents one of the measures, currently in place, with the higher potential. The Directive, which covers a wide range of industrial activities, requires that permit conditions for installations are established based on BAT reference documents (BREFs), which describe the operating conditions and emission rates of industrial processes. According to a recent study (Ricardo Energy & Environment and VITO, 2019), the IED could provide a greater contribution to CE, with regard to waste generation, recycling rates, the use of SRMs and innovation. Therefore, the Commission has proposed, *inter alia*, to: 1) introduce, as part of the basic obligations of operators, requirements on resource efficiency and on taking into account of the overall life-cycle performance of the value chain; 2) require operators to produce transformation plans by 30 June 2030 as part of their environmental management systems, as a contribution towards achieving EU objectives on a clean, circular and climate neutral economy; 3) revise BREFs between 2024–2027 to better cover new elements such as CE, decarbonisation and less toxic environment (a formal role will be given to the European Chemicals Agency in

¹⁴ Materials/products that are partly or wholly made from biomass, i.e. renewable materials of plant or animal origin.

their preparation); 4) extend the scope of the Directive to the extraction of industrial and mineral materials;¹⁵ 3) adopt BAT conclusions on landfills (EC, 2022c). All these proposals may be particularly beneficial both to biodiversity and climate (e.g. through improved energy and resource efficiency, reduced waste generation, better management of risks posed by chemicals used in installations, and increased water reuse), given the broad scope of the Directive.

The 2020 CEAP (European Commission, 2020) also supports the sustainable and circular bio-based sector, through the implementation of the Bioeconomy Action Plan (EC, 2018a). When considering the bioeconomy sectors, the transition to sustainable food systems is crucial to both halt biodiversity loss and achieve carbon neutrality. The need to adopt a 'resource-efficient and circular approach' to ensure food security, which is stated by the Action Plan, has been reaffirmed by the Farm to Fork Strategy (EC, 2020e). The development of a regulatory framework for certifying carbon removals by farmers, based on robust and transparent carbon accounting and 'in full respect of biodiversity objectives' (EC, 2020e; European Commission, 2020), may be a 'win-win' solution for climate (increased CO₂ absorption capacity and improved climate adaptation) and nature (increased soil fertility and lower need for fertilizers, nature restoration, improved water quality, wildlife corridors, etc.).¹⁶ Carbon farming initiatives should support the increase by 42 Mt CO₂eq of the land sink that is required to meet the objective of 310 Mt CO₂eq net removals by 2030 (EC, 2021k). However, several barriers exist to upscaling carbon farming. In particular, all carbon removals (from both ecosystems and industrial solutions) need to be accounted in full transparency and by considering criteria such as the duration of the storage, the risk of reversal, the uncertainty of the measurement or the risk of carbon leakages increasing GHG emissions elsewhere. At the same time, some mitigation measures could negatively affect biodiversity (e.g. when agroforestry measures that are not locally appropriate are implemented or when afforestation is carried out in high nature value grasslands; EEB, 2021; McDonald et al., 2021). This risk may be higher: 1) whether carbon farming schemes are narrowly focused on GHG emissions and do not adequately take into account of their broader environmental impacts; 2) if there is no binding legal framework on soil and nature (it will be, therefore, very important to adopt the planned nature restoration and soil health laws; EEB, 2021).

In food processing and retail, sustainable production methods and circular business models will be scaled-up. For instance, the proposed revision of the EU marketing standards is particularly interesting, as they may significantly contrast food waste (as well as pressure on land and water), by ensuring that, through a better definition and rewarding of quality, as many products enter human consumption market as possible (see e.g. EC, 2019).

3.3 Circular economy measures on sustainable consumption and extending the life of products

With reference to consumption, CE policies aim, in the first place, at extending the lifetime of products, so as to prevent waste generation and reduce the negative impacts associated with the need to manufacture new products (e.g. exploitation of natural resources, change in land/sea use, pollution, climate change).

Reuse targets have not a stand-alone-status within the EU legislation, but, for many waste streams,¹⁷ they are applied in combination with recycling targets (which, undoubtedly, decreases the effectiveness of the former). The European Commission will consider the feasibility of setting quantitative targets on reuse of packaging by the end of 2024 (EU, 1994). Specific initiatives have been planned by the EGD policy framework to favour the reuse of some products/materials. Of particular interest are the provisions of the new Soil

¹⁵ According to the proposal (EC, 2022c), 'industrial minerals' means minerals used in industry for the production of semi-finished or finished products, with the exception of metalliferous ores, energy minerals, construction minerals and precious stones, while 'metalliferous ores' means ores that yield metals or metallic substances.

¹⁶ Carbon farming can be defined as a green business model that rewards land managers for taking up improved land management practices, resulting in the increase of carbon sequestration in living biomass, dead organic matter and soils, by enhancing carbon capture and/or reducing the release of carbon to the atmosphere, in respect of ecological principles favourable to biodiversity and the natural capital overall (EC, 2021k).

¹⁷ ELVs; WEEE; construction and demolition waste; paper, plastic, glass and metal from households; municipal solid waste. The new EU Strategy for Sustainable and Circular Textiles (European Commission, 2022) plans the introduction of reuse/recycling targets for this waste stream.

Strategy (EC, 2021h) on the circular use of excavated soil, which give priority, when possible, to reuse over recycling, e.g. through the eventual introduction of a binding ‘passport for excavated soil’ to ensure that it is transported, treated or reused safely. The Strategy will also prioritise ‘the circular use of land over greenfield development’ to limit the acute pressure from soil sealing and land take (EC, 2021h, p. 7), which directly contributes to achieving the ‘no net land take’ objective by 2050.

Some legal requirements have been established to reduce the consumption of selected products that can be substituted by reusable or more sustainable ones (as in the case of lightweight plastic carrier bags and plastic cups for beverages/food containers; EU, 1994, 2019). Based on the 2020 CEAP (European Commission, 2020), an initiative on reuse will be developed to replace single-use packaging, tableware and cutlery by reusable products in food services.

‘Remanufacturing’, ‘refurbishing’ and ‘reconditioning’ are not currently comprehensively addressed by EU legislation (there is not even a commonly accepted legal definition of these terms). The Commission intends to work towards establishing a new consumers’ ‘right to repair’ (textiles and electronics/ICT have been selected as pilot sectors; European Commission, 2020). The lifetime of many products has in fact been decreasing in recent years and consumers are perceived by the Commission as key actors, in order to reverse this trend. Some studies have recently shown that extending lifetime would considerably cut EU’s GHG emissions, also with respect to products for which ‘early replacement’ could be justified based on energy efficiency reasons (e.g. EEE; EEB, 2019), but this could remain an open issue in specific cases (e.g. electric cars compared to fuel cars; Zoboli et al., 2019).

Within the new proposed Regulation on eco-design requirements (EC, 2022e), the planned introduction of bans on the destruction of unsold durable products (along with the obligation for large companies to provide information on the number of discarded products and their subsequent treatment) will contribute to extending the life of products that are fully suitable for use, preventing the loss of valuable resources. According to the Impact Assessment of the French Law prohibiting the destruction of unsold durable goods (n. 105/2020), ‘out of €140 billion consumed by household in non-food consumer durables, €6 billion represent the gross amount of unsold goods’ with hygiene and beauty products accounting for €180 million and textiles and shoes for €49 million (EC, 2022b, p. 206). Therefore, the absolute magnitude of this phenomenon, which may be linked to the rapid growth of online sales, remains considerable.

Another objective of CE policies is to foster the purchase of sustainable/eco-designed products, which is generally beneficial to biodiversity/ecosystems and climate. For instance, it has been estimated that the proposed new Directive on empowering consumers in the green transition would bring a total saved CO₂e of 5-7 MtCO₂e over a period of 15 years (EC, 2022a, p. 53). It is important, however, to prevent any ‘adverse side-effect’, such as stimulating an additional demand of (sustainable/eco-designed) products (overconsumption) and, in particular, of bio-based products. GPP and eco-label criteria are the two main EU policy tools addressing consumption, but their impact is reduced due to their voluntary nature (European Commission, 2020). The Commission has, however, now proposed to set minimum mandatory GPP criteria and targets as part of the legislative initiative on sustainable product policy (European Commission, 2020; EC, 2022e). These could be a powerful instrument both in a CE and biodiversity perspective, given that: 1) the EU yearly spend the equivalent of 14% of the Gross Domestic Product on the purchase of works, goods and service (EC, 2022h) and 2) EU GPP criteria asking for thresholds for chemical substances and for a recycled content in products are among the most common ones, across different product groups (Neubauer et al., 2017). Moreover, as previously noted (see chapter 2.1), in order to enhance the role of consumers in the CE, according to the 2020 CEAP, the EU consumer law is being revised to ensure that consumers receive trustworthy and relevant information on products at the point of sale (EC, 2022d) and companies will be required to substantiate their environmental claims legislation (European Commission, 2020). Minimum requirements will be set for sustainability labels/logos and the Commission will consider how to integrate Product and Organisation Environmental Footprint methods, as well as durability, recyclability and recycled content, in the EU Ecolabel criteria.

Table 3 Impact of CE measures on biodiversity and climate change

	<i>Main CE policy and legislative measures in place (and to be adopted)</i>	<i>Sectors, products, materials (and planned revisions, extensions)</i>	<i>How do CE measures affect biodiversity? (synergies and trade-offs)</i>	<i>How do CE measures affect climate change? (synergies and trade-offs)</i>
Eco-design	EPR	Several waste streams (e.g. packaging, WEEE, ELVs, waste batteries, selected single use plastic products, etc.). <i>Possible extension to textiles.</i>	<p>The four main dimensions of eco-design (selection of low impact materials, reduction of material use, optimization of initial lifetime, optimization of end-of-life system) are in general beneficial to biodiversity, as they are aimed at decreasing resource extraction and waste generation (with associated land/sea use change and pollution).</p> <p>The use of renewable materials could increase pressure on natural resources, especially if it is based on the exploitation of virgin raw materials (instead of SRMs).</p>	<p>The four dimensions of eco-design are beneficial in terms of both climate change mitigation (reduction of GHG emissions; GHG emissions removals via nature protection/restoration) and adaptation (via nature protection/restoration). Renewable materials perform better than fossil-based ones in terms of GHG emissions, but if their use results in the exploitation of virgin raw materials (instead of SRMs), they could damage/decrease natural carbon sinks and the ability of ecosystems to contribute to climate adaptation.</p>
	Legislation on chemicals	Several products/sectors, such as EEE, toys, textiles, etc. <i>(improvements/extension, e.g. to the intentional use of microplastics)</i>		
	Prohibition to place on the market certain materials/products	Selected products (e.g. plastic products with regard to oxodegradable plastic)		
	Technical requirements related to product making	EEE (Eco-design Directive); plastic products (caps/ lids must remain attached to plastic beverage containers during their entire intended use stage; recycled content requirements for plastic bottles <i>to be extended e.g. to batteries, vehicles, plastic products, construction materials, etc.</i>), packaging (essential requirements and related standards; <i>to be revised</i>).		
	EU Ecolabel and GPP criteria <i>(possible introduction of binding GPP criteria and targets in sectoral legislation; possible integration of Product and Organisation Environmental Footprint methods, as well as of durability, recyclability and recycled content, in the EU Ecolabel criteria)</i>	Several products (e.g. selected EEE, furniture, textiles, etc.).		
	Legislative framework on sustainable product policy setting <i>eco-design requirements (based on the revision of the Ecodesign Directive; EC, 2022e)</i>	<i>Cross-sectoral (but focus on electronics, ICT, textiles, furniture, steel, cement, chemicals, etc.).</i>		
	Development of a policy framework on bio-based plastics and biodegradable or compostable plastics.	Plastic		
	Planned initiatives to improve the design of selected products and materials	Textiles (European Commission, 2022), EEE, packaging, batteries (EC, 2020k), vehicles, plastic, construction materials (EC, 2022f), etc.		

Circular production processes	IED Directive and BREFs (revision of BREFs to cover CE, decarbonisation and less toxic environment; introduction of requirements on resource efficiency EC, EC, 2022c)	Several sectors	CE measures regulating production processes (such as those addressing resource and energy efficiency and waste generation) are in general beneficial to biodiversity, as they decrease resource extraction and waste generation (with associated land/sea use change and pollution).	CE measures regulating production processes contribute to climate mitigation (e.g. by increased energy and resource efficiency and reduced waste generation) and climate adaptation (e.g. water reuse is a way to deal with water scarcity).
	Carbon farming	Agriculture		
	Promotion of circular business models in food processing and retail (e.g. by revising marketing standards to provide for the uptake and supply of sustainable agricultural, fisheries and aquaculture products)	Food	Carbon farming schemes may be beneficial to biodiversity (e.g. increased soil fertility, decreased use of fertilizers, nature restoration, etc.), but, to this end, they should take into account of all their environmental impacts (no narrow focus on GHG emissions).	Carbon farming schemes are expected to widely contribute to GHG emissions removals and improved climate adaptation. Several barriers need to be overcome, in order to make this contribution effective (accounting should consider the duration of the storage, the risk of reversal, etc.).
Sustainable consumption and extending the life of products	EU Ecolabel (minimum requirements to protect consumers against greenwashing and premature obsolescence; integration of Product and Organisation Environmental Footprint methods, as well as durability, recyclability and recycled content) and GPP (introduction of binding criteria and targets in sectoral legislation)	Several products (e.g. selected EEE, furniture, textiles, etc.)	Stimulating the purchase of sustainable/eco-designed products is in general beneficial to biodiversity, unless it results in the promotion of overconsumption (which can negatively affect biodiversity, especially in the case of bio-based products/materials not incorporating SRMs). The extension of products' life-cycle is beneficial to biodiversity as it results in reducing both the need to place on the market new products/materials (exploitation of natural resources, changes in land/sea use; pollution) and waste generation (changes in land/sea use, pollution, invasive alien species).	Stimulating the purchase of sustainable/eco-designed products is in general beneficial to climate, unless it results in promoting overconsumption (which, in the case of bio-based products/materials not incorporating SRMs, may damage/decrease natural carbon sinks and the ability of ecosystems to contribute to climate adaptation).
	Revision of EU consumer law (EC, 2022d) to ensure that consumers receive trustworthy and relevant information on products at the point of sale	Cross-sectoral		With regard to extending the life of products, in specific cases (e.g. fuel cars vs electric cars), there could be open issues about the net energy/emissions effects, because the related gains from innovations in new equipment/products might be higher than those from longer life, re-use.
	Reuse targets (often combined with recycling or recovery targets)	Several waste streams (e.g. ELVs; WEEE; construction and demolition waste; paper, plastic, glass and metal from households; MSW).		
	Legislative provisions encouraging the reuse of discarded products and their components	Some waste streams (e.g. packaging and vehicles).		

	Legislative provisions aimed at reducing the consumption of certain products/materials	Plastic packaging/items (lightweight plastic carrier bags and cups for beverages/ food containers)		
	Possible introduction of bans on the destruction of unsold products (mandatory provision of information by large companies)	Cross-sectoral (e.g. textiles)		
	Establishment of a new 'right to repair' to encourage consumers to repair defective products and purchase more second-hand and refurbished ones	Cross-sectoral (textiles and electronics/ICT selected as pilot sectors)		
	Legislative initiative on reuse in food services	Single-use packaging/items		
	Circular Electronics Initiative (including regulatory measures on chargers for mobile phones and similar devices)	EEE		
	Making drinkable tap water accessible in public places to promote the use of reusable water bottles	Packaging		
	New initiatives to promote the circular use of excavated soil and of land over greenfield development	Soil/land		
	See also eco-design measures (information requirements are eco-design requirements)			
Waste management <i>Separate collection and recycling</i>	Obligation to separately collect waste	Glass, plastic, metal, paper; WEEE; waste batteries; biowaste (by 2023); textiles (by 2025); plastic bottles (by 2025).	Improved/higher waste collection and recycling reduce pollution associated with littering (with a positive impact on invasive alien species) and result in the production of SRMs that may substitute virgin materials in production processes, while minimising energy recovery/waste disposal (with related benefits in terms of reduced exploitation of natural resources, land/sea use change, pollution, etc.). It is important that higher waste	Improved/higher waste collection and recycling can contribute to climate change mitigation, as recycling results in the production of SRMs, while it minimises landfilling (reduced GHG emissions from resource extraction and processing and from waste management). It is important that higher waste collection rates are coupled with the development of an adequate EU recycling capacity, to avoid energy recovery and the export of
	New initiatives to improve waste collection and sorting	Packaging, batteries, waste oils and WEEE		
	EPR	Several waste streams (e.g. packaging, WEEE, ELVs, waste batteries, selected single use plastic products, etc.). Possible extension to textiles (European Commission, 2022).		
	Recycling/recovery targets	Packaging; ELVs; waste batteries; WEEE; MSW; C&D waste; paper, plastic, glass and metal from households; plastic bottles (by 2025). Planned introduction of new reuse/recycling targets for textiles (European		

		Commission, 2022) Introduction of new material-specific recycling targets (e.g. for C&D waste) .	collection rates are coupled with the development of an adequate EU recycling capacity, to avoid landfilling, energy recovery and the export of waste for recycling outside the EU. It is also important to produce high quality SRMs to ensure that they may compete with primary raw materials.	waste for recycling outside the EU. It is also important to produce high quality SRMs to ensure that they may compete with primary raw materials.
	Measures to improve recycling efficiency	ELVs, batteries		
	New measures to improve the recycling of selected products	E.g. ships, fishing gears, decommissioned offshore platforms, food contact materials other than PET		
	New initiatives aimed at improving the quality of recyclates and SRMs markets	New standards; creation of harmonised systems to track information on chemicals; specific measures to support the market for recovered nutrients		
	New initiatives to promote the circular use of excavated soil	Soil		
	EU plastic tax	Non-recycled plastic packaging		
	WSR. To be revised to facilitate the shipments of waste for recycling in the EU and prevent the export of waste that can be treated within the EU to third countries	Non-hazardous waste for recovery		
	See also eco-design measures			
Waste management <i>Energy recovery</i>	Recycling/recovery targets	ELVs and WEEE.	When non-recyclable waste is used to produce energy, instead of being landfilled, this can alleviate pressure on biodiversity/ecosystems (RES is produced, which replaces fossil fuels and the impact on land-use is lower than the one associated with landfilling). The use of recyclable waste and products/materials that are not waste as a source of energy may result in higher pressure on biodiversity.	Waste to energy supports climate mitigation when the only available alternative is landfilling. In particular, biodegradable waste to energy is a source of RES and prevents relevant methane emissions from landfilling.
	The sustainability criteria for bioenergy within the RES Directive will be strengthened/revised to ensure that the use of whole trees for energy production, whether from the EU or imported, is minimised.	Production of energy from biomass		
	Provision of targeted support to accelerate the development of the market for biogas from sustainable	Production of energy from biomass		

	sources such as manure or organic waste /residues.			
Waste management <i>Landfill</i>	Reduction targets and bans	Biodegradable municipal waste and municipal waste (reduction targets); waste separately collected for recycling/recovery (prohibition to accept in landfills; strategic objective)	Reducing the waste to be landfilled allows to avoid the related negative effects on biodiversity (e.g. on soil, water, landscape, etc.), while better preserving the value of waste materials (through recycling or waste to energy).	Reducing the waste to be landfilled contributes to climate mitigation (by cutting GHG emissions from landfilling and from extracting/processing virgin materials). The disposal of biodegradable municipal waste is a relevant source of methane emissions.
Cross-cutting: waste prevention targets	New target on food waste reduction	Food waste	Preventing food waste could considerably lessen environmental impacts from food production, processing, transport, and food waste management with substantial benefits to biodiversity (reduced exploitation of natural resources, land/sea use change, pollution, etc.). The magnitude/type of benefits depend on food categories and how food is produced, processed and transported.	Preventing food waste could considerably benefit climate mitigation, through reduced GHG emissions from food production processing, transport, and food waste management (biodegradable waste is a major source of methane emissions). A comparison between studies in different countries on savings in GHG emissions achieved through food waste prevention shows high variability. Most studies, however, conclude that preventing food waste yields far greater life-cycle savings of GHG than incineration and anaerobic digestion.

Note: planned measures/extension & revision of current measures is reported in blue.

Source: own elaboration

3.4 Circular economy measures addressing waste management

CE policies addressing products' end-of-life are aimed at promoting waste management in accordance with the EU waste hierarchy. Landfilling should represent the last resort. Indeed, in addition to emitting methane and carbon dioxide, despite technical measures such as bottom sealing, landfills may reduce the quality of groundwater/surface water, contaminate soil, and impact on the landscape. Moreover, when recyclable or recoverable waste is landfilled, materials are unnecessarily lost from Europe's economy. Recycling and composting, on the contrary, are the preferable waste treatment options, as they better preserve the value of materials compared to energy recovery, by generating SRMs that may substitute virgin materials within production processes (with related benefits in terms of reduced exploitation of natural resources, land/sea use, and pollution). Producing goods from recycled sources is also often less energy intensive than manufacturing from virgin raw materials (with positive effects on climate change). Finally, in spite of the limited consideration that it receives in CE strategies, also consistently with the waste hierarchy, waste to energy can be an important transitional option towards 'zero landfill' objectives (Zoboli et al., 2019). When applied to non-recyclable waste, it offers the opportunity to valorise waste that would be otherwise discarded to produce renewable energy (being, therefore, a net GHG reducer).

In the first place, at the EU level, there is a wide range of policy tools that promote separate waste collection and recycling. This includes collection obligations/targets,¹⁸ recycling/recovery targets,¹⁹ EPR,²⁰ and the new EU plastic tax (which is applied since 2021, based on the amount of non-recycled plastic packaging waste). All these measures are in general beneficial to biodiversity/ecosystems and climate, as they contribute to increasing recycling and preventing littering. An issue that deserves attention, however, is that of the relationship between recycling targets and waste shipments. Pursuant to EU legislation, in order to achieve recycling targets, waste shipped for recycling within and outside the EU is counted as being recycled by the EU exporting country. This means that the EU waste recycling rates do not always reflect the actual recycling capacity of EU Member States and that the EU often export its waste challenges to third countries, with adverse impacts on their environment. Following the introduction of waste trade bans by Asian countries, the export of certain waste (mostly paper and plastics) outside the EU has recently decreased, even if waste flows from the EU have also been partially redirected to other third countries (EC, 2021a). The Commission has now proposed to revise the Waste Shipment Regulation (EC, 2021x) to, *inter alia*, allow the shipment of non-hazardous waste for recovery to third countries only when evidence is made available that the exported waste in the destination countries is treated in an environmentally sound manner. The higher availability of waste for recycling within the EU should be matched with the development of an adequate recycling capacity at EU level to avoid that waste is incinerated with energy recovery or, even worse, disposed of, with related impacts on climate change and biodiversity. Several measures to improve waste collection and recycling have been proposed within the 2020 CEAP (European Commission, 2020). For instance, the Commission intends to create a well-functioning EU market for SRMs by shaping harmonised systems to track and manage information on chemicals, enhancing the role of standardisation and defining further EU-wide end-of-waste criteria for certain waste streams.

Secondly, a few policy tools address waste to energy. In particular, recycling/recovery targets are currently applied to ELVs and WEEE and, in the context of the revision of the RES Directive, the Commission is working to strengthen the sustainability criteria for bioenergy/biofuels (EC, 2021o) and to provide targeted support to accelerate the development of the market for biogas from sustainable sources such as manure or organic waste/residues (EC, 2020j). Overall, energy production from waste²¹ in 2018 amounted to 40.4MTOE, equal to about 2.4% of the total energy supply in the EU (Levaggi et al., 2020). As noted before, waste to energy

¹⁸ Collection obligations/targets apply to glass, plastic, metal, paper; WEEE; waste batteries; biowaste from 2023; textiles from 2025; plastic bottles from 2025.

¹⁹ Recycling/recovery targets apply to packaging; ELVs; waste batteries; WEEE; MSW; C&D waste; paper, plastic, glass and metal from households; plastic bottles from 2025. Reuse/recycling targets will be introduced for textiles (European Commission, 2022).

²⁰ EPR currently applies to packaging, ELVs, WEEE, batteries and selected single-use plastic items (from 2023/2024). The Commission plans to introduce it also for textiles (European Commission, 2022).

²¹ Industrial waste, renewable and non-renewable municipal solid waste, non-renewable waste.

can be considered beneficial in an environmental perspective only when it is limited to non-recyclable waste (which was already stated by the Roadmap to a Resource Efficient Europe, EC, 2011c).

Finally, some CE measures are aimed at banning/reducing the amount of certain waste which is landfilled. Specific targets cover both municipal waste and its biodegradable fraction (the latter being a major source of methane emissions). At the strategic level, the Landfill Directive (EU, 1999) states that Member States shall endeavor 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. Landfill bans make sense in both a CE and biodiversity perspective, but do not necessarily result in higher recycling rates (as waste may be simply redirected to energy recovery) and need, therefore, to be combined with additional policy tools.

3.5 Cross-cutting: food waste prevention

As underlined above, waste prevention is one of the most important objectives guiding CE measures that apply to the production and consumption phases. The 2020 CEAP (European Commission, 2020) plans to shape 'waste reduction targets for specific streams' as part of a broader set of initiatives on waste prevention in the context of the review of the Waste Framework Directive (EU, 2008).

In particular, in line with the SDGs, the Commission will propose a legislative target on food waste reduction. The scope and size of the target are still to be defined, but, in any case, it is expected to have significant positive environmental impacts (both in EU and globally), in particular on GHG emissions, biodiversity, land use, water use and eutrophication. These impacts will come not only from food production, but also from the storage, transport and preparation of food, as well as disposal of food waste (EC, 2021I). Indeed, approximately 88 million tonnes (173 kg per person) of food is wasted every year in the EU-28 (28 EU Member States) along the entire food value chain. This corresponds to about 20% of all food produced (EEA, 2020). The sector contributing the most to food waste are households, followed by processing (Fusions, 2016). With specific regard to climate change, food waste accounts for about 6% of total EU GHG emissions (Fusions, 2016), even if different foods have different impacts on global warming (for instance, meat and dairy tend to have a higher footprint than plant-based foods).

4. Financing the green transition: the Multiannual Financial Framework 2021-2027 and the Taxonomy Regulation

To achieve the ambition set by the EGD, there are significant investment needs. For instance, €20 billion a year should be unlocked for spending on nature to implement the 2030 BDS (EC, 2020d). The EU budget will have to play a key role with this regard. The EU's 2021-2027 Multiannual Financial Framework (MFF), together with the Next Generation post-COVID recovery instrument (NGEU), amounts to €2.018 trillion in current prices (€1.8 trillion in 2018 prices). Based on the Commission proposal, the political agreement of the Special European Council of 17-21 July 2020 (European Council, 2020) established that an overall climate target of 30% will apply to the total expenditures from the MFF and NGEU (including environmental and biodiversity protection). Each EGD strategy identifies the relevant EU funds/programmes to support the achievement of the related objectives. For instance, the 2020 CEAP (European Commission, 2020) lists the European Regional Development Fund (ERDF), LIFE and Horizon Europe as fundamental instruments to develop circular innovations and bring them to the market. The Cohesion Policy funds, LIFE and Horizon Europe (which includes the Mission 'A Soil Deal for Europe'), along with the Common Agriculture Policy (CAP) and the European Maritime and Fisheries Fund will provide new financial resources to tackle biodiversity loss and restore ecosystems (EC, 2021h, 2020d). Moreover, within the InvestEU programme, a dedicated natural-capital and CE initiative will be launched to mobilise at least €10 billion over the next 10 years, through public/private blended finance (EC, 2020d).

Most funds from Next Generation EU (€723.8 billion in current prices, divided into loans -€385.8 billion- and grants -€338 billion-) will be spent through the Recovery and Resilience Facility (RRF). The programme finances reforms and investments in Member States from the start of the pandemic in February 2020 until 31 December 2026. To benefit from the RRF, Member States must submit their national recovery and resilience plans (RRPs) to the European Commission, setting out the reforms and investments to be implemented by end-2026 (all the EU Member States have currently submitted their RRP, apart from the Netherlands; EC, 2022i). The RRF is performance-based, i.e. the unlock of regular payment is made dependent on the fulfilment of agreed milestones and targets towards achieving the reforms and investments in the national RRP. The RRP should devote at least 37% of total expenditure to investments and reforms that support climate objectives and all investments and reforms in the plans must respect the 'do no significant harm' principle. Member States have allocated almost 40% of their spending scheduled in the 22 RRP approved so far to climate measures, exceeding the agreed 37% target (EC, 2022i). According to the available analysis (CEPS, 2022; Wuppertal Institute and E3G, 2021), under the green transition pillar, the main receiving economic sectors are, by far, transport, buildings, and energy (electricity). This is driven, *inter alia*, by the need for the Member States to comply with the stringent requirements/targets of the new energy-climate EGD framework and to finance the related large infrastructure projects. A negligible amount of resources has been invested in the CE transition, since CE is not generally recognised as a national priority by all the EU Member States, even if it may stimulate economic growth and competitiveness. For instance, the assessment of recovery measures in 17 EU Member States performed by Wuppertal and E3G (2021) shows that only 20% of the total recovery investments allocated to industry (€9.3 bn out of €52 bn) will accelerate the green transition and that, within this context, CE does not feature strongly in most Member States RRP. Even a lower priority has been assigned by national governments to the EGD biodiversity and zero pollution goals, which are mainly supported by NGOs and citizens (Paleari, 2022). For instance, over five years, only 0.3% per cent of spending from the RRP of the ten Central and Eastern European countries assessed by CEE Bankwatch Network and EuroNatur will be invested in biodiversity (2021).

Besides allocating a significant share of its budget to support the achievement of climate and environmental objectives, the EU is also greening the way its budget is fed. A new revenue source has been shaped and applied since January 2021, consisting of a national contribution (with a uniform rate of € 0.80 per kilogram), based on the amount of non-recycled plastic packaging waste (EU and Euratom, 2020). The Commission will also propose three additional sources of revenue for the EU budget by the end of 2023. Two of them will be, respectively, based on the carbon border adjustment mechanism and the revised EU ETS.

Since public funds provided by the EU and the Member States will not suffice to meet the EGD investment needs, private finance is expected to contribute to bridging the gap. In order to guide investments towards a green recovery and better integrate environmental considerations into business decision-making, different tools are provided by the EGD strategic framework, including MBIs and the EU taxonomy. MBIs may play a relevant role by sending the right price signals and shaping the right incentives for sustainable behaviour by producers, users and consumers. They are currently implemented in the energy-climate and waste policy areas (e.g. EU ETS, energy taxation, and EPR), where their use will be further extended, but not in the biodiversity policy area. With this regard, the 2030 BDS (EC, 2020d) argues that the European Commission will ‘promote tax systems and pricing that reflect environmental costs, including biodiversity loss’ (but no specific initiatives have been scheduled up to now). Also, the EU taxonomy may help the EU to scale up sustainable investment, by establishing a list of economic activities that can be considered ‘environmentally sustainable’, to the benefit of companies, investors and policy makers. The EU Taxonomy Regulation (EU, 2020) identifies six fundamental environmental objectives, namely: (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a CE, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems. The definitions of CE and key biodiversity concepts, provided by the Regulation, are summarised by Box 1.

Box 1 Definition of CE and key biodiversity terms pursuant to the EU Taxonomy Regulation

‘Circular economy’ means an economic system whereby the value of products, materials and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their use, minimising waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy (Art. 2.9).

‘Biodiversity’ means the variability among living organisms arising from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and includes diversity within species, between species and of ecosystems (Art. 2.15).

‘Ecosystem’ means a dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit (Art. 2.13).

‘Ecosystem services’ means the direct and indirect contributions of ecosystems to the economic, social, cultural and other benefits that people derive from those ecosystems (Art. 2.14)

‘Soil’ means the top layer of the Earth’s crust situated between the bedrock and the surface, which is composed of mineral particles, organic matter, water, air and living organisms (Art. 2.11).

Source: EU (2020)

Pursuant to the Regulation, in order to be qualified as ‘environmentally sustainable’, an economic activity must: 1) contribute to at least one of the six environmental objectives; and 2) do no significant harm to any of the other objectives, while respecting basic human rights and labour standards. Moreover, the Regulation indicates the means by which an activity can make a substantial contribution to the six environmental objectives or can significantly harm them. Table 4 reports the relevant information with regard to the CE and biodiversity-related objectives (i.e. objectives 3, 4, and 6).

The European Commission has to come up with the actual list of environmentally sustainable activities by defining technical screening criteria for each environmental objective through delegated acts. A [first delegated act on sustainable activities for climate change adaptation and mitigation objectives](#) was adopted in 2021 (EU, 2021a) and is applicable since January 2022. A second delegated act for the remaining objectives will be adopted in 2022. These criteria will be particularly important to clarify how the different

environmental objectives (and the related supporting activities) interact in practice and to ensure the coherence of the overall framework.

Table 4 Taxonomy Regulation: ‘substantial contribution’ and ‘do no significant harm’ criteria set for the CE and BIO objectives

<p>Substantial contribution to the transition to a CE (Art. 13.1). a) The activity uses natural resources, including sustainably sourced bio-based and other raw materials, in production more efficiently, including by: (i) reducing the use of primary raw materials or increasing the use of by-products and secondary raw materials; or (ii) resource and energy efficiency measures; b) The activity increases the durability, reparability, upgradability or reusability of products, in particular in designing and manufacturing activities; c) The activity increases the recyclability of products, including the recyclability of individual materials contained in those products, inter alia, by substitution or reduced use of products and materials that are not recyclable, in particular in designing and manufacturing activities; d) The activity substantially reduces the content of hazardous substances and substitutes substances of very high concern in materials and products throughout their life cycle, in line with the objectives set out in Union law, including by replacing such substances with safer alternatives and ensuring traceability; e) The activity prolongs the use of products, including through reuse, design for longevity, repurposing, disassembly, remanufacturing, upgrades and repair, and sharing products; f) The activity increases the use of secondary raw materials and their quality, including by high-quality recycling of waste; g) The activity prevents or reduces waste generation, including the generation of waste from the extraction of minerals and waste from the construction and demolition of buildings; h) The activity increases preparing for the re-use and recycling of waste; i) The activity increases the development of the waste management infrastructure needed for prevention, for preparing for re-use and for recycling, while ensuring that the recovered materials are recycled as high-quality secondary raw material input in production, thereby avoiding downcycling; j) The activity minimises the incineration of waste and avoids the disposal of waste, including landfilling, in accordance with the principles of the waste hierarchy; k) The activity avoids and reduces litter; or l) enables any of the activities listed in points (a) to (k) of this paragraph.</p>	<p>Significant harm to CE (Art. 17.1.d). i) The activity leads to significant inefficiencies in the use of materials or in the direct or indirect use of natural resources such as non-renewable energy sources, raw materials, water and land at one or more stages of the life cycle of products, including in terms of durability, reparability, upgradability, reusability or recyclability of products; (ii) The activity leads to a significant increase in the generation, incineration or disposal of waste, with the exception of the incineration of non-recyclable hazardous waste; or (iii) the long-term disposal of waste may cause significant and long-term harm to the environment.</p>
<p>Substantial contribution to the protection and restoration of biodiversity and ecosystems (Art. 15.1) The activity contributes substantially to protecting, conserving or restoring biodiversity or to achieving the good condition of ecosystems, or to protecting ecosystems that are already in good condition, through: a) nature and biodiversity conservation, including achieving favourable conservation status of natural and semi-natural habitats and species, or preventing their deterioration where they already have favourable conservation status, and protecting and restoring terrestrial, marine and other aquatic ecosystems in order to improve their condition and enhance their capacity to provide ecosystem services; b) sustainable land use and management, including adequate protection of soil biodiversity, land degradation neutrality and the remediation of contaminated sites;</p>	<p>Significant harm to biodiversity and ecosystems (Art. 17.1.f) i) The activity is significantly detrimental to the good condition and resilience of ecosystems; or ii) The activity is detrimental to the conservation status of habitats and species, including those of Union interest.</p>

<p>c) sustainable agricultural practices, including those that contribute to enhancing biodiversity or to halting or preventing the degradation of soils and other ecosystems, deforestation and habitat loss;</p> <p>d) sustainable forest management, including practices and uses of forests and forest land that contribute to enhancing biodiversity or to halting or preventing degradation of ecosystems, deforestation and habitat loss; or</p> <p>e) enabling any of the activities listed in points (a) to (d) of this paragraph.</p>	
<p>Substantial contribution to the sustainable use and protection of water and marine resources (Art. 12.1)</p> <p>The activity either contributes substantially to achieving the good status of bodies of water, including bodies of surface water and groundwater or to preventing the deterioration of bodies of water that already have good status, or contributes substantially to achieving the good environmental status of marine waters or to preventing the deterioration of marine waters that are already in good environmental status, by:</p> <p>a) protecting the environment from the adverse effects of urban and industrial waste water discharges, including from contaminants of emerging concern such as pharmaceuticals and microplastics, for example by ensuring the adequate collection, treatment and discharge of urban and industrial waste waters;</p> <p>b) protecting human health from the adverse impact of any contamination of water intended for human consumption by ensuring that it is free from any micro-organisms, parasites and substances that constitute a potential danger to human health as well as increasing people’s access to clean drinking water;</p> <p>c) improving water management and efficiency, including by protecting and enhancing the status of aquatic ecosystems, by promoting the sustainable use of water through the long-term protection of available water resources, inter alia, through measures such as water reuse, by ensuring the progressive reduction of pollutant emissions into surface water and groundwater, by contributing to mitigating the effects of floods and droughts, or through any other activity that protects or improves the qualitative and quantitative status of water bodies;</p> <p>d) ensuring the sustainable use of marine ecosystem services or contributing to the good environmental status of marine waters, including by protecting, preserving or restoring the marine environment and by preventing or reducing inputs in the marine environment; or</p> <p>e) enabling any of the activities listed in points (a) to (d).</p>	<p>Significant harm to waters and marine resources (Art. 17.1.c)</p> <p>The activity is detrimental:</p> <p>i) to the good status or the good ecological potential of bodies of water, including surface water and groundwater; or</p> <p>ii) to the good environmental status of marine waters.</p>

Source: EU (2020)

5 Conclusions

Based on the above policy framework analysis, which is mainly focussing on the policies in the context of the European Green Deal, the following conclusion can be made:

- By maintaining the value of products, materials and other resources in the economy for as long as possible, enhancing their efficient use in production and consumption, and returning them into the product cycle at the end of their life, CE measures are generally beneficial to both biodiversity and climate.
- ‘Nature regeneration’ is another dimension of CE that can be beneficial to both biodiversity and climate. According to some scholars (Ellen MacArthur Foundation, 2022), this dimension is part of the CE concept. At the EU level, although the 2020 CEAP is aimed at moving towards a ‘regenerative growth model that gives back to the planet more than it takes’, it is not formally included in the available CE definitions (EC, 2014; EU, 2020) and it rarely represents the objective of CE measures. Obviously, the implementation of nature regeneration measures in the EU is supported by other policy areas (e.g. CAP, common fishery policy, etc.).
- CE measures (directly and indirectly) contribute to meeting biodiversity and climate/energy strategic objectives, but they cannot be considered a panacea. In particular, even if CE is preferable to a linear economy, the idea of closing cycles alone does not touch the question on how large and fast such cycles can be (Desing et al., 2020).
- Although in general synergies exist between CE policy and biodiversity/climate policies, specific conflicts/trade-offs may arise. Selected relevant examples are provided below.
- In the production phase, the use of renewable bio-based materials/products is largely promoted by both CE and DEC policies, since, compared to fossil-based materials/products, the former can be often more easily recycled and perform better in terms of GHG emissions. This choice, however, risks to increase pressure on natural resources and biodiversity (especially when it results in the extraction of virgin materials), with widespread consequences also on climate mitigation (carbon sinks) and adaptation. Bio-based materials/products should be supported only when they meet sustainability criteria that consider all their environmental impacts along their whole life-cycle.
 - The 2020 CEAP plans the development of an EU regulatory framework for the certification of carbon removals. Carbon farming practices can foster climate change mitigation/adaptation, while providing renewable resources for a circular bioeconomy and contributing to the recovery of biodiverse and resilient nature. However, some agroforestry measures (as well as some industrial solutions that remove carbon) could negatively affect biodiversity. Therefore, it should be ensured that all types of carbon removals are sustainable, considering of their impacts on biodiversity and ecosystems.
 - In general, CE measures supporting sustainable consumption (extending the life of goods and encouraging the purchase of sustainable products) generate relevant co-benefits for biodiversity/ecosystems and climate. In specific cases (e.g. fuel cars vs electric cars), there could be open issues about the net energy/emissions effects, because the related gains from innovations in new equipment/products might be higher than those from longer life, re-use (Zoboli et al., 2019). It is also important that CE measures aimed at fostering the purchase of sustainable goods do not result, as a side-effect, in an additional demand of products (overconsumption). This could increase pressure on biodiversity, especially in the case of bio-based products.
 - With regard to waste management, many CE policy measures (collection targets, bans on waste shipment outside the EU, etc.) tend to increase the availability of waste to be treated in EU Member States. If these measures are not coupled with the development of an adequate recycling capacity within the EU (both in terms of infrastructure and technology), the supplied waste risks to be destined to energy recovery or, even worse, to landfills. Landfilling represents a ‘lose-solution’ in a CE-BIO-DEC perspective. Energy recovery may, comparatively, offer some advantages (production of energy and, in particular, of RES when biodegradable waste is processed), but it is, in any case, less preferable than recycling and it may result in a greater pressure on biodiversity/ecosystems due to both waste treatment and the need to extract natural resources (instead of using SRMs). Practically,

however, energy recovery turns out to be a transitional solution, while waiting for the scaling-up of recycling processes.

- In order to enhance synergies and manage trade-offs between CE-BIO-DEC policies the following should be considered:

- It is urgent to promote the transition from a 'silo' to an 'integrated' approach in the design and implementation of EU environmental policies. This would help to boost synergies and fix (ex ante or, at least, ex post) potential conflicts between them. The green oath to 'do no harm', which, according to the EGD, is to be applied to all new EU legislative initiatives, should in the first place 'regulate' the relationship between different environmental policy areas. Policy measures that are too narrowly focused on the achievement of specific objectives risk to produce unintended negative effects on the environment.

The EU Taxonomy Regulation (EU, 2020), with its delegated acts, reflects this commitment to moving towards an integrated policy approach. Indeed, it aims at providing clarity for companies, capital markets, and policy makers on which economic activities are sustainable, considering of six main environmental objectives (including climate mitigation/adaptation, the transition to a CE and biodiversity protection and restoration).

- Secondly, there is a wide difference among the policy tools currently applied, at the EU level, to achieve CE, climate and biodiversity goals. The CE and climate policy domains are characterized by an extensive use of stringent regulatory tools (e.g. binding targets, emission limit values, prohibition to place on the market certain substances/materials) and market-based instruments (MBIs, e.g. EPR, ETS, energy taxation, etc.). In the biodiversity policy area, on the contrary, voluntary approaches predominate and there are no MBIs.

The 'weaknesses' of the biodiversity policy domain, compared to the CE and climate/energy ones has two main consequences: 1) it makes biodiversity particularly 'vulnerable' to the adverse side-effects generated by the other two policy areas; 2) it makes biodiversity co-benefits generated by CE and climate policies especially valuable. Therefore, it is key to: 1) adopting an integrated approach in the design and implementation of CE, biodiversity, and climate policies; 2) strengthening the legal framework on soil and nature. With regard to the latter, it has to be underlined that the 2030 BDS and the new EU Soil Strategy provide for the introduction of mandatory nature restoration targets (EC, 2022g) and a new Soil Health Law.

- A strict application of CE principles may help to alleviate the potential adverse effects generated by certain climate policies on biodiversity/ecosystems. Several examples can be provided. As noted before, the increasing demand for low-emission bio-based materials/products can be considered sustainable, in a biodiversity perspective, only if largely based on the use of SRMs. Limiting energy recovery to non-recyclable waste (including non-recyclable biomass residues) prevent higher pressure on natural resources (caused by the need to increase RES, but also to lower the EU's external energy dependence). Building energy renovation, which is critical to shift to an energy-efficiency and low-carbon built environment (EC, 2020g), will result in an additional demand of construction materials and further waste generation. Again, CE principles can contribute to managing both these problems in a sustainable way.

- Since the EU is the world's largest trader of manufactured goods and services, the implementation of CE principles generates relevant environmental benefits beyond EU borders. First, the export by the EU of eco-designed goods reduces their environmental impacts during consumption (e.g. by minimizing/preventing the negative effects of chemicals on human health and the environment) and in the end-of-life phase (e.g. by facilitating waste recycling). Second, enhancing waste recycling and the production of high-quality SRMs in the EU decreases the need to export recyclable waste to extra-EU countries (often characterized by low environmental standards) and to import virgin raw materials from outside the EU (contributing to the secure supply of these materials in Europe). Finally, it has to be underlined that EU trade partner countries will be encouraged to match their criteria with those of the EU 'circular' standards (e.g. eco-design requirements or SRMs quality standards). Trade may, therefore, be a key vehicle to support a shift from a linear to a circular economy not only in the EU, but also globally (Kettunen et al., 2020).

- Both private and public finance is expected to contribute to meeting the huge investment needs to achieve the EGD ambition. An overall climate target of 30% will apply to the MFF 2021-2027 and NGEU together (€2.018 trillion in current prices). The target increases to 37% for the financial resources provided by the RRF (which is a component of NGEU). Based on RRFs, these resources have been mainly allocated to the energy, building and transport sectors, while investments in nature protection, sustainable food systems, CE and zero pollution are negligible and not widespread. Although CE does not represent a national priority in all EU Member States, it may be attractive for private investors, since it can stimulate economic growth and competitiveness. Instead, the objective of nature protection/restoration is mainly supported by citizens and NGOs. The undervaluation of biodiversity/ecosystem services in the economic system is widely recognized as a fundamental problem in biodiversity conservation, but the 2030 BDS (EC, 2020b) does not contain major innovative proposals with this regard (Paleari, 2022).

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