Towards a circular economy that begins and ends in nature

Barbara Pia Oberč, Roza de Jong, Tommaso Demozzi, Barbara Battioni Romanelli

Alberto Arroyo Schnell, editor

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

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Table of contents

Foreword

We all depend on nature. It is essential to life on earth and it underpins our health, wellbeing and prosperity. If we want to keep global warming under control, secure our food and water, and maintain a supply of resources for the economy, we must ensure that natural ecosystems remain healthy, resilient and productive.

However, human activities are using nature faster than it can recover, degrading ecosystems and pushing them towards dangerous tipping points. They undermine the very basis on which our economy depends, threatening humanity's life-support system.

The EU response to this challenge is the European Green Deal. Its holistic framework reconciles climate, biodiversity and socio-economic objectives, with a view to transforming the EU into a sustainable, fair and competitive economy. At the heart of the deal is the EU Circular Economy Action Plan, which will play an important role in reshaping economic activities so that they do not harm the planet, but contribute instead to the protection, restoration and sustainable use of nature, in line with the EU Biodiversity Strategy for 2030.

A more circular economy is a vital requirement for the more sustainable use of natural resources, and for tackling the triple crises of climate change, loss of biodiversity and pollution. More than 90% of biodiversity loss and water stress, and fully 50% of our greenhouse gas emissions can be traced back to resource extraction and processing. Our use of natural resources has more than tripled from 1970, and it continues to grow. Switching to a more circular economy means moving towards a more sustainable and circular way of life, reducing the use of virgin natural resources and waste, increasing use of recycled materials, promoting repair and reuse of products and keeping them in use for as long as possible. The fewer virgin natural resources we use, the more our biodiversity will thrive.

Virginijus Sinkevičius
Commissioner for the Environment, Oceans and Fisheries, European Commission

At the global level, the Kunming-Montreal Biodiversity Framework adopted under the Convention on Biological Diversity provides a powerful renewed agenda for moving forward with the needed transformative change. It sets targets to enable the transition to sustainable production and consumption, with the involvement of all actors, at all levels - from large and transnational companies and financial institutions' operations, their supply chains and portfolios, through to individual consumers.

This IUCN report makes a significant contribution to the discussion on how to develop a circular economy that also works for nature, minimising trade-offs and searching for multiple wins. Much will depend on the policy choices of the coming years. We need innovative solutions that give more space to nature, while still eradicating hunger and securing the energy and resources that we need. We need all parts of society, all sectors of the economy, all levels of governance on board to enable a green transition that really would 'bend the curve'. This report is a welcome addition to this all-important process of reflection.

Executive summary

Human activities, especially linked to the conventional, linear economy, have caused the planet to plummet into a biodiversity crisis. According to the International Resource Panel of the United Nations Environment Programme, 90% of biodiversity loss and water stress are caused by resource extraction and processing (IRP, 2019). Currently, more than 40,000 species are documented as threatened based on the IUCN Red List (IUCN, 2022), with extrapolation from this suggesting that one million species may be threatened with extinction (IPBES, 2019a).

The circular economy is a positive step forward to help achieve our environmental targets. When implemented with nature in mind, it can present an important opportunity for nature and biodiversity. As outlined by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019b), to halt and reverse biodiversity loss by 2030 we will need to transform our production and consumption systems. This is precisely what the circular economy aims to address.

The positive effects of a circular economy on the state of nature and biodiversity are, therefore, often taken as a given. However, this is not necessarily the case. Certain theories or practices associated with the circular economy concept today may, in fact, pose limitations to conserving biodiversity. This might include potential issues related to land use or pressures on biodiversity resulting from a growing demand for bio-based materials.

Although there have been some important developments of late that are beginning to bring the two areas closer together (INEC, 2021; EMF, 2021b; Sitra 2022), the relationship between the circular economy and nature has to date been insufficiently explored.

At the international level, the Post-2020 Global Biodiversity Framework of the United Nations Convention on Biological Diversity is increasingly recognising the links between the topics, as reflected in several negotiating documents and in Parties' statements. However, to date the term 'circular economy' has not been included in the official texts of the Framework.

The European Union (EU) is a key actor in the development and promotion of the circular economy as well as leading in the efforts to conserve nature and biodiversity. Some positive steps to integrate these two areas have already been taken. Under the flagship European Green Deal, the European Commission has recently made important strides in connecting the dots to help the circular economy address key environmental challenges – which should be its ultimate goal.

This report thus takes a close look at both the EU's Circular Economy Action Plan and the Biodiversity Strategy for 2030. Both have been launched under the mentioned European Green Deal, while it is important to note that the two make little reference to one another. Specifically, this report focuses on the *Food, water and nutrients* section

of the Circular Economy Action Plan. This area is presented as the value chain within the Plan most linked to land use as well as other key drivers of biodiversity loss. The issues linked to this key value chain thus pose both the greatest impact and the greatest potential benefit to nature and biodiversity. The report concludes that circular economy policy can actually go beyond what it currently focuses on, particularly in terms of sectors. Central to much of this is ensuring that the bioeconomy is developed in a sustainable and circular way, with full respect of its ecological boundaries. An important example of a lesson to be learned from the circular economy is that, in accordance with its principles, biomass should in principle not be used directly for energy.

This report explores the relationship between the circular economy and biodiversity, especially from a policy point of view. Through examining potential challenges and opportunities in existing policy, it aims to identify some ways forward to more closely interlink the transition to a circular economy with the protection and restoration of nature. The report seeks to further integrate these two policy priorities towards establishing a circular economy that works for nature. While focusing on the EU level, it includes conclusions relevant for the global level as well.

The report does not aim to provide a comprehensive or in-depth exploration of all possible links between the circular economy and biodiversity policy areas, nor does it propose a definitive way forward. Rather, it endeavours to shed light on the not yet fully explored space in-between, illustrating some of the ways in which the two areas could mutually reinforce one another. In particular, it strives to contribute to the understanding of how the circular economy could be an indispensable tool in helping us achieve the goals of biodiversity conservation. By providing some general conclusions, it makes the case and calls for the closer integration of these two areas. The report also aims to help provide the basis for further dialogue and action in creating a circular economy that works for nature.

The following are some of the elements identified as crucial in the way forward to establish a circular economy that works for biodiversity, with nature at its core:

- It is important to begin with how the circular economy is understood, including how it is defined, to better serve biodiversity. To help frame a better understanding in the policy discussion of the role of nature in the circular economy and vice versa, it is helpful to keep in mind Rockström's and Sukhdev's "wedding cake model" of the Sustainable Development Goals. Using this model, nature is appropriately placed as the foundation for achieving all of our societal priorities.

- Recent research has shown that certain sectors such as food and agriculture, as well as forestry, hold significant potential for conserving nature and biodiversity if these were to become fully circular. In this context, Nature-based Solutions can be a very helpful tool.

- Another key tool by which to bring the circular economy closer to nature would be through the use of the natural capital concept. Furthermore, many solutions tackling nature loss and climate change will require investment, with sustainable finance a key priority for the transition to a circular economy that embraces biodiversity.

- To support the transition to a circular economy with nature at its core, it is fundamental to enhance policy coherence.

- At the global level, although the current draft of the Post-2020 Global Biodiversity Framework does not include the term 'circular economy', we would expect this to be different in its final version.

- At the EU level, it is important to highlight the need to maintain and reinforce EU leadership on both advancing the circular economy and halting biodiversity loss. The European Green Deal is a step in the right direction, helping to integrate relevant environmental policies under the same umbrella.

Conservation and restoration will remain crucial activities in the fight against the interdependent crises of biodiversity loss, ecosystem degradation, and climate change. However, the transition to a circular economy that both begins and ends in nature, and that transforms our unsustainable production and consumption systems, is an invaluable tool to help us achieve our fast-approaching environmental targets.

Acknowledgements

We wish to thank the European Circular Economy Stakeholder Platform (ECESP) for providing us with the space and support to explore the further integration of the circular economy and biodiversity policy agendas. Within this context, we remain grateful to our ECESP partners the Ellen MacArthur Foundation, the Finnish Innovation Fund Sitra, and the French National Institute for Circular Economy (INEC), for our continued collaboration in bringing together these two topics. The recently created Leadership Group on Biodiversity and Climate, led by IUCN as a member of the ECESP Coordination Group, will follow this task in the future.

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Introduction

The concept of the circular economy is increasingly prevalent in the scientific and policy worlds alike, as an answer to our continued, unsustainable use of resources. In light of the increasing importance ascribed to the circular economy as a sustainable solution, environmental priority, and global movement, recent research (Buchmann-Duck & Beazley, 2020; Desing, et al., 2020; INEC, 2021) has called for a closer examination of the relationship between the environmental priorities of transitioning to a circular economy and ensuring the conservation of nature and biodiversity.

Although there have been some important developments of late that are beginning to bring the two areas closer together (INEC, 2021; EMF, 2021b; Sitra 2022), to date, the relationship between the circular economy and nature, and how circular economy practices can benefit or impact nature, have been insufficiently explored. The positive effects of the circular economy on the state of nature and biodiversity are often taken as a given, however this is not necessarily the case. Certain theories or practices associated with the circular economy concept today may, in fact, pose limitations to conserving biodiversity. This may include potential issues related to land use or pressures on biodiversity resulting from the growing demand for bio-based materials.

At the same time, when implemented with nature in mind, the circular economy can present an important opportunity for nature and biodiversity. As outlined by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019b), to halt and reverse biodiversity loss by 2030 we will need to transform our production and consumption systems, which is precisely what the circular economy aims to do.

The European Union (EU) is a key actor in the development and promotion of the circular economy. It launched the first Circular Economy Action Plan in 2015 (EC, 2015), reinforcing it with a second action plan in 2020 (EC, 2020a) under the flagship European Green Deal (EC, 2019b). As it stands, the Biodiversity Strategy (EC, 2020b) – another key document under the European Green Deal – makes little reference to the circular economy, nor does the Circular Economy Action Plan significantly mention biodiversity. The links between the two fields at the EU policy level could be more strongly addressed and the same goes for beyond the EU.

This report explores the relationship between the circular economy and biodiversity, especially from a policy point of view. Through examining potential challenges and opportunities in existing policy, it aims to identify some ways forward to more closely interlink the transition to a circular economy with the protection and restoration of nature. The report seeks to further integrate these two policy priorities towards establishing a circular economy that works for nature. While focusing on the EU level, it

includes conclusions relevant for the global level as well.

The report does not aim to provide a comprehensive or in-depth exploration of all possible links between the circular economy and biodiversity policy areas, nor does it propose a definitive way forward. Rather, it endeavours to shed light on the not yet fully explored space in-between, illustrating some of the ways in which the two areas could mutually reinforce one another. In particular, it strives to contribute to the understanding of how the circular economy could be an indispensable tool in helping us achieve the goals of biodiversity conservation. By providing some general conclusions, it makes the case and calls for the closer integration of these two areas. The report also aims to help provide the basis for further dialogue and action in creating a circular economy that works for nature.

The information in this publication is up to date as of the time of writing in September 2022.

IUCN Europe is a member of the coordination group of the European Circular Economy Stakeholder Platform (ECESP), where we help coordinate the biodiversity effort through the Leadership Group on Biodiversity and Climate. Along with other ECESP coordination group members, the Ellen MacArthur Foundation, the Finnish Innovation Fund Sitra, and the French National Institute for Circular Economy (INEC), we have been collaborating on the development of this report, part of a larger exercise of integrating the circular economy and biodiversity policy agendas. Each of these partners has recently developed their own report to help shed light on the insofar underexplored relationship between the circular economy and nature (INEC, 2021; EMF, 2021b; Sitra 2022).

Theoretical overview

Biodiversity

According to Article 2 of the United Nations' Convention on Biological Diversity (CBD), biodiversity means "*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems*" (CBD, 1992). The European Environmental Agency says that biodiversity includes all "*unique living organisms that inhabit Earth, and the interactions among them*" (EEA, 2019a).

Unfortunately, our understanding of the importance of biodiversity is not reflected in most peoples' lifestyles and actions. Human activities, especially linked to the linear economy, have caused the planet to plummet into a biodiversity crisis. Currently, more than 40,000 species are documented as threatened based on the IUCN Red List (IUCN, 2022), with extrapolation from this suggesting that one million species may be threatened with extinction (IPBES, 2019a). The rate of biodiversity loss is directly linked to our use of natural resources: the International Resource Panel of the UN Environment Programme (UNEP) discovered that 90% of biodiversity loss and water stress are caused by resource extraction and processing (IRP, 2019).

The dramatic negative trend in biodiversity loss is caused by a wide range of drivers (EEB, 2018). The Biodiversity Information System for Europe (BISE) defines six predominant, interlinked, biodiversity threats and pressures: climate change, invasive species, fragmentation, land use change, pollution, and overexploitation (Biodiversity Information System for Europe, n.d.). In the EEA's 2020 State of Nature in the EU report (EEA, 2020b) agriculture is the most frequently reported pressure for habitats and species, especially when it comes to intensification, land use change, and habitat fragmentation. Furthermore, almost 50% of all pressures related to pollution can be attributed to air, water and soil pollution caused by agriculture (EEA, 2020b).

The interdependent crises of biodiversity loss, ecosystem degradation, climate change, and pollution are among the main challenges of our times, and they are accelerating at an unprecedented rate. Considering this acceleration, caused largely by human activities, there have been many initiatives that aim to restore damaged natural ecosystems and protect biodiversity from the threats and pressures that cause further deterioration. In 2021, the United Nations (UN) launched the Decade on Ecosystem Restoration (2021-2030) (UNEP & FAO, 2022), led by UNEP and the Food and Agriculture Programme (FAO). The Decade challenges everyone to massively scale up restoration efforts to prevent, halt, and reverse ecosystem degradation worldwide. Ecosystem restoration is one of the most important ways of delivering Nature-based Solutions

(IUCN, 2022c) to prevent biodiversity loss (UNEP, 2021b). Nature-based Solutions (NbS) are ecosystem-based actions that address societal challenges while providing human well-being and biodiversity benefits (IUCN, 2022c). When implemented with the guidance provided by the IUCN Global Standard for Nature-based Solutions (IUCN, 2020c), several actions can be considered NbS. These include, but are not limited to, planting mangroves or grass, natural or assisted regeneration, agroforestry, soil enhancement measures, and improved and sustainable management to accommodate a mosaic of land, aquatic, or marine uses (Cohen-Shacham, et al., 2016).

The circular economy

It is difficult to provide one single definition for the circular economy (Desing, et al., 2020). A study from Kirchherr et al. (2017) gathered 114 circular economy definitions, coded on 17 dimensions. The findings indicate that the circular economy is most frequently described as a combination of reduce, reuse, and recycle activities, whereas it is rarely highlighted that the circular economy necessitates a systemic shift. Most often the main aim of the circular economy is considered to be economic prosperity, with environmental quality following. Economic prosperity is most frequently mentioned by practitioners, who often also view the circular economy as a "*pathway to boost growth*" (Kirchherr, et al., 2017). At the same time, business models and consumers are rarely outlined as enablers of the circular economy.

The first Circular Economy Action Plan, published by the European Commission (EC) (EC, 2015), defined the circular economy as maintaining the value of products, materials, and resources in the economy for as long as possible while minimising the generation of waste, highlighting this as "*an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy*" (EC, 2015). The EU's first legal definition for the circular economy was introduced with the recently approved framework to facilitate sustainable investment, which states that:

> *"'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"*
> (EU 2020b p. 26).

The understanding and definition of the circular economy at the EU level is thus evolving, which should allow for the closer consideration of nature. For the purposes of this report, we will highlight a few more approaches to defining the circular economy which already better incorporate the linkages with nature. These are outlined in the box below.

BOX 1: Select definitions of the circular economy with an emphasis on nature

According to the Ellen MacArthur Foundation (2021b), the circular economy is a framework for systems solutions and transformation that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It has three principles, all driven by design, which can help tackle the root causes of biodiversity loss by:

1. Eliminating waste and pollution – to reduce threats to biodiversity;
2. Circulating products and materials (at their highest value) – to leave room for biodiversity;
3. Regenerating nature – to enable biodiversity to thrive.

This third principle is considered especially crucial in the context of preserving and restoring biodiversity, implying that it is both possible and necessary to go beyond reducing the negative effects of economic activity on biodiversity, and instead to employ the circular economy to actively regenerate natural systems.

The Finnish Innovation Fund Sitra (2022) states that the circular economy is a systemic approach to production, consumption and materials management that maximises both value and use, and applies regenerative principles. It prioritises non-toxic, renewable[1], and recyclable resources, and minimises waste by closing resource flows. This approach reduces the environmental pressures of resource extraction, production, consumption and waste to benefit habitats, species and genetic diversity. In a nutshell, Sitra (2022) defines the circular economy as an economic model that aims to optimise the system as a whole and tackle the root causes of biodiversity loss, climate change, and depletion of natural resources.

According to the French National Institute for Circular Economy (INEC, 2021), the circular economy is defined as a solution to the challenges of resource scarcity, aiming to decouple the creation of societal value from its impact on the environment. This model implies the implementation of new ways of design, production, consumption, and use that are more sober and efficient (eco-design, industrial and territorial ecology, economy of functionality, etc.), and to consider waste as a resource. The circular economy is built around five principles:

1. Non-toxicity, to limit the use of harmful substances to humans and the environment;
2. Sobriety in production and consumption;
3. Resource efficiency, as the objective is not to waste resources and use them sustainably;
4. Renewability, which promotes the extraction of renewable resources at a sustainable rate;
5. A closing of flows, which regenerates value for materials that are already in the economic system by reusing or recycling them.

INEC outlines the need for a territorial approach to implementing the circular economy that works for nature – this makes it possible to set up relevant economic projects within the limits set by the local environment in terms of availability of natural resources and pressures on biodiversity.

While definitions continue to evolve, there are a few elements that have and continue to underpin the understanding of the circular economy.

The management of materials and the closing of loops are a strong focus in the circular economy. Materials should be used in a way that they can be cycled *ad infinitum*,

1 The concept of renewability relates mainly to substitution, and links back to Sitra's earlier definition, not limited to bio-based products; namely "using renewable and recyclable materials as well as renewable energy in product and manufacturing". Source: (Sitra, 2019)

as happens in nature. Moreover, these materials should be cycled at the highest value possible (preferably as whole products), and eventually recycled back down to basic raw materials (Metabolic, 2019). The prioritisation should follow the principles of the **waste hierarchy** (see Figure 1 below).

The circular economy concept is also based on **Cradle to Cradle principles** (McDonough & Braungart, 2000). Here, the circular economy is considered to be composed of two distinct yet inextricably intertwined parts – the 'biological cycle' which includes products intended for consumption, and the 'technical cycle' which includes service products (Wautelet, n.d.) (see Figure 2 below). The biological and technical cycles together comprise the whole economy, and are crucial to consider in understanding the linkages between the circular economy and biodiversity.

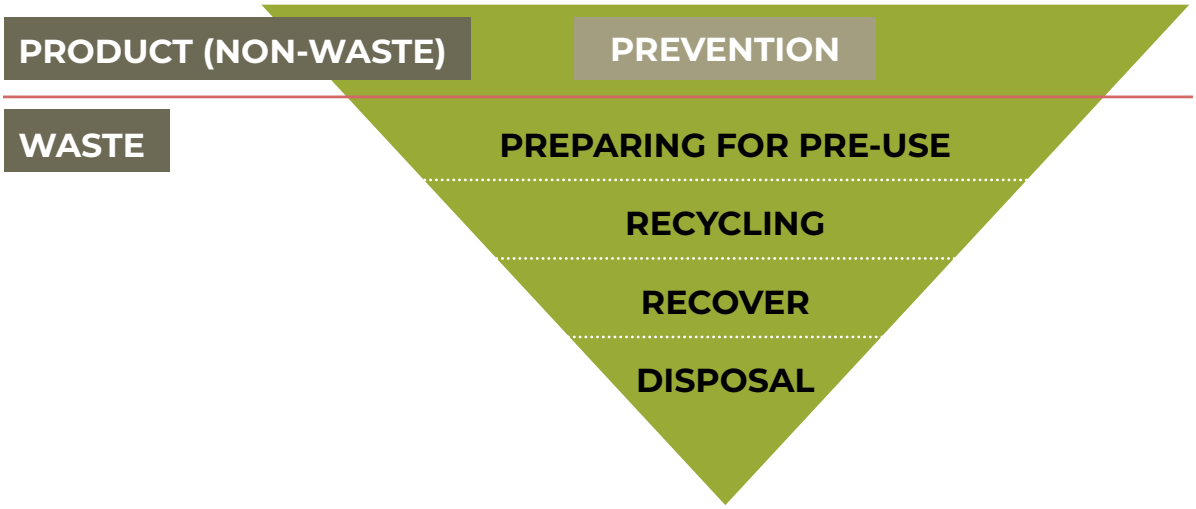

Figure 1: The waste hierarchy (DG Environment, n.d. j).

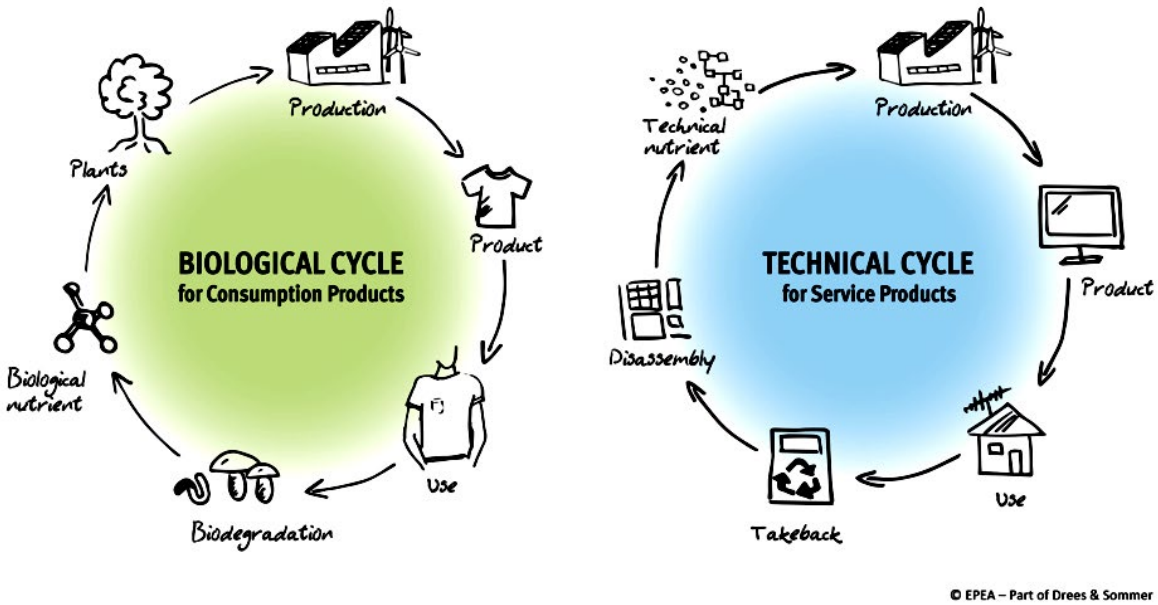

Figure 2: The biological and technical cycles (EPEA GmbH, 2022).

The underexplored relationship between the circular economy and biodiversity

Greater attention to nature and biodiversity is increasingly recognised as a fundamental component in more comprehensive definitions for the circular economy, as outlined above. This is already a welcome development, and an important one to consider in policy discussions in order to link the circular economy with biodiversity.

The circular economy can, in principle, benefit biodiversity by complementing the conservation and restoration of ecosystems, contributing to more sustainable production, consumption, materials management, reduced land use, and pollution (Gorst & Forslund, 2021). It provides tools that can tackle some of the main threats and pressures on biodiversity, such as land use change and overexploitation (Forslund, 2021). Sitra's recent study finds that, if circular interventions are implemented across a number of sectors, the world's biodiversity could recover to 2000 levels by 2035 (Sitra, 2022).

However, as it stands, biodiversity is an important yet underrepresented aspect of circular economy (Buchmann-Duck & Beazley, 2020; Desing, et al., 2020; Kirchherr, et al., 2017). Biodiversity is under constant threat in the mainstream linear economy, yet little research thus far has focused on how this might change in a circular economy. For example, the circular economy is often linked to the concept of the bioeconomy, yet even if the latter can provide positive benefits, such as supporting a transition away from fossil fuels, it could also lead to changes in land use that might pose a negative impact on nature, e.g. if crops for timber or food production would compete with other uses (Buchmann-Duck & Beazley, 2020). At the same time, recent research (Sitra, 2022) has shown that there are four main sectors that have the largest biodiversity impact, as well as the potential to transition to a circular economy. These sectors in fact pertain largely to the bioeconomy: food and agriculture, forestry, buildings and construction, and fibre production and textiles (Sitra, 2022).

Furthermore, applying economic concepts to ecosystems also implies that they are "natural capital" (INEC, 2021). This approach could include assigning monetary value to some elements of nature, which is of course not straightforward, as there is the obvious risk of selecting these according to an anthropocentric vision and preferring indicators more suitable to humans (INEC, 2021).

Within the 3Rs (reduce, reuse, recycle) at the base of the circular economy, the regenerative and restorative dimensions are less prominent. The first set of 3Rs may therefore require a second one – remediation, restoration and regeneration – that shifts the focus to the positive impact of reversing the world's degrading ecosystems (Schröder, et al., 2021). The regenerative principle is, in fact, core to the Ellen MacArthur Foundation's definition of a circular economy, where the circular economy is understood to be regenerative and restorative by design (EMF, 2021b). Similarly, the Science Based Targets Network' AR3T action framework (2020, p. 9), as introduced in their initial guidance for businesses, covers actions that "*avoid* future impacts, *reduce* current impacts, *regenerate* and *restore* ecosystems, and *transform* the systems in which companies are embedded".-

In some cases, solutions understood to fall under the circular economy, if not applied with nature in mind, could lead to unsustainable spillovers and trade-offs. For example, the use of renewable materials could result in additional land use pressures, e.g. an increase in the use of timber in the construction sector (Gorst & Forslund, 2021). It is therefore necessary to take on a systems-level approach to our solutions, when identifying where and how the circular economy can actually benefit biodiversity and where certain activities could prove harmful. This is fundamental to ensuring that complementary tools for biodiversity protection are prioritised and implemented, and that the positive effects of the circular economy on the state of nature and biodiversity are not take as a given (Buchmann-Duck & Beazley, 2020; Desing, et al., 2020).

The relationship between the circular economy and nature needs further exploration. To be able to achieve the objectives of a sustainable economy and the regeneration of nature, we need to know how to better link the two to achieve our environmental targets. In light of the need to achieve environmental sustainability, some challenges linked to the circular economy can be identified as follows, in the box below.

BOX 2: Six limits and challenges for the circular economy concept

Korhonen et al. (2018) outline six limits and challenges for the circular economy concept, as follows:

- **Thermodynamics limits:** Recycling will always require energy and will always be incomplete, generating waste and side products.
- **Spatial and temporal system boundary limitations:** Normally circular economy projects are local or regional; instead, each project should be considered based on its contribution to global net sustainability.
- **The rebound effect, Jevon's Paradox, and the Boomerang Effect:** When production efficiency increases, production costs decrease and eventually the prices of end-products decrease - this boosts consumption. As a result, overall economic growth may more than offset the initial environmental gains created by better efficiency.
- **Path dependencies and lock-in**: New innovations, models, and systems designed for product reuse, remanufacturing, and refurbishment have to compete in the market with the more conventional recycling for low quality raw materials utilisation systems and combustion for energy solutions (i.e. the linear economy).
- **Intra-organisational & inter-organisational strategies and management**: The physical flows of materials and energy extracted from nature travel through many different interdependent parts within the economic system before ending up as waste and emissions in ecosystems. These flows do not respect man-made/defined sectoral or organisational borders. New business models require intra- and inter-organisational cooperation.
- **Use of the definition of physical flows in environmental statistics**: The circular economy material flow categories are missing from existing statistics used by environmental administrations globally.

Policy context

For a long time, mankind has considered the economy to be a separate entity from the environment. The pace at which modern society developed has been markedly asynchronous from natural regeneration cycles, causing an unprecedented decline in biodiversity and an increase in global temperatures. Through our unsustainable consumption and production patterns we have pushed our planetary boundaries (Rockström, et al., 2009) to the extreme and disregarded the pressures placed on ecosystems. The current perilous state of our planet is well documented (IPBES, 2019a; WWF, 2020; IUCN, 2022a; EEA, 2019b), as are our unsuccessful attempts at tackling this issue at the global level (Secretariat of the CBD, 2020).

As we enter the UN Decade of Action, which calls for accelerating sustainable solutions to all the world's biggest challenges (UN, n.d.), it is essential to address the underlying causes that prevented policymakers from effectively and efficiently tackling the biodiversity loss crisis. An economic system perceived as detached from nature is without a doubt one of the core culprits. To achieve the CBD's long-term vision for 2050 of *Living in Harmony with Nature* (CBD, 2010), there is a need to transform our economies, prioritising human and environmental health. Up until now, however, transitioning to a nature-centric economy has been perceived by the majority of the population as an impossible, or even undesirable, shift.

Fortunately, the priorities in the global political agenda are changing. International institutions are pushing for more sustainable alternatives to current practices, there are citizen-led movements demanding radical changes, and a whole range of new actors have entered the environmental arena. Indeed, private businesses and economic and financial institutions are becoming increasingly engaged in nature conservation, providing new resources and a different perspective.

The early efforts from The Economics of Ecosystems and Biodiversity (TEEB) in 2017-2011 (TEEB, 2020), were followed more recently by the publication of the report *The Economics of Biodiversity* by Professor Sir Partha Dasgupta (2021), as well as the UN's adoption of a new framework that includes the contributions of nature when measuring economic prosperity and human well-being (UN, et al., 2021). Another indication of this new trend is the launch in 2021 of the Taskforce on Nature-related Financial Disclosures (TNFD, 2022b), a group of 35 business leaders who aim to develop a risk management and disclosure framework for organisations to report and act on evolving nature-related risks. One of the co-chairs of this initiative is Ms. Elizabeth Maruma Mrema, the Executive Secretary of the CBD. IUCN is also one of the 13 core knowledge partners of this initiative (TNFD, 2022a). In addition to these developments, a flurry of commitments to protect biodiversity has also been recently announced by private actors and philanthropists in the context

of ongoing global biodiversity negotiations (National Geographic, 2021).

The interest from economic actors does not derive solely from an ethics-driven shift to protect the environment, but also from a business perspective. Studies have confirmed that more than half of global Gross Domestic Product is dependent on nature (World Economic Forum, 2020), since industries rely on a wide range of ecosystem services, such as pollination and water purification. Yet the effects of climate change and biodiversity loss are hampering nature's ability to provide those services. In the top ten risks identified by the 2022 Global Risks Report of the World Economic Forum, five of them were related to nature (World Economic Forum, 2022). Thus, just as there cannot be a healthy population on a sick planet, a profitable economy cannot exist without healthy ecosystems. The question then revolves around how we can join these two complex systems, economy and ecology, in such a way that benefits both.

The transition to a circular economy can be a solution to this challenge. By applying its core principles, businesses would be able to prevent the overexploitation of natural resources, to drastically reduce pollution, and to allow ecosystems to regenerate. The concept is increasingly prevalent in the scientific and policy worlds alike as an answer to the pervasive problem of humankind's unsustainable use of resources.

The circular economy and biodiversity policy agenda at the global level

An essential element of the circular economy is its beneficial impact on the environment, both in terms of limiting the use of resources and in reducing pollution. The advantages derived from a shift to a non-linear economic model have already been recognised in the environmental policy arena, especially within climate change debates. For example, former UN Climate Change Executive Secretary Patricia Espinosa recently affirmed how the circular economy plays a definitive role in achieving climate neutrality (UNFCCC, 2021) and urged immediate action on this in the run up to the 26th UN Climate Change conference (COP26). Moreover, an increasing number of studies have highlighted how the circular economy can support achieving the goals of the Paris Agreement (Circle Economy & Ecofys, n.d.) and the UN Sustainable Development Goals (UNIDO, n.d.; ECOSOC, 2018; IISD, 2018; Anderson, 2021; Schröder & Raes, 2021).

The global policy discussion around the circular economy has thus been more focused more on climate and less on biodiversity. In fact, despite the rise of circular economy discussions on the global agenda, few studies and policies have been focused on its implications for biodiversity, as mentioned in previous chapters. In analysing the work of the CBD, including its strategic plans, the lack of direct mentions of the circular economy is evident (CBD, 2002; CBD, 2010; Secretariat of the CBD, 2022a). However, a more in-depth study reveals how these references are not absent, but rather implicit, as we point out in the following paragraphs.

The three objectives of the CBD, as set out in the 1992 treaty, are: *the conservation of*

biological diversity, the sustainable use of its components and *the fair and equitable sharing of the benefits arising out of the utilization of genetic resources (Art. 1)* (CBD, 1992). The circular economy should not place additional pressures on ecosystems, as it advocates instead for the decoupling of natural resources from economic growth, thus using them in a more sustainable manner. Its social component calls for a more equitable economic paradigm. Therefore, as the ultimate goal of the CBD is to protect life on earth while supporting a thriving human population, the circular economy could be seen as an essential tool.

Looking at more specific strategies, the circular economy can be further linked to the work of the convention in different documents. In the 2011-2020 Strategic Plan for Biodiversity (CBD, 2010), the decade-long strategy agreed at the tenth Conference of the Parties (COP10), the Parties requested, inter alia, enhanced collaboration on: *(i) further developing the economic aspects related to ecosystem services and biodiversity; (ii) developing implementation tools for the integration of economic aspects of biodiversity and ecosystem services; and (iii) facilitating implementation and capacity*-building for such tools (para 17.e). This request was complemented by two targets of the plan, Target 4 and Target 8, which concerned sustainable consumption and production patterns, as well as reducing pollution (CBD, 2010). While neither of these two goals, nor their indicators (CBD, 2016) mention the circular economy, they clearly indicate the parties' will to relate biodiversity conservation to the socio-economic system. These targets point to the need to mainstream biodiversity across government and society, as well as promote sustainable use.

Unfortunately, the 2011-2020 Strategic Plan for Biodiversity did not translate into effective action at the national level and failed almost entirely (Secretariat of the CBD, 2020). There are different explanations for this, ranging from economic constraints to a lack of political will. For the purposes of this publication, the analysis by former Executive Secretary of the CBD, Braulio F. S. Dias is most relevant. In his opinion piece for IUCN in 2020 (Dias, 2020), he described three obstacles to the implementation of the 2020 targets, also known as the Aichi targets (CBD, 2010): an insufficient level of implementation of national targets in most countries, a lack of engagement of heads-of-state in the CBD Framework negotiation and implementation, and a lack or insufficiency of mainstreaming biodiversity in the social and economic sectors. The latter can be interpreted as a call for action to implement a more multisectoral approach to biodiversity conservation, one that diverges from traditional models and that includes a restructuring of our economy. In line with this argument, the Global Biodiversity Outlook 5 (Secretariat of the CBD, 2020) recognises the need for more efforts in this direction. When analysing the progress made on Target 4, the Secretariat of the CBD mentions the 2015 EC's Circular Economy Package and France's 2018 circular economy roadmap as positive examples. This acknowledgement not only confirms the relevance of the circular economy in biodiversity discussions, but also opens the possibility for Parties to better consider this aspect in the development of the next strategic plan, the Post-2020 Global Biodiversity Framework.

Fortunately, the new draft strategic plan seems to take a more holistic approach than its predecessors by calling for a whole-of-government and whole-of-society

approach, and it underscores the necessity of better involving the economic and financial sector in nature conservation.

As of publication, the post-2020 strategic plan has not yet been adopted. For this reason, the following analysis focuses on Draft 1 (CBD, 2021) of the plan published in the summer of 2021, as well as reports from the ongoing negotiations.

In the current version of Draft 1, the circular economy can be linked to several targets and enabling conditions to delivering the framework. To start with, the entire plan is based upon a theory of change that aims, inter alia, at *transforming economic, social and financial models to stabilize the trends that have exacerbated biodiversity loss* (CBD, 2021). The academic underpinning of the new framework marks an improvement from the 2011-2020 plan and could facilitate the embodiment of other useful theoretical principles, including those of the circular economy.

When it comes to the currently draft Action Targets to be achieved by 2030, the most relevant ones to circular economy are:

- **Target 7**. *Reduce pollution from all sources to levels that are not harmful to biodiversity and ecosystem functions and human health, including by reducing nutrients lost to the environment by at least half, and pesticides by at least two thirds and eliminating the discharge of plastic waste*.
- **Target 10**. *Ensure all areas under agriculture, aquaculture and forestry are managed sustainably, in particular through the conservation and sustainable use of biodiversity, increasing the productivity and resilience of these production systems*.
- **Target 14**. *Fully integrate biodiversity values into policies, regulations, planning, development processes, poverty reduction strategies, accounts, and assessments of environmental impacts at all levels of government and across all sectors of the economy, ensuring that all activities and financial flows are aligned with biodiversity values*.
- **Target 15**. *All businesses (public and private, large, medium and small) assess and report on their dependencies and impacts on biodiversity, from local to global, and progressively reduce negative impacts, by at least half and increase positive impacts, reducing biodiversity-related risks to businesses and moving towards the full sustainability of extraction and production practices, sourcing and supply chains, and use and disposal*.
- **Target 16**. *Ensure that people are encouraged and enabled to make responsible choices and have access to relevant information and alternatives, taking into account cultural preferences, to reduce by at least half the waste and, where relevant the overconsumption, of food and other materials*.
- Additionally, one of the enabling conditions (I. 15) also reiterates the inclusive reach of the framework and calls for the inclusion of the business and financial sector in the implementation of the plan.

The circular economy is thus not directly mentioned in the latest versions of the framework or its proposed indicators, however, it is mentioned in certain supporting documents that were published at the very beginning of the negotiation process by the CBD Secretariat (CBD, 2020; Secretariat of the CBD, 2022b). This points to the willingness to include explicit mentions of the circula r economy in the new framework, and this assumption is supported by the round of negotiations that ended in September 2021. From the report of the third open-ended working group (CBD, 2020), it is possible to sense a push to include clearer references to the circular economy. Nevertheless, as of publication it is not possible to foresee whether a clear mention to the circular economy will be included in the adopted Post-2020 Global Biodiversity Framework.

It is nevertheless possible to note an increased prominence of the circular economy in the international debate. Indeed, as a result of the UN Environment Assembly 5.2, UN countries adopted resolution UNEP/EA.5/Res.11 on *Enhancing Circular Economy as a contribution to achieving sustainable consumption and production* (UNEP, 2022). The resolution, inter alia, invites "*Member States to integrate circular economy approaches into national and regional strategies and action plans, including those related to relevant multilateral environmental agreements, taking into account national circumstances and capacities*" *(UNEP 2022, p. 2)*.

The circular economy and biodiversity policy agenda in the European Union

Having led policy discussions in both realms for decades, the EU emerges as one of the major actors in the debate about the integration of circular economy principles in biodiversity conservation.

The roots of biodiversity conservation in Europe can be traced back to 1979 with the adoption of the Birds Directive (Council EU, 1979), a law which provides comprehensive protection to all wild bird species naturally occurring in the Union. The Habitats Directive (Council EU, 1992) was subsequently adopted in 1992 with the goal to protect over 1000 animals and plant species and over 200 types of habitats. These cornerstones of European environmental law also established the EU-wide Natura 2000 network of protected areas, which now spans over 18% of total EU land's area and 8% of its marine territories (DG Environment, n.d. h). Later on, in 1999, the EU reinforced the role of zoos in the conservation of biodiversity with the Zoos Directive (Council EU, 1999) and, in the wake of the EU Biodiversity Strategy for 2020 (EC, 2011), the block committed to protect native biodiversity and ecosystem services against Invasive Alien Species (DG Environment, n.d. g). Relevant for the circular economy discussion are also the EU Water Framework Directive (Council EU, 2000), aimed at achieving good ecological and chemical status for all EU water bodies, and the EU's Marine Strategy Framework Directive (Council EU, 2008a), adopted to protect more effectively the marine environment across Europe.

A wide range of policies, both continental and international, complement the complex yet comprehensive environmental policy mosaic of the EU. An important addition is the EU Biodiversity Strategy for 2030 (EC, 2020b): building on the previous decade-long EU Biodiversity Strategy for 2020, the new plan aims to put biodiversity on a path to recovery for the benefits of the people, the planet, the climate and our economy.

With regard to the circular economy, the discussion is more recent. In the context of the natural capital debate, in the EU Biodiversity Strategy for 2020 (EC, 2011) adopted in 2011, the Commission recognised the lack of an economic assessment for ecosystem services in the rationale for Target 2 and developed an action aiming to: *map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020* (EC, 2011, p. 12). According to the final evaluation of the strategy this target was not achieved, despite some progress (EC, 2022h). In 2013, the EC also published the 7th Environment Action Programme to 2020, which had the goal, inter alia, *to turn the Union into a resource-efficient, green, and competitive low-carbon economy* (EC & DG Environment, 2014). Within this document the circular economy is briefly mentioned, and the EU had hinted at its willingness to move in this direction. The political will to support the shift to a non-linear economic model is restated in the 8th Environment Action Programme to 2030 with the objective of: *advancing towards a regenerative growth model, decoupling economic growth from resource use and environmental degradation, and accelerating the transition to a circular economy* (DG Environment, n.d. c). Before this, the circular economy appeared in the EU institutions' documents largely as a component or aspect of other policies, rather than its own, distinct policy area.

In December 2015, the EC adopted the first Circular Economy Action Plan; "*Closing the loop - An EU action plan for the Circular Economy*" (EC, 2015). The plan laid out a set of actions aimed at enhancing sustainability along the entire life cycle of products, taking into consideration production, consumption, waste management and the market for secondary raw materials. The plan was fully completed by 2019, with all 54 actions delivered, though at the time of writing work continues on some of them (DG Environment, n.d. e). This first Circular Economy Action Plan was followed by a second Circular Economy Action Plan; "*For a cleaner and more competitive Europe*" (EC, 2020a). This new plan, launched in 2020, focused on seven key product value chains and envisioned 35 actions to support the transition to a circular economy. In the next chapters the new Circular Economy Action Plan (hereafter known simply as the CEAP) as well as its interlinkages with the EU Biodiversity Strategy for 2030 (hereafter known as the Biodiversity Strategy) will be analysed from a policy perspective.

Since 2019, the European Green Deal (EC, 2019b) has acted as the overarching umbrella under which the EC aims to holistically tackle all environmental issues. The EC presented the flagship initiative as a new plan to transform the EU into a *"fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use"*

(EC, 2019b). The 2019-2024 von der Leyen Commission started their mandate with the development of a wide range of legislative and non-legislative proposals to strengthen nature protection and restoration, reduce the bloc's emissions, and transform sectors to enhance their sustainability. The deal includes policies that range from greening the European food system, such as the Farm to Fork Strategy (EC, 2020c), to limiting pollution, i.e. through the Zero Pollution Action Plan (EC, 2021a), to important reform proposals for the finance sector via the EU Taxonomy for Sustainable Activities (EU, 2020b) (explored later on in the report in the section *Further linkages between circular economy and biodiversity policy*).

Two important pillars of the European Green Deal are the strategies mentioned in the previous paragraphs: the Biodiversity Strategy and the CEAP. Although grouped under the same initiative, there is room to better exploit the synergies between the two documents. The EU policy analysis part of this publication explores in greater detail the relevant commitments and targets included in each of these strategies, underscoring existing and potential linkages, and building towards a set of policy recommendations that can support their implementation as well as the further integration of biodiversity in the circular economy discussion.

To conclude the overview of the EU's efforts to promote a circular economy, it is important to mention the EU leadership displayed outside the borders of the bloc of 27. In February 2021, the EU launched the Global Alliance on Circular Economy and Resource Efficiency (GACERE) with the goal of identifying knowledge and governance gaps in advancing a global circular economy and taking forward partnership initiatives (DG Environment, 2021). At the moment, the alliance consists of the EU Member States, Canada, Kenya, Republic of Korea, Chile, Morocco, Rwanda, Colombia, New Zealand, South Africa, Nigeria, Switzerland, India, Norway, Japan, and Peru (DG Environment, n.d. f). Furthermore, the EU, and almost all of its Member States, endorsed the Leaders Pledge for Nature (2022), a document adopted at the UN Summit for Biodiversity that calls for urgent actions to address the biodiversity crisis. Among the commitments included in the text, many of which are highly relevant to the circular economy, one stands out: *Accelerating the transition to sustainable growth, decoupled from resource use, including through moving towards a resource-efficient, circular economy, promoting behavioural changes and a significant scale-up in Nature-based Solutions and ecosystem-based approaches on land and at sea* (Leaders pledge for nature, 2020, p. 2).

EU policy analysis

The fact that both the circular economy and biodiversity have been placed as priority areas under the umbrella of the European Green Deal is an essential and welcome step towards a better integration of the two at the policy level. Still, there is significant potential for these two priority areas to further reinforce one another and help meet the goals underpinning each agenda. For this, policy coherence is vital. Although there are obvious links, and it is in the spirit of the European Green Deal to ensure economic growth is decoupled from resource use, the Biodiversity Strategy (EC, 2020b) makes little reference to the circular economy, and the CEAP does not significantly mention biodiversity.

As former EU Commissioner for the Environment Janez Potočnik outlined during EU Green Week 2020, in a session on protecting biodiversity and nature through a circular economy, the targets and commitments are the easy part, but what is needed is the effective integration of these targets and commitments into policies that define our actions, including the way we consume (EU Environment, 2020). Starting with the commitments in the Biodiversity Strategy (EC, 2020b), and then moving to the ambitions, actions, and policies underpinning the key value chains relevant for nature as outlined in the CEAP, we explore in the following sections how biodiversity and the circular economy intersect in the EU policy domain. We focus on some key drivers for biodiversity loss, as described in previous chapters. With the understanding that coherence in implementation on the ground begins with coherence at the policy level, we seek to outline the main opportunities for further reinforcement between the two priority areas.

EU biodiversity targets

The main objective of the EU Biodiversity Strategy for 2030 is to protect and restore degraded ecosystems, in particular those with the most potential to: capture and store carbon, prevent and reduce the impact of natural disasters, deliver further benefits such as soil health and pollination, and improve knowledge and monitoring of ecosystems and their services (DG Environment, n.d. d). Key commitments outlined in the Biodiversity Strategy (EC, 2020b) include:

Nature protection: key commitments by 2030:

- Legally protect a minimum of 30% of the EU's land area and 30% of the EU's sea area and integrate ecological corridors, as part of a true Trans-European Nature Network.
- 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: key commitments by 2030

- Legally binding EU nature restoration targets to be proposed in 2021, subject to an impact assessment. By 2030, 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.
- The decline in pollinators is reversed.
- The risk and use of chemical pesticides are reduced by 50% and the use of more hazardous pesticides is reduced by 50%.
- At least 10% of agricultural area is under high-diversity landscape features.
- At least 25% of agricultural land is under organic farming management, and the uptake of agro-ecological practices is significantly increased.
- Three billion new trees are planted in the EU, in full respect of ecological principles.
- Significant progress has been made in the remediation of contaminated soil sites.
- At least 25,000 km of free-flowing rivers are restored.
- There is a 50% reduction in the number of Red List species threatened by Invasive Alien Species (IAS).
- The losses of nutrients from fertilizers are reduced by 50%, resulting in the reduction of the use of fertilizers by at least 20%.
- Cities with at least 20,000 inhabitants have an ambitious Urban Greening Plan.
- No chemical pesticides are used in sensitive areas such as EU urban green areas.
- 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.

In addition to these goals, the EC also envisions a series of measures to enhance the governance framework and to step up its commitments globally.

EU circular economy targets

The Circular Economy Action Plan (2020) presents a set of interrelated initiatives to establish a strong and coherent product policy framework that will make sustainable products, services and business models the norm and transform consumption patterns so that no waste is produced (EC, 2020a). As stipulated in the Plan, the sustainability challenge posed by key value chains requires urgent, comprehensive, and

coordinated actions, which will form an integral part of the sustainable product policy framework – a key deliverable of the Plan. Those coordinated actions will contribute to the response to the climate emergency and will feed into the EU Industrial Strategy, as well as into the (then forthcoming) Biodiversity, Farm to Fork, and Forest strategies (EC, 2020a).

The CEAP includes objectives (EC, 2020a) to:

- make sustainable products the norm in the EU;
- empower consumers and public buyers;
- focus on the sectors that use most resources and where the potential for circularity is high such as: *electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water and nutrients*;
- ensure less waste;
- make circularity work for people, regions and cities;
- lead global efforts on circular economy.

The CEAP includes 35 actions in total, listed in the Annex to the Plan (EC, 2020a). At the time of writing, the EC has already carried out a number of these actions, including adopting a proposal for a new regulation on sustainable batteries, launching the Global Alliance on Circular Economy and Resource Efficiency (GACERE), adopting a proposal to update the rules on persistent organic pollutants in waste, and adopting a proposal for new rules on waste shipments. In March 2022, the EC adopted a package of measures, including the Sustainable Products Initiative (including the proposal for the Ecodesign for Sustainable Products Regulation) (EC, 2022a), the EU strategy for sustainable and circular textiles (EC, 2022b), the proposal for a revised Construction Products Regulation (EC, 2022e), and a proposal for empowering consumers in the green transition (EC, 2022d). In April 2022, the EC followed with proposals for revised EU measures to address pollution from large industrial installations (EC, 2022f; DG Environment, 2022).

Under the CEAP, the EC has identified various key value chains which present various sustainability challenges that require substantial and coherent action (EC, 2020a). The sectors that require the most natural resource use, with a high potential for action for the circular economy, are: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food, water and nutrients (EC, 2020a).

For our 'deep dive', and as part of the policy analysis, we focus on the latter sector of *Food, water and nutrients*, as this is the key value chain in the CEAP which is the most linked to land use as well as other key drivers of biodiversity loss, and thus both poses the greatest impact on and presents the greatest potential benefit for nature and biodiversity. Through a concise analysis of the main targets, strategies, and directives presented under this *Food, water and nutrients* key value chain, the following analysis seeks to provide insight into the opportunities and challenges of circular economy policy in tackling biodiversity loss.

DEEP DIVE: Food, Water and Nutrients

As indicated in the CEAP, the circular economy has the potential to decrease the negative effects imposed by the inadequate management of natural resources and be instrumental in achieving nature restoration and conservation commitments in Europe (EC, 2020a).

The circular economy commitments under the *Food, water and nutrients* value chain aim to ensure:

- the sustainable use of renewable bio-based materials;
- the reduction of food waste in Europe;
- the substitution of single-use products by reusable alternatives in food services;
- efficient water reuse in agriculture and industrial processes and the sustainable management of nutrients, including wastewater treatment (EC, 2020a).

These key circular economy commitments are explored in turn in the following subsections.

Sustainable use of renewable bio-based materials

The ambitions in the Circular Economy Action Plan

The *Food, water and nutrients* section of the CEAP outlines:

> *"The circular economy can significantly reduce the negative impacts of resource extraction and use on the environment and contribute to restoring biodiversity and natural capital in Europe. Biological resources are a key input to the economy of the EU and will play an even more important role in the future. The Commission will aim at ensuring the sustainability of renewable bio-based materials, including through actions following the Bioeconomy Strategy and Action Plan"* (EC, 2020a, p. 12).

Other parts of the CEAP include ambitions related to the bioeconomy, under the key value chain *Plastics*: the "*sourcing, labelling, and use of bio-based plastics", "use of biodegradable or compostable plastics*", and under the key value chain *Textiles*; the support for "*circular materials and processes*". In the Annex, under the list of actions, a policy framework is proposed for bio-based plastics and biodegradable or compostable plastics. On the latter point, it is important to note that the CEAP outlines that the sourcing, labelling, and use of bio-based plastics will be "*based on assessing where the use of bio-based feedstock results in genuine environmental benefits, going beyond reduction in using fossil resources*" (EC, 2020a, p. 9).

The CEAP touches upon forests and forestry mainly in relation to carbon removals, outlining that "*Carbon removals can be nature based, including through restoration of*

ecosystems, forest protection, afforestation, sustainable forest management and carbon farming sequestration, or based on increased circularity, for instance through long term storage in wood construction, reuse and storage of carbon in products such as mineralisation in building material." (EC, 2020a, p. 16). However, as outlined in the *Food, water and nutrients* section, on the subject of the sustainable use of renewable bio-based materials the CEAP largely defers to the EU Bioeconomy Strategy and Action Plan.

The updated EU Bioeconomy Strategy and Action Plan (EC, 2018b) positions a sustainable bioeconomy as the "*renewable segment of the circular economy*", with the potential to valorise bio-waste, turning residues and discarded material into valuable resources and cutting waste (e.g. turning food waste into feed for animals to help cut food waste by 50% by 2030), or with the potential for cities to become major "*circular bioeconomy hubs*", improving the recycling of their high value organic residue streams.

The Bioeconomy Strategy and Action Plan outlines that the bioeconomy can also contribute to restoring ecosystems, e.g., through the use of bio-based, biodegradable materials as an alternative to plastics, towards achieving plastic-free seas and oceans. The box below outlines some important ways in which the Bioeconomy Strategy and Action Plan relates to biodiversity.

BOX 3: The Bioeconomy Strategy and Action Plan and biodiversity

The Bioeconomy Strategy and Action Plan (EC, 2018b) touches on a number of vital areas, with a significant impact on biodiversity. The bioeconomy includes all sectors and organisms which are dependent on natural capital, incorporating land and marine ecosystems, as well as all economic, industrial and production sectors involving the use of biological resources (EC, 2018b). The way in which these areas are approached, planned for, and managed will define whether biodiversity continues to be exploited and lost, or whether it can be conserved and even restored.

To that end, the Bioeconomy Strategy and Action Plan outlines something crucial, and that is the ambition to better "*understand the ecological boundaries of the bioeconomy*" (EC, 2018b, p. 6). Here, the Strategy and Action Plan outlines that it will be necessary to:

- Enhance the knowledge base and understanding of specific bioeconomy areas, including on the status and resilience of terrestrial (agricultural and forest) and marine ecosystems and their biodiversity – including their socio-economic costs and benefits and capacities to serve as a sustainable domestic biomass source, sequester carbon, and increase climate resilience – and on the availability of sustainable biomass as well as public and private bioeconomy investments;
- Systematically monitor progress in the bioeconomy for responsible and inclusive governance and coherent policy-making, as well as the status of biodiversity, ecosystem, degraded land areas and land at risk of climate change impacts, such as desertification, to restore land based and marine ecosystems. This will involve the implementation of an EU-wide, internationally coherent monitoring system to track progress towards a sustainable, circular bioeconomy in Europe and to underpin related policy areas;
- Provide voluntary guidance for operating the bioeconomy within safe ecological limits;
- Provide specific support for a few target activities, including agroecology, the development of microbiome-based solutions, and new tools to integrate pollinators in value chains, to better integrate the benefits from biodiversity-rich ecosystems in primary production.

Challenges and opportunities

According to some, the bioeconomy is not fully part of the circular economy – this relates to where material flows are inevitably either lost in the environment or in landfills and cannot be looped back into the system or maintained in the economy (Carus, 2017). Specifically, when it comes to growing and harvesting biomass for energy purposes, the utilisation of this resource is lost for cascading use. Within the circular economy context, "cascading" (World Business Council for Sustainable Development, 2018; EMF, 2017; Sitra, n.d.) means using biomass in products that create the most economic value over multiple lifetimes, wherein energy recovery should be the last option, only after all other higher-value options have been exhausted. This is in line with the waste hierarchy, which outlines that materials should be cycled at the highest value possible (see *Theoretical overview*). If used directly for energy, even if the biomass is grown sustainably and could be understood as renewable, this is not in accordance with the circular economy (Carus, 2017).

Others would consider the bioeconomy and the circular economy to be strongly interconnected. Stegmann et al. (2020), who looked into the concept of the 'circular bioeconomy', identified three overarching perspectives on this concept in terms of how it relates to the bioeconomy and the circular economy. Some consider the (circular) bioeconomy to be a part of the circular economy (i.e. relating to the 'biological cycle' of the circular economy), others consider the circular bioeconomy to be at the intersection of the bioeconomy and the circular economy, while still others consider it to be greater than the other two concepts alone (i.e. encompassing the two).

The circular economy covers the whole of the economy, which involves both technical and biological flows (see *Theoretical Overview*). While we can think of the circular economy in terms of these two material flows, in practice these are far less distinct and in fact are very much interconnected. The circular bioeconomy is thus an important component of the circular economy; this is also made clear by the referral in the CEAP to the Bioeconomy Strategy and Action Plan, regarding the sustainable use of renewable bio-based materials.

With that in mind, it is important to reiterate that activities pertaining to the bioeconomy are not by definition sustainable or, indeed, circular. The use of biological resources and the production of biomass for food, feed, fuel and bio-based products can have both positive and negative environmental and socioeconomic impacts. Bringing the bioeconomy closer together with the circular economy is a step in the right direction; up until recently the two policy areas have developed largely distinctly, with different objectives.

However, even with a shift towards embracing the principles and aligning with the circular economy, circular solutions for the bioeconomy could pose a risk to biodiversity if not managed correctly. This could be through the use of timber as a sustainable building material, when additional timber demand may lead to a loss of primary forest for timber extraction. Similar issues may arise with increased pressure on land to, for example, grow cotton in a shift away from synthetic, fossil-based fibres in textiles, or to grow food organically in a move to reduce the use of harmful pesticides.

The bioeconomy is perhaps the sector posing the greatest impact to biodiversity,

encompassing in its challenges many of the key direct drivers of biodiversity loss (IPBES, n.d.) including land use change and the use and exploitation of natural resources. At the same time, this also means that the bioeconomy is the sector with the greatest potential to tackle biodiversity loss. According to findings from Sitra's recent study (Sitra, 2022), biodiversity decline could be halted and reversed following a shift to a circular economy, with a major role played by the food and agriculture sector; a shift to a circular food and agriculture sector would make the greatest contribution to biodiversity recovery, constituting 73% of the total contribution to the circular scenario in this study.

The box below outlines some key challenges related to the growing demand for biomass.

BOX 4: The biomass challenge

The factors driving an upshot in biomass use include a growing necessity to move away from a fossil-fuel based economy and toward renewables, the need to meet climate change targets including carbon emissions reductions, and a regulatory environment that favours the development and use of biomass as fuel (Keam & McCormick, 2008). With regard to bioenergy, which signifies the conversion of biomass (e.g. agricultural and forest by-products and residues) into energy, such as electricity and fuels (EC, n.d. a), this is seen as instrumental in meeting the EU's anticipated renewable energy targets for 2030 (Scarlat, et al., 2019). In the EU, the growth in bioenergy has happened largely as a result of policy; starting in 2001 and reinforced with the adoption of renewable energy targets in 2009, the EU has introduced subsidies and quotas to encourage the use of bioenergy (Material Economics, 2021). Since 2000, there has been a 150% increase in the use of bioenergy in the EU, and still today, current biomass use is split 60% for energy and 40% for materials (Material Economics, 2021). In 2016, forestry accounted for around 60% of all EU internal biomass produced for energy purposes, with approximately 27% originating from agricultural biomass (Scarlat, et al., 2019).

In this respect, it is important to highlight that the use of biomass directly for energy purposes is in principle not in line with the circular economy (e.g. cascading). The updated Bioeconomy Strategy and Action Plan does not directly advocate for this either, rather for the utilisation of waste, through biorefineries, towards the use of more advanced biofuels.

A particular challenge with a growing demand for biomass is that its cultivation risks dislocating food production to non-agricultural land (DG Energy, n.d.). Related to this is the removal of forests to be used for biomass or to grow biomass in their place. Both processes risk augmenting greenhouse gases (GHGs), through a process that is known as 'Indirect Land Use Change' (ILUC) (DG Energy, n.d.).

In 2019, the EC adopted a delegated act to the Renewable Energy Directive (EC, 2019a), setting limits on biofuels, bioliquids and biomass fuels with a high risk of ILUC – EU Member States are still able to use and import such fuels, but they will not count towards their national targets when calculating the overall national share of renewables and the share of renewables in transport (DG Communication, 2019). Yet a more recent move was met with opposition from climate campaigners (Euractiv, 2022) – the EU is allowing bioenergy investments to be labelled sustainable, classing bioenergy (derived from e.g. agricultural and forest biomass) as renewable based inter alia on the fact that plants and trees absorb CO2 as they grow, which at least partially offsets what is emitted when they are burned for fuel. However, biomass used in the EU must also comply with sustainability criteria to protect old forests and habitats (Euractiv, 2022). While the debate surrounding the revision of Renewable Energy Directive continues, in September 2022 the European Parliament voted to phase down the share of primary wood that can be counted as renewable energy (European Parliament, 2022).

The aim of the updated EU Bioeconomy Strategy and Action Plan to better understand and to be in line with the ecological boundaries of the bioeconomy is admirable, but it is a question whether this is really achievable when it comes to biomass. According to a recent report by Sitra on EU biomass use (Material Economics, 2021), current climate scenarios risk over-reliance on biomass, claiming 40%-100% more than what will be available. A similar warning was outlined by the EEA in 2018 (EEA, 2018) – approximately 72% of the net annual increment of forests is currently harvested, pointing at a limited potential for the increased sourcing of wood biomass.

It is essential not only where, but also how biomass is produced. Intensive and monocultural biomass production is more likely to negatively impact ecosystems and soil, which will result in the loss of nutrients and the degradation of land areas (Larbodière, et al., 2020). These adverse consequences for natural ecosystems can be further aggravated if preference is given to the production of homogeneous genetically improved crops, without considering their detrimental impacts on biodiversity and ecosystem services (IUCN, 2019).

Linking back to the commitments in the Biodiversity Strategy for 2030

Linking back to the commitments under Biodiversity Strategy, in particular considering the actions to protect and restore nature in the EU, the actions defined under the CEAP as regards the sustainable use of renewable bio-based materials outline many important intersections that have the potential to be further addressed. Some of these key interlinkages are explored in the following paragraphs.

The Biodiversity Strategy (EC, 2020b) has the ambition to plant 3 billion trees. Although the commitment mentions that this will be done in full respect of ecological principles, it is uncertain whether the trees are intended to be non-productive or whether other priorities might lead to growing trees for other purposes, such as biomass. A point about this is included in the recently published Forest Strategy (EC, 2021b). However, it is not very detailed or clear: "*This Strategy includes a roadmap for the implementation of the pledge based on the overall principle of planting and growing the right tree in the right place and for the right purpose*" (EC, 2021b, p. 15).

On top of this, some monoplantations could pose a further threat to biodiversity through changes/simplifications in habitat – also running counter to the ambition in the Biodiversity Strategy. If the plantations are to be done in full respect of ecological principles, as foreseen, the scope must include the right mix of tree species to be planted not only in forests, but also in rural and urban areas, and no trees can be planted in areas of high nature value such as mires, bogs, fens, wetlands, peatlands, and grasslands (DG Environment, n.d. a).

It bears mentioning, in this respect, that the EC recently took a decision, linked to a communication concerning food security in the wake of the crisis in Ukraine, to temporarily allow biodiversity-rich areas on farmland (Ecological Focus Areas) to be cultivated (IUCN, 2022b) - a move that will not only delay environmental action but could also jeopardise long-term food security and food systems resilience.

Another element to consider (see *BOX 4: The biomass challenge*), is Indirect Land Use

Change (ILUC). A growing demand for cultivating biomass may risk removing forests or dislocating food production to non-agricultural land – both processes risk augmenting greenhouse gases (GHGs), through a process that is known as ILUC (DG Energy, n.d.). When this is a consequence of an unsustainable bioeconomy it could, through rising GHG emissions, lead to further indirect negative impacts on the state of nature and biodiversity. In this context, forests and forestry actions emerge as crucial factors to be considered by circular economy policy. In the introduction to the individual key value chains, which includes *Food, water and nutrients*, the CEAP mentions that a link must be made to the (then upcoming) Forest Strategy, as well as the Farm to Fork and the Biodiversity Strategies. However, forests are thereafter mentioned only in one other part, or rather context, under *Cross-cutting actions* and *Circularity as a prerequisite for climate neutrality*. Here, the text focuses on achieving climate neutrality through carbon removals from the atmosphere. These can be "*nature based, including through restoration of ecosystems, forest protection, afforestation, sustainable forest management and carbon farming sequestration, or based on increased circularity, for instance through long term storage in wood construction, re-use and storage of carbon in products such as mineralisation in building material.*" (EC, 2020a, p. 16).

In any case, this notion of achieving carbon neutrality through long-term storage in wood construction needs to be considered alongside other options for doing so – top among them, both in terms of carbon sequestration benefits as well as benefits for nature, would still be the preservation of old-growth forests rather than the harvesting of wood for material purposes (IUCN, 2020b). Additionally, while the CEAP includes a focus on the sector *Construction and buildings*, and within that aims to improve the sustainability, durability and adaptability of construction products, the integration of Life Cycle Assessment (LCA), and a focus on carbon storage, the section does not make a distinct connection to wood or other bio-based materials for this sector. The revision of the Construction Products Regulation (EC, 2022e), launched in March 2022 under the umbrella of the CEAP, makes no mention of wood, or bio-based materials or products, either.

Biomass production is, as already mentioned, a key link between the circular economy and biodiversity. An increase in the production of biomass to shift to natural, regenerative, non-toxic materials may lead to increased pressure on land through increased land use and land use change, with forests lost to make room for productive land, or with biomass production pushing the production of food onto non-agricultural land. This would lead to further losses for biodiversity and habitats, running counter to the target under the Biodiversity Strategy (EC, 2020b) to restore significant areas of degraded and carbon-rich ecosystems, have habitats and species show no deterioration in conservation trends and status, and ensure at least 30% reach favourable conservation status or at least show a positive trend (EC, 2020b). Furthermore, if the production of biomass is unsustainable and/or intensive, this could be detrimental to achieving the targets in the Biodiversity Strategy involving the reductions in pesticides and fertilizers, the protection of some species or habitats, and reversing the decline in pollinators – the latter already being negatively impacted by the habitat loss as a consequence of an increase in land use. Ultimately, it will be important to assess whether the use of bio-based feedstock

results in genuine environmental benefits beyond reduced fossil fuel usage.

Finally, there is potential for a positive impact on marine environments and species through tackling overfishing and promoting sustainable aquaculture - activities which are in line with the circular economy - as well as on pollution in general. This can be achieved by adopting bio-based materials to replace plastics or other harmful materials. This always needs to be considered in the broader land use context as mentioned, as the benefits may be outweighed by the land use needed to make such a substitution.

Conclusions

Moving forward, it is important that the values of sustainability and circularity are at the core of the bioeconomy in the EU (EC, 2018b). The updated EU Bioeconomy Strategy and Action Plan aims to safeguard natural resources in Europe for the next generations, while focusing on ecosystem restoration and biodiversity conservation (Robert, et al., 2020). The ecological boundaries of the bioeconomy are of course not only stretched by the growing demand for biofuels to help meet climate targets, but increasingly also by the push for the substitution of renewable bio-based materials, which is a core focus of circular economy policy and the CEAP.

Given the significant potential for forests and forestry to, through following circular economy principles, contribute to the preservation and restoration of nature, it is important for circular economy policy to more closely integrate the potential of the forestry sector into its core considerations. This includes the CEAP, or rather the actions coming out of it. Through effective incentives it is also crucial to involve private forest owners into broader forest governance frameworks, incorporating various sizes of forest ecosystems with the aim of linking habitats and preserving biodiversity (Palahí, et al., 2020). The new Forest Strategy is a good place to start, however even this has presented open questions for nature and biodiversity (WWF, 2021b).

Similarly, it is necessary to more closely integrate agriculture within the circular economy context, considering the significant potential of our food and agriculture system to contribute to the preservation and restoration of nature. By following circular economy principles and focusing on methods of production, the agricultural sector can be even more impactful than that of forests and forestry. To reach the Biodiversity Strategy and the Farm to Fork Strategy's targets of reducing the use of and harm from pesticides and fertilizers and reversing the decline in pollinators, agricultural production will need to be sustainable, for which several pathways exist. Sustainable agricultural approaches such as agroecology can overcome the impact on biodiversity via intercropping, polycultures, crop-livestock integration, agroforestry, and other related actions (Oberč & Arroyo Schnell, 2020).

Sustainable agriculture is a key pathway to help curb biodiversity loss, not least because unsustainable agriculture is a contributor to the destruction of nature (more about sustainable agriculture as it relates to the circular economy in the following section: *A target on food waste reduction*). As it stands, agriculture and farming are not mentioned in the CEAP, apart from within the context of water reuse (re. agriculture) and carbon sequestration (re. farming).

The EEA, in their 2018 report, highlighted ways in which circular economy and bioeconomy policy areas might be further integrated. While the update to the EU Bioeconomy Strategy and Action Plan reflects many of these, some suggestions could still be taken up by circular economy policy and are indeed highlighted in this section. These include a shift to sustainable agricultural practices that do not rely on chemical inputs, thereby contributing to nutrient circularity (e.g. organic farming), more efficient biomass production (e.g. precision farming), or a shift to alternative sources of biomass such as aquatic products, reducing the need to put additional pressure on land. A similar point may be made for the marine bioeconomy, involving renewable, living aquatic resources. As pointed out earlier, overfishing and unsustainable aquaculture could be tackled through the circular economy – as it is, the CEAP only mentions the marine environment in relation to plastic pollution (EEA, 2018). The recent Bioeconomy Strategy progress report outlined the need for a stronger focus on the better management of land and biomass demands, but also on sustainable consumption patterns to enhance environmental integrity (EC & DG Research and Innovation, 2022).

With respect to the potential adverse impacts of biomass production, it is important to consider renewable natural capital and NbS as crucial aspects of a circular bioeconomy in the EU (Palahí, et al., 2020). According to the European Forest Institute, the integration of natural capital accounting and investments in NbS should be central to achieve a sustainable circular bioeconomy (Palahí, et al., 2020). Specifically, highly biodiverse environments and carbon stock regions, such as wetlands and forested areas, should not be made available for energy crop cultivation, as a general rule (Núñez-Regueiro, et al., 2021).

Making the best use of resources already circulating in a given system (such as transforming waste into fuel) is also very much in line with the circular economy. It is also very important to prioritise what biomass is used for; as outlined previously, the use of biomass directly for energy is not in line with circular economy principles such as cascading. A circular bioeconomy, by that logic, would not encompass growing crops directly for the purpose of fuel, for instance, thus presenting an important baseline for the development of the bioeconomy moving forward. Similar methods of prioritisation should be applied to other biomass for other purposes – for example wood, which would be put to multiple uses before being recycled and, as a final resort, could be used for energy (the EC provides some examples of how this can be done (EC & DG for Internal Market, Industry, Entrepreneurship and SMEs, 2019)). According to a recent study by Material Economics (2021), bio-based materials are the applications where biomass resources typically have the highest value in a net-zero context, while the opposite is now true for many energy applications.

Sitra's modelling (Sitra, 2022) has quantified the potential of applying circular economy principles to forest (i.e. forestry and the forest industry) sectors. This links back to the commitment in the CEAP on the sustainable use of renewable bio-based materials. Circular economy policy will need to closely align with the Biodiversity Strategy as well as the new Forest Strategy, to ensure sustainable use and the protection of nature. For instance, the commitment in the Biodiversity Strategy (EC, 2020b) and the new Forest Strategy (EC, 2021b) to plant 3 billion trees across the EU by 2030 will, as outlined, need to be in full respect of ecological principles. At the moment, the linkages to forests and forestry in the CEAP are not

as clear. Regarding the bioeconomy, there is no mention in the CEAP of the Regulation on land use, land use change, and forestry (LULUCF), nor of the Renewable Energy Directive – not even to land use as such. The Biodiversity Strategy (EC, 2020b), on the other hand, makes clear references to both.

The following initiatives, outlined in the boxes below, highlight some positive ways forward, with nature a core priority.

BOX 5: The Circular Bioeconomy Alliance

The Circular Bioeconomy Alliance (Circular Bioeconomy Alliance, 2022), launched in August 2020 and hosted by the European Forest Institute, aims to accelerate the transformation to a global circular bioeconomy that functions in synergy with nature. The Alliance provides support through knowledge-sharing and platforms for learning and networking, in order to involve different stakeholders including companies, governmental and non-governmental organisations, and local communities. The Alliance has the objective to ensure a circular bioeconomy, while restoring biodiversity on a global level (Circular Bioeconomy Alliance, 2022; European Forest Institute, 2020).

IUCN aims to increase its engagement with the bioeconomy sector. By partaking in the Alliance, IUCN strives to stimulate the creation of a truly sustainable bioeconomy, while decreasing overconsumption and effectively promoting natural capital accounting as well as Nature-based Solutions (IUCN, 2020d).

The European Forest Institute (EFI) published the 10-point Action Plan for a Circular Bioeconomy of Wellbeing, written by a multidisciplinary team of over 25 authors. The Action Plan asks for collective action to ensure that nature is positioned at the core of our economy, in order to pave the way for a sustainable future. This is necessary to establish a circular bioeconomy founded on a "*synergistic relationship between economy and ecology*" (Palahí, et al., 2020).

10-point Action Plan for a Circular Bioeconomy of Wellbeing

1. Focus on sustainable wellbeing;
2. Invest in nature and biodiversity;
3. Generate an equitable distribution of prosperity;
4. Rethink land, food and health systems holistically;
5. Transform industrial sectors;
6. Reimagine cities through ecological lenses;
7. Create an enabling regulatory framework;
8. Deliver mission-oriented innovation to the investment and political agenda;
9. Enable access to finance and enhance risk-taking capacity;
10. Intensify and broaden research and education.

BOX 6: Forest biodiversity in Europe and The Bonn Challenge

The Bonn Challenge (IUCN, 2020a) is an initiative to take action for the restoration of degraded and deforested land. It aims to restore 350 million hectares by 2030 through forest landscape restoration, combining ecological integrity and human well-being. Currently, 210 million hectares are being restored by more than 60 countries. The 2020 target for the Bonn Challenge was launched at a high-level event in Bonn in 2011, organised by the Government of Germany and IUCN, and was later endorsed and extended to 2030 by the New York Declaration on Forests at the 2014 UN Climate Summit (Dave, et al., 2019).

Europe's forests are critical for biodiversity protection and for mitigating and adapting to climate change. They provide many goods and services that support human wellbeing. The conservation status of forest species and habitats in the EU is worsening and progress towards protecting natural forests and restoring degraded lands has been lacking. At the same time, demand for forest products is increasing as the bioeconomy grows.

In governing and managing forests for multiple ecosystem services, it will be important to prioritise protecting and restoring forests for biodiversity and ecosystem services. Old-growth trees and forests are ecologically valuable, constitute important carbon stocks, can be more resilient to climate change, and are, therefore, the first priority for strict protection. In line with the Bonn Challenge to restore deforested and degraded land, reforestation must be focused on restoring forest ecosystems and soils, rather than planting monoculture plantations, due to the substantial benefits of healthy and diverse forest ecosystems for biodiversity and people (IUCN, 2020b).

A target on food waste reduction

The ambitions in the Circular Economy Action Plan

The *Food, water and nutrients* section of the CEAP (EC, 2020a) outlines:

> *"While the food value chain is responsible for significant resource and environmental pressures, an estimated 20% of the total food produced is lost or wasted in the EU. Therefore, in line with the Sustainable Development Goals and as part of the review of Directive 2008/98/EC38 referred to in section 4.1, the Commission will propose a target on food waste reduction, as a key action under the forthcoming EU Farm-to-Fork Strategy, which will address comprehensively the food value chain"* (EC, 2020a, p. 12).

The relevant policies or strategies mentioned in the *Food, water and nutrients* section of the Plan, for the target on food waste reduction, are expanded in the box below.

BOX 7: Food waste in the Waste Directive and Farm to Fork Strategy

Directive 2008/98/EC of the European Parliament and the Council of 19 November 2008 on waste and repealing certain Directives (Council EU, 2008b.) defines measures to prevent or reduce the negative impacts of the generation and management of waste as well as of resource use. This Directive defines food waste as the main type of bio-waste, besides biodegradable garden and park waste, and identifies households, restaurants, caterers, retailers and food processing plants as the sources.

The Farm to Fork Strategy (EC, 2020c) identifies food waste as a key point for environmental and socioeconomic sustainability. Therefore, one of its objectives is to reduce food waste by 50% by 2030 at the retail and consumer levels. The establishment of binding targets is envisaged for 2023, when a robust methodology to calculate food waste and data from EU Member States are available. These efforts towards food loss and waste reduction will also be integrated with other EU policies.

In terms of circularity as it relates to the food sector, the CEAP also outlines the ambition to increase the sustainability of food distribution and consumption - namely by determining the scope of a legislative initiative on reuse, which would substitute single-use packaging, tableware and cutlery with reusable products in food services. This ambition is part of the *Food, water and nutrients* key value chain, and is described in the section *Reusable products in food services*, though it relates somewhat more concretely to the issue of plastic rather than food waste.

Challenges and opportunities

Since waste generated from food production has a large carbon footprint, targeting food waste as a way to mitigate GHG emissions is an essential step forward in the anticipated transition to a carbon-neutral economy (Feldstein, 2017). This is highly relevant, as food waste accounts for a major source of waste in landfills and hence adds to the short-term climate effects of methane (Feldstein, 2017). In addition, commercial fisheries comprise a large proportion of total waste in the form of wasted 'bycatch' (including endangered species), which accounts for approximately 40% of the total catch globally. While the impact of this 'bycatch' is detrimental for ocean ecosystems on a global scale, bycatch is generally excluded from the environmental footprint assessments of food waste (Feldstein, 2017).

The amount of food wasted globally is immense, with over a third of all the food produced never making it to the plate (FAO, 2011). When considering a probable increase in human population and the food we will need to produce to feed everyone on the planet, we must keep in mind the fact that we already produce the amount of food needed to feed 10 billion people; the population we are expecting to reach by 2050 (Holt-Giménez, et al., 2012; UNEP, 2020b). While we note a rise in obesity, we equally see a rise in food insecurity. According to the WHO (EIT Food, 2021), while almost two billion adults and 380 million children and adolescents around the world are either overweight or obese, some two billion people face food insecurity, and about 462 million adults and over 200 million children under five are malnourished and underweight. To solve the latter issue, and in light

of a growing population, there is in many places still a push to grow more food. Yet half of all habitable land globally is already used for agriculture (Ritchie, 2019), and should we keep increasing this area we will continue putting pressure on nature, destroying habitats, and contributing to the fall in biodiversity.

Tackling the issue of food waste could, through appropriate (re)distribution, also address the issue of food insecurity. This would lessen the pressure on food production and in turn on land use, and could present significant gains for biodiversity. Examples of initiatives towards this end include the EU Platform on Food Losses and Food Waste (DG Health and Food Safety, n.d.), as mentioned in the Farm to Fork Strategy.

At the same time, the pressure on nature exerted by our food and agricultural system cannot merely be traced to the volumes of food produced and wasted, and the area of land needed to grow it or hold the landfills to contain it at the very end of the food value chain. As outlined by Sitra (Gorst & Forslund, 2021), in examining the ways the circular economy can turn the tide on biodiversity loss, "*reducing waste and loss is important but does not by itself halt biodiversity loss*"; which is to say, there are many more factors at play.

Next to how much food we are producing, it is important to examine how we are producing it. As outlined in IUCN's recent report on approaches to sustainable agriculture (Oberč & Arroyo Schnell, 2020), there are a number of sustainable agricultural practices which are helpful for nature and biodiversity, including reducing synthetic pesticide and mineral fertiliser use, the inclusion of landscape elements such as hedgerows and flower strips, and many others (see *BOX 8: Approaches to sustainable agriculture and building "Common Ground"*). These practices align well with the principles of the circular economy – reducing pollution and waste through a reduction in pesticide and fertilizer applications, enabling nitrogen and other nutrient cycling, improving water efficiency and soil quality, and so on. They also meet many of the important targets in the Biodiversity Strategy.

It is also important to examine what kind of food we are producing. In their recent work (Gorst & Forslund, 2021), Sitra draws attention to the fact that half of all habitable land is used for agriculture, and yet three quarters of that land is used to farm livestock for meat and dairy production. Yet meat and dairy contribute respectively 18% and 37% of the global calorie and protein supply, with the rest made up of plant-based food. Meanwhile, 42 million hectares of forest lost in recent decades have been converted to cattle ranching areas in Latin America, and around 7.5 million hectares for plantations in Southeast Asia. In Europe, significant quantities of soybeans are imported from third countries to be used as feed for livestock – incidentally, the EU is also starting to import soy for the purposes of biofuels (Fortuna, 2019b). The EU recently blacklisted palm oil, but spared soybeans from being identified as ILUC crops (Fortuna, 2019a). At the same time, the EU is working on a proposal for a regulation (EC, 2021d) that will set mandatory due diligence rules for operators placing commodities on the EU market associated with deforestation and forest degradation, e.g. soy, beef, palm oil, wood, cocoa, coffee, and others - the Council of the EU adopted its negotiating position on the proposal in June 2022 (Council EU, 2022).

According to a recent report by the Ellen MacArthur Foundation (2021c), today just four crops provide 60% of the world's calories, and in the EU and UK 40% of agricultural land use is influenced by the top 10 fast moving consumer goods companies and retailers. Local ingredients that could substitute for higher impact ones are seldom used. Sourcing locally would fall more in line with the circular economy, seeking to close material loops and lessen the environmental footprint, while a more diverse mix of plants and livestock would be an important pathway to conserving and enhancing biodiversity.

Finally, it is crucial to examine how we are processing the food that we grow. Not only is the processing of our food resource- and energy-intensive, it is also leading to a health crisis. One of the cornerstones of the Farm to Fork Strategy, led by the EC's Directorate-General for Health and Food Safety, is a focus on health, a focus that became further reinforced following the COVID-19 crisis. According to INEC (2021), one of the key principles of the circular economy is non-toxicity – "*to limit the use of substances harmful to humans and the environment*" (INEC, 2021, p. 16), which would apply here as well.

Linking back to the commitments in the Biodiversity Strategy for 2030

Linking back to the commitments under the Biodiversity Strategy, and particularly considering the actions to protect and restore nature in the EU, the actions defined under the CEAP targeting food waste reduction highlight some important intersections.

Besides lessening the pressure on landfills and directly contributing to the emission of GHGs, the reduction of food waste could contribute to fulfilling specific commitments of the Biodiversity Strategy - but only if this would relieve pressure on food production as well. Less pressure on food production would mean less pressure on land and resources, and in doing so contribute to the goal of ecosystem restoration, reverse the decline in pollinators, reduce the use of chemical pesticides and fertilizers, and create space for 10% of agricultural land to be under high-diversity landscape features and 25% of agricultural land to be under organic farming.

However, these same commitments could be further supported, or rather directly supported, through an overall transition to sustainable agricultural practices as well as a shift from animal to plant protein and from processed and harmful to fresh and healthy food. Furthermore, better awareness and a better appreciation of the resources needed to produce the food we eat will help consumers make better choices, not only in the kinds of food that we buy, but also in helping manage and reduce our household food waste (BEUC, 2020).

Many of these aims are part of the ambitions of the previously mentioned Farm to Fork Strategy (EC, 2020c). This Strategy aims to reduce the environmental and climate footprint of the EU food system and strengthen its resilience, ensure food security in the face of climate change and biodiversity loss, and lead a global transition towards competitive sustainability from farm to fork. The Strategy aims ensure that the food chain has a neutral or positive environmental impact through "*preserving and restoring the land, freshwater and sea-based resources on which the food system depends; helping to mitigate climate change and adapting to its impacts; protecting land, soil, water,*

air, plant and animal health and welfare; and reversing the loss of biodiversity" (EC, 2020c, p. 4).

Conclusions

With the aim of targeting food waste in the EU, emphasis should be placed on cultural change that stresses the value and inclusion of biodiversity in our food value chain and diet (Feldstein, 2017). The majority of food waste reduction efforts predominantly emphasise food recovery and recycling, despite prevention presented as the prime concern when tackling food waste (Feldstein, 2017). According to the Ellen MacArthur Foundation (EMF, 2021c), the upcycling of food waste as inputs into alternative industries and the upcycling of food products into high-value ingredients could be boosted to make use of a currently underutilised resource stream, as well as create new market opportunities. However, an increase in product recycling alone will not resolve the environmental issues created by detrimental production systems and overconsumption (Feldstein, 2017). Tackling production and consumption more concretely could help decrease GHGs, conserve water and land, and help mitigate the harmful impacts of prevalent agricultural practices on natural ecosystems (Feldstein, 2017) .

As explored in IUCN's recent work detailing the different approaches to sustainable agriculture (Oberč & Arroyo Schnell, 2020), there are a number of sustainable agricultural practices which are in line with the principles of the circular economy, e.g. reducing (especially harmful) inputs, nutrient cycling, and diversifying crops (see *BOX 8: Approaches to sustainable agriculture and building "Common Ground"*). As outlined in the Ellen MacArthur's recent work on redesigning the food system (EMF, 2021c), sustainable agriculture such as regenerative agriculture is a key component of this circular redesign. Farmers may draw from different approaches to sustainable agriculture such as regenerative agriculture, agroecology, or conservation agriculture, to grow food in a way that generates positive outcomes for nature, including healthy and stable soils, improved local biodiversity, and improved air and water quality. Sitra's modelling (Sitra, 2022), meanwhile, shows that in a circular economy scenario - one in which food waste and loss is one out of three levers alongside alternative proteins and regenerative agriculture - 90% of methane emissions from agriculture could be tackled.

The CEAP refers to food mainly within the scope of food waste and food packaging, and mentions agriculture mainly within the scope of water reuse (examined in a later section of this report). It refers to the Farm to Fork Strategy twice, specifically on the point of food waste, and once generally in the introduction, but does not delve into further potential linkages. Given the significance of the entire food and agricultural sector for biodiversity, and given the potential of the sector to halt the loss of and/or restore nature if aligned with circular economy principles, there is room for circular economy policy to align much more closely with the Farm to Fork Strategy, which itself aims to close loops and optimise the entire food value chain for the benefit of nature. A good opportunity to do this moving forward would be for circular economy policy to link up with the Sustainable Food Systems Framework Initiative (EC, n.d. e), an upcoming regulation which aims to make the EU food system sustainable and integrate sustainability into all food-related polices.

For the same reason, circular economy policy needs to refer to the crucial role of the Common Agricultural Policy (CAP). The CAP is not mentioned in the CEAP at all, even though it is the single most important policy for agriculture in Europe. Modelling carried out by Sitra (2022) projects significant benefits to nature and biodiversity from applying the principles of a circular economy to food and agriculture. According to the study outcomes, biodiversity decline can be reduced through reforming other sectors, but not halted without reforming the food and agriculture sector. It is therefore crucial for the circular economy to more closely align with the agricultural sector, including at the policy level. In doing so, circular economy policy could more directly support the achievement of further biodiversity commitments, such as reversing the decline of pollinators. With prevention at the top of the waste hierarchy, circular economy policy could also align more closely with other strategies aimed at addressing consumption, such as the Farm to Fork Strategy, which shares many of the same targets with the Biodiversity Strategy.

The following initiatives, outlined in the box below, highlight some positive ways forward, with nature as a core priority.

BOX 8: Approaches to sustainable agriculture and building "Common Ground"

IUCN's Common Ground report (Larbodière, et al., 2020) highlights the importance of reducing food loss and waste to diminish the environmental impact of agriculture. It advocates for a more efficient and sustainable use of resources which would lead to lower land use change, input use, biodiversity loss, and GHG emissions. Together with North America, Europe leads the amount of agricultural land used to produce food that is lost or wasted. Food loss at the food supplier level, and food waste at the retailer, food service and consumer level should be targeted. The report calls for cross-sectorial and intergovernmental action to respond to this challenge. Policy and legislation should support farmers, agricultural investors, food supply chain actors, and consumers to transition to a model where natural resources are used in a sustainable way. The promotion of sustainable agriculture and land health is a key point for this transition. Land health is a common interest for both agricultural and environmental actors, and it can be the starting, key point to transform food systems.

The IUCN's Sustainable Agriculture and Land Health Initiative (IUCN, 2021) is currently working on building these necessary commitments to transition towards sustainable agriculture. It is raising awareness on sustainable agriculture's role to preserve land health as a Nature-based Solution, developing tools and methodologies useful for its scaling up and integration into policymaking, and supporting the debate on food system transformation through stakeholder dialogues.

IUCN's report on Approaches to sustainable agriculture (Oberč & Arroyo Schnell, 2020) aims to shed light on the abundance of concepts and practices linked to food production. The report finds that the approaches examined – be they agroecology, regenerative agriculture, organic farming, nature-inclusive agriculture, ecological intensification or others, including circular agriculture – share more similarities with each other than with conventional agriculture. They share the common goal of striving for sustainability, which includes environmental aspects but also socio-economic considerations. Each approach is valid in a given set of circumstances; while sharing important commonalities, their diversity is also a strength in itself. Importantly, many of the approaches share similar environmentally-friendly practices, including: *crop rotation, cover and companion cropping, mixed and intercropping, the reduction of synthetic pesticide and mineral fertiliser use, no or minimal tillage, lower livestock densities, managed and free range grazing*, as well as: *crop diversification, mixing farming and forestry, mixed crop and animal farming, nutrient balancing, recovery and reuse, and the inclusion of landscape elements such as hedgerows and flower strips*. It is possible to conclude that these practices can be considered "sustainable agricultural practices", providing an important way forward for the transition to sustainable agriculture.

Reusable products in food services

The ambitions in the Circular Economy Action Plan

The *Food, water and nutrients* section of the CEAP (EC, 2020a) outlines:

> *"The Commission will also consider specific measures to increase the sustainability of food distribution and consumption. Under the sustainable products initiative, the Commission will launch the analytical work to determine the scope of a legislative initiative on reuse to substitute single-use packaging, tableware and cutlery by reusable products in food services"* (EC, 2020a, p. 12).

Aside from the mentioned legislative proposal for a sustainable product policy initiative and an initiative to substitute single-use packaging, tableware and cutlery by reusable products in food services, there are several other relevant key actions in the Annex of the Plan. These include: a review to reinforce the essential requirements for packaging and to reduce (over)packaging and packaging waste; mandatory requirements on recycled plastic content and plastic waste reduction measures for key products such as packaging, construction materials and vehicles; the restriction of intentionally added microplastics and measures on unintentional release of microplastics; a policy framework for bio-based plastics and biodegradable or compostable plastics; and leading efforts towards reaching a global agreement on plastics.

Some key policies or strategies mentioned in the *Food, water and nutrients* section of the Plan regarding reusable products in food services are expanded in the boxes below.

BOX 9: The Sustainable Products Initiative

The Sustainable Products Initiative (EC, n.d. f) is included in the CEAP as a key element to achieve climate neutrality, resource efficiency, circular economy, reduce waste, and foster sustainable innovation. Coordination with other initiatives announced in the CEAP regarding consumer empowerment and environmental claims will be ensured to create a coherent policy framework for sustainable goods, services and business models.

The communication on *Making Sustainable Products the Norm* (EC, 2022a), or the proposal for a Regulation on Ecodesign for Sustainable Products (EC, 2022c), was launched on 30 March 2022. The proposal sets new requirements to make products more durable, reliable, reusable, upgradable, repairable, easier to maintain, refurbish and recycle, and energy and resource efficient. Product-specific information requirements will help inform consumers of the environmental impacts of their purchases, and all regulated products will have Digital Product Passports. The proposal also contains measures to end the destruction of unsold consumer goods, as well as expand green public procurement and provide incentives for sustainable products. The proposal effectively extends the existing Ecodesign framework in terms of the range of products, as well as the scope of requirements with which products are to comply.

BOX 10: The EU Plastics Strategy and the Directive on single-use plastics

In June 2019, the Directive on the reduction of the impact of certain plastic products on the environment, also known as the Directive on single-use plastics (Council EU, 2019), was adopted in order to mitigate the negative effects of plastic products on the natural (aquatic) environment and to foster the anticipated transition to a circular economy in the EU (EC, 2021c). The Directive applies to the single-use plastic products listed in the Annex, to products made from oxo-degradable plastic and to fishing gear containing plastic.

The Directive on single-use plastics is part of the EU's Plastics Strategy adopted in 2018 (EC, 2018a), which aims to transform the way plastic products are designed, produced, used and recycled in the EU, as well as to protect the environment from pollution, lower GHGs, and enhance sustainable consumption and production of plastics. The actions are foreseen to make recycling profitable by introducing new rules on packaging, curbing plastic waste through Directive on single-use plastics, and other measures.

The CEAP outlines a specific key value chain for *Packaging*. In order to ensure that all packaging on the EU market is reusable or recyclable in an economically viable way by 2030, the Commission will review the Directive on packaging and packaging waste to reinforce the mandatory essential requirements for packaging to be allowed on the EU market and consider other measures, including:

"• reducing (over)packaging and packaging waste, including by setting targets and other waste prevention measures;

• driving design for re-use and recyclability of packaging, including considering restrictions on the use of some packaging materials for certain applications, in particular where alternative reusable products or systems

are possible or consumer goods can be handled safely without packaging;

• considering reducing the complexity of packaging materials, including the number of materials and polymers used" (EC, 2020a, p. 8).

The Commission also aims to assess the feasibility of EU-wide labelling that facilitates the correct separation of packaging waste at the source, establishes rules for safely recycling material into food contact materials of plastic materials other than PET (polyethylene terephthalate), and strictly monitors and supports the implementation of the requirements of the Drinking Water Directive to make drinkable tap water accessible in public places, which should reduce dependence on bottled water and prevent packaging waste.

The CEAP also outlines a specific key value chain for *Plastics*. Building on the EU Strategy for Plastics in the Circular Economy to increase the uptake of recycled plastics and contribute to the more sustainable use of plastic, the Commission will, in addition to proposing mandatory requirements as mentioned above, address the presence of microplastics in the environment through further restrictions and measures. Furthermore, a policy framework will be developed on the sourcing, labelling, and use of bio-based plastics, and on the use of biodegradable and compostable plastics, as mentioned in the section *Sustainable use of renewable bio-based materials*. Finally, the Commission will implement the Directive on single-use plastics to address the problem of marine plastic pollution.

It is important to note that the use of biodegradable or compostable plastics will be "*based on an assessment of the applications where such use can be beneficial to the environment, and of the criteria for such applications. It will aim to ensure that labelling a product as 'biodegradable' or 'compostable' does not mislead consumers to dispose of it in a way that causes plastic littering or pollution due to unsuitable environmental conditions or insufficient time for degradation*" (EC, 2020a, pp. 9-10).

Building on the aforementioned commitments on plastics, the EU aims to advance the global discussion in this respect, leading efforts at the international level to reach a global agreement on plastics, and promoting the uptake of the EU's circular economy approach on plastics.

Challenges and opportunities

In 2018, packaging waste generated in the EU was estimated at 174.1 kg per inhabitant. From 2008 to 2018, paper and cardboard was the main packaging waste material in the EU (31.8 million tonnes in 2018) followed by plastic and glass (14.8 million tonnes for plastic and 14.5 million tonnes for glass waste materials in 2018) (Eurostat, 2022). Although recycling and recovery rates have steadily increased within this 10-year period, the generation of all types of packaging waste material increased, although to a different extent. The highest increase was observed for 'paper and cardboard', 'plastic' and 'wooden' packaging waste (Eurostat, 2022).

According to the Ellen MacArthur Foundation (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016), only 14% of plastic

packaging is collected for recycling globally, with the rest ending up burned, landfilled, or leaking into the environment; after sorting and reprocessing, only 5% of material value is retained for subsequent use. Plastic pollution is overwhelming our soils, oceans, and wildlife, if no action is taken, by 2050, there could be more plastic than fish in the ocean.

Single-use plastic products can be defined as various often-used items, which are discarded after a one-time use by consumers and, since they are seldom recycled, are likely to end up as waste (Council EU, 2019). In particular, a large amount of single-use plastic products and fishing gear containing plastic are often not collected for treatment, posing harmful consequences for biodiversity and marine ecosystems through marine litter (Council EU, 2019). If plastics are not collected or recycled, plastic waste will obstruct waterways and pollute ocean ecosystems, with major damaging effects on biodiversity (Center for Biological Diversity, n.d.).

Approximately one third of all discarded plastics re-appears in soil or freshwater, with microplastic pollution in soils being a potentially larger issue than microplastic pollution in marine environments (de Souza Machado, et al., 2018). Microplastics pose a risk to our own health as well, ending up in our drinking water, our food, and our bodies. It is important to differentiate here between primary and secondary microplastics – primary microplastics can be intentional additions to products such as scrubbing agents in personal care products, or unintentionally released microplastics, originating mainly from the erosion of tyres or the abrasion of synthetic textiles during washing (Boucher & Friot, 2017). Secondary microplastics, on the other hand, originate mostly from the degradation of large plastic waste into smaller plastic fragments – this is mostly due to the mismanagement of waste during the disposal process. While IUCN in 2017 (Boucher & Friot, 2017) estimated that between 15-31% of all of the plastic in the oceans may originate from primary sources, secondary microplastics still make up a significant remainder (European Parliament, 2018).

The production of food packaging also requires various resources, e.g., energy, water, chemicals, minerals, and wood, and the manufacturing process releases GHGs in addition to wastewater and sludge comprising toxic contaminants (FoodPrint, 2020).

The Strategy for Plastics stimulates the transition to a circular economy in Europe, with the design and production of plastic products in accordance with reuse, repair and recycling requirements, and with a focus on the use of sustainable materials (Council EU, 2019). The Directive on single-use plastics promotes circularity and strives to substitute single-use products with sustainable and non-toxic re-usable products, with the objective of decreasing waste (Council EU, 2019).

In seeking alternatives for single-use packaging, with the understanding that according to the waste hierarchy reuse is of higher priority than recycling, it will be crucial to examine the sustainability of reusable alternatives. Reusable plastic packaging, for instance, has a generally more positive environmental performance in relation to single-use plastic packaging, but only provided that the product is reused multiple times (UNEP, 2020c). It is important to note that even for single-use plastics, for e.g. tableware, the major contributor to its environmental impact is the production

phase (UNEP, 2021a); the production of any kind of plastic perpetuates our fossil fuel dependency.

In addition, delivery and transportation models, as well as transportation distances, are crucial aspects in determining whether reusable packaging has a less harmful environmental impact compared to single-use versions (UNEP, 2020c). As end-of-life waste treatment is another important contributor to life cycle impacts, recycling and/or composting in combination with incineration and/or landfill still provides a more positive alternative to only resorting to landfill (UNEP, 2021a), provided that the potential release of harmful emissions through incineration is factored in. Further to this, the co-disposal of food-service waste and food waste could present both a challenge and an opportunity for waste management (UNEP, 2021a).

For alternative materials to plastic, it is important that the material for the (reusable) product is sustainably sourced and processed. Of course, any alternative material will come with its own environmental footprint and impact. Plastic alternatives, in particular when it comes to products in food services, are more likely to draw from natural, bio-based materials due to a number of reasons, including: limiting toxicity by ingestion (European Food Safety Authority, n.d.), limiting toxicity to the environment at the end of its life, and its biodegradability. Paper and cardboard packaging, as well as wood packaging, are, next to plastic packaging, already among the fastest growing segments of packaging waste. A stronger shift from plastic to such alternatives, if resulting in a higher rate of production of these alternatives, could still lead to added pressure on land.

According to the Ellen MacArthur Foundation (2021b), today's plastic packaging industry is not directly dependent on biodiversity, as over 90% of plastics produced globally are derived from virgin fossil feedstocks. However, with the projected growth of bio-based plastics, land and ecosystems could become increasingly important for the industry's biomass production. In this way, the industry would inadvertently pose a significant impact on nature and biodiversity (as described in the section *Sustainable use of renewable bio-based materials*).

On the subject of biodegradable and compostable plastics, as mentioned previously the CEAP already highlights some important considerations for nature and biodiversity – namely, that the use thereof should ensure that *"labelling a product as 'biodegradable' or 'compostable' does not mislead consumers to dispose of it in a way that causes plastic littering or pollution*." (EC, 2020a, pp. 9-10). Yet the question remains as to whether biodegradable and compostable plastics still pose a significant risk to the environment (Oakes, 2019).

According to a recent report exploring innovative feedstocks in biodegradable bio-based plastics, currently the majority of bio-based plastics are made from first generation feedstocks e.g. carbohydrates derived from agricultural crop production, and LCA studies predominantly state that bio-based plastics of the first generation are inferior to their fossil-based counterparts, due to intensive agriculture and the associated environmental influences (Wellenreuther & Wolf, 2020).

To assess the feasibility and desirability of the various alternatives and substitutes for single-use packaging – whether from the perspective of reuse, recyclability, or

biodegradability, an LCA would be useful to accurately measure the full environmental footprint from sourcing to production and manufacturing through to end of life. Yet as noted by a recent study (UNEP, 2020c), certain impacts of littering on marine and terrestrial ecosystems, the impact of land use on biodiversity, and the toxic effects of microplastics released into the marine environment, are seldom included in LCAs, mainly due to a lack of sufficiently robust and established characterisation methods.

Reflecting on the Commission's larger aim – as outlined in the *Food, water and nutrients* part of the CEAP – to "*consider specific measures to increase the sustainability of food distribution*" and "consumption" more specifically, it once again would be worth highlighting prevention, the action that lies at the top of the waste hierarchy. A change in consumption would effectively, through e.g. a more conscious choice of packaging, reduce food packaging waste, with the added benefit of potentially reducing food waste as well. Effecting a change in consumption with positive outcomes for nature and biodiversity would require stronger alignment with the Farm to Fork Strategy.

Linking back to the commitments in the Biodiversity Strategy for 2030

The aim to substitute reusable alternatives for single-use packaging would support the fulfilment of a number of commitments under the Biodiversity Strategy (EC, 2020b), including a reduction in microplastics in the environment (at the end of the value chain). A move away from plastics in general would also reduce our reliance on and consumption of fossil fuels (at the start of the value chain). The reduction in pollution would support the targets on restoration and conservation and also support the remediation of contaminated soil sites by reducing further contamination of soil. The reduction in plastic debris and other waste could support the ambition to restore free-flowing rivers, while the reduction of plastic leakage into our seas and oceans would lessen the negative impacts on sensitive marine and aquatic species and habitats.

On the other hand, a shift to or increased reliance on biomass for packaging alternatives, such as plastic alternatives derived from wood, pulp, or paper, should be carefully monitored to avoid any negative effects on nature. There may be a continued need for plastic in food services, yet in order to ensure that reusable plastic containers carry a smaller environmental footprint than single-use, there would be a need to ensure their sustained use, circulation, and that a suitable end-of-life solution is available – with the understanding that recycling rates for plastics are, for various reasons, relatively low (Samson, 2021). The Biodiversity Strategy (EC, 2020b) targets that would be hindered by an unsustainable reliance on biomass would include the restoration and conservation targets, as well as those described in the section *Sustainable use of renewable bio-based materials*.

Conclusions

According to the Ellen MacArthur Foundation (2021b), there are two basic solutions, or circular economy opportunities, for plastic packaging to tackle the main direct drivers of biodiversity loss: eliminating the need for plastic packaging where possible, and circulating packaging and materials in the economy. Their vision of a circular economy for plastic packaging is one in which

"*unnecessary plastics are eliminated; innovation ensures that all necessary plastics are reusable, recyclable, or compostable; and all used plastics are circulated, keeping them in the economy and out of the environment. In doing so, the sector can minimise the demand for finite virgin materials, eliminate waste and pollution, and reduce greenhouse gas emissions, thereby alleviating pressures on biodiversity*" (EMF, 2021b, p. 6).

The Sustainable Products Initiative (EC, n.d. f) aims to provide a sound foundation for safeguarding a durable and high environmental performance of all products and services on the EU market. With this in mind, it is important to ensure coherence between the Sustainable Products Initiative and other existing and upcoming policies under the European Green Deal. The Commission's aim for EU product policy to reduce environmental pressures is important, and covers resource extraction, environmental pollution, biodiversity loss, and ecosystems toxicity associated with contemporary production and consumption patterns (EC, 2020d). However, the initiative should explicitly consider the products' impact on biodiversity – including but not limited to ensuring that products are not sourced from materials that would drive biodiversity loss e.g. encroaching on natural areas currently not under production. It will be important that the implementation of the Sustainable Products Initiative (EC, n.d. f) embraces nature and biodiversity, contributing to the Biodiversity Strategy for 2030. The same considerations regarding nature and biodiversity should be taken up in the upcoming revised Packaging and Packaging Waste Directive (EC, n.d. d).

As substituting disposable products (e.g. plastic) with disposable products created from alternative materials (e.g. bio-based materials or biodegradable plastic) will in all probability carry similar negative impacts or create other potential trade-offs, it is important to note that for a product's environmental impact to decrease it will be necessary to ensure repeated and sufficient usage (UNEP, 2021c). Using first generation feedstocks to make bio-based plastics, as is currently largely the case, is neither desirable nor circular, as outlined in previous sections. Still, it is important to consider the environmental impact of any seemingly sustainable substitution, including reusable packaging of all kinds of materials. The forthcoming policy framework on bio-based, biodegradable, and compostable plastics aims to promote such packaging alternatives that may lead to genuine environmental benefits (DG Environment, n.d. b). It should be noted that it would be good to strive for this aim not only for plastics, but for all bio-based, biodegradable, and compostable materials. Furthermore, it might be beneficial to focus on the recycling and upcycling of existing materials, rather than composting or manufacturing them out of virgin materials, including bio-based ones.

Considering the biomass and/or energy that will serve as inputs into the production or recycling/upcycling of these alternatives, no matter how sustainable the end product is, it would perhaps be more important to focus on overall consumption. Reducing or eliminating the (over)consumption of single use or other unnecessary products through e.g. the adoption of reuse/refill models should remain the top priority.

It is thus crucial for policymakers to ensure that any circular economy approach incorporates the principles of waste and pollution, as well as consumption reduction, which requires the effective and comprehensive

rethinking of not only the product or packaging itself but also of services, business and delivery models to enable multiple lifecycles (UNEP, 2021c). Considering that an LCA might not capture the full picture[2], policies should be based on several sources of information to assess environmental impacts (UNEP, 2021c).

The CEAP's ambition to substitute single-use packaging, tableware, and cutlery with reusable products in food services is part of the larger aim to increase the sustainability of food distribution and consumption. If the production of reusable products presents a significant environmental impact, then reusable products will only relieve pressure on the environment the longer they remain in use. To a certain extent, whether and how long products will be in use, and reused, will depend on the actions of consumers, retailers, and other stakeholders along the food value chain. It would therefore be pertinent for this ambition, as it is implemented, to closely align with the Farm to Fork Strategy, which aims to comprehensively address the entire food value chain.

The following initiative, outlined in the box below, highlights some positive ways forward, with nature as a core priority.

BOX 11: National Guidance for Plastic Pollution Hotspotting and Shaping Action

The 'National Guidance for Plastic Pollution Hotspotting and Shaping Action' (UNEP, 2020a) is a guide for national authorities on plastic pollution. It provides methods to identify plastic leakage 'hotspots', find their impacts along the value chain, and prioritise actions once these hotspots are identified. It was developed in 2020 as a collaboration between UNEP, IUCN and the Life Cycle Initiative.

IUCN's Close the Plastic Tap Programme is working towards reducing marine plastics by providing solutions to reduce plastic production and pollution at its source. It focuses on the engagement of stakeholders - governments, industries and society – and on improving the knowledge about the problems caused by plastic through research and compiling information. Several projects are currently ongoing under this Programme. For example, 'Plastic Waste Free Islands', supported by the Norwegian Agency for Development Cooperation, aims to reduce plastic leakage to the ocean from six small island developing states (SIDS) in the Pacific and the Caribbean. This process can also contribute to socioeconomic growth in the local communities by converting waste into commercially viable products. Moreover, a blueprint targeting entire value chains will be developed by regional authorities. Similar projects are being implemented in the Mediterranean, Indian Ocean, and Asia-Pacific regions.

2 Aside from biodiversity, other aspects seldom or only indirectly covered by LCAs include food safety (chemicals leaching into food), the health impacts of packaging materials, and terrestrial and marine littering and the subsequent effects on ecosystems (UNEP, 2021c).

Water reuse and sustainable nutrient management

The ambitions in the Circular Economy Action Plan

The *Food, water and nutrients* section of the CEAP (EC, 2020a) outlines:

> *"The new Water Reuse Regulation will encourage circular approaches to water reuse in agriculture. The Commission will facilitate water reuse and efficiency, including in industrial processes. Furthermore, the Commission will develop an Integrated Nutrient Management Plan, with a view to ensuring more sustainable application of nutrients and stimulating the markets for recovered nutrients. The Commission will also consider reviewing directives on wastewater treatment and sewage sludge and will assess natural means of nutrient removal such as algae"* (EC, 2020a, p. 12).

Key relevant policies or strategies for water reuse and sustainable nutrient management mentioned in the *Food, water and nutrients* section of the Plan are expanded in the boxes below.

BOX 12: The new Water Reuse Regulation

Until the 2020 EU regulations on minimum requirements for water reuse (EU, 2020a), there were no European-wide standards or guidelines to regulate water reuse in Europe (Water Reuse Europe, 2022). From 26 June 2023, a new EU Regulation on minimum requirements for water reuse for agricultural irrigation will be implemented (DG Environment, n.d. k). While the objective of this new Water Reuse Regulation is to foster circular systems in agricultural water reuse, the Commission also aims to facilitate water reuse in industrial processes (EC, 2020a).

In response to the CEAP, the Commission already approved a new regulation on minimum requirements for water reuse in 2020 (EU, 2020a), with a specific focus on the safe use of reclaimed water for agricultural irrigation. Reusing water in the agricultural sector is a promising option to tackle the increasing problem of water scarcity in Europe. As agriculture is a highly water-demanding sector, this solution has significant potential to help achieve sustainability – water reuse for agricultural irrigation can also contribute to the promotion of the circular economy by recovering nutrients from the reclaimed water and applying them to crops. Reclaimed water may also be used for industrial water reuse, and amenity-related and environmental purposes. Water reuse could contribute to the recovery of the nutrients contained in treated urban wastewater, and the use of reclaimed water for irrigation purposes in agriculture or forestry could be a way of restoring nutrients, such as nitrogen, phosphorus and potassium, to natural biogeochemical cycles. This regulation aims to promote the circular economy and climate change adaptation, and to contribute to the objectives of the Water Framework Directive in a safe way for the environment and human and animal health.

BOX 13: Wastewater directive and its review

The Urban Wastewater Treatment Directive adopted in 1991 (Council EU, 1991) aims to protect the environment from urban wastewater impacts, especially from certain industrial sectors and domestic use. It establishes requirements regarding the collection, treatment, and discharge of wastewater. The EC recently released a new initiative to revise this Directive with the aim to address identified shortcomings and increasing challenges such as climate change and pollution (EC, n.d. g). The initiative suggests different policy options to tackle several sources of pollution, such as storm water overflows, urban runoff, and small agglomerations. It also addresses emerging challenges like contaminants of emerging concern, and aligning with new EU ambitions on nutrient recovery, energy efficiency, and production.

BOX 14: Sewage sludge directive and its review

The Directive on the protection of the environment, and in particular of soil, when sewage sludge is used in agriculture (Council EU, 1986) was approved in 1986 and aims to ensure the safe use of sewage sludge in farming. It establishes rules on the use of sludge as a fertiliser and monitoring of sludge and soil conditions, especially heavy metal content. It also aims to promote the use of sewage sludge in safe conditions. This Directive set an important basis for sewage sludge reuse, but it has not been adapted to address current challenges such as emerging contaminants or the increase of sewage sludge due to the increase of urban wastewater treatment. To address these issues, an initiative has been proposed by the EC to evaluate the effectiveness of the Directive and analyse the risks and opportunities of the use of sewage sludge in agriculture (DG Environment, n.d. i).

The EC is also planning to develop an Integrated Nutrient Management Plan, with a view to ensuring more sustainable applications of nutrients and stimulating the market for recovered nutrients – this is currently under development, to be published in 2022 (European Parliament, 2021; EC, n.d. c). Nutrients are not referred to explicitly elsewhere in the CEAP. Food, housing, transport, and textiles are, however, highlighted as the highest-pressure categories for the use of primary raw materials and water.

Challenges and opportunities

Water reuse can be defined as the use of water generated from wastewater, after treatment in accordance with the health and environment risk considerations and local and EU legislation (EC, 2016).

If wastewater is reused after responsible treatment, e.g. by urban wastewater treatment plants, water reuse is indicated to have a lower environmental impact compared to different water supply procedures, such as water transfers or desalination (Regulation (EU) 2020/741). In addition, efficient water reuse could positively affect Europe's natural environment through mitigating pressures by replacing extraction with a

circular approach, as well as by alleviating the adverse effects of discharge from urban wastewater treatment plants to sensitive regions (EC, 2012). Agriculture and industrial processes currently require intensive water use, which can present conflicts of use with drinking water.

The reuse of wastewater after treatment could also be a reliable water supply source, as it is unaffected by seasonal drought and changing weather, and special attention to nutrients in the process of wastewater reuse could help decrease the addition of fertilisers (DG Environment, n.d. k).

Despite the various positive effects of wastewater reuse, the method is scarcely implemented in the EU due to the high costs of wastewater reuse procedures and the absence of set guidelines on environmental and health regulations for water reuse (Regulation (EU) 2020/741, 2020). Another reason for the low participation in water reuse in the EU thus far is related to the significant investment required to improve urban wastewater treatment plants, as well as the absence of effective financial incentives for water reuse in agricultural sectors (Regulation (EU) 2020/741, 2020). In addition, significant investments are needed to address the maintenance of existing wastewater infrastructure (EEA, 2021a).

Another issue with water reuse systems is related to the possibility of pollutants from industry and urban wastewater treatment plants being transported back into the natural environment (EEA, 2021a; Dingemans, et al., 2020). Various industrial or agricultural activities can result in the release of contaminants in water bodies, also through contaminated air and soil polluted with pathogens and chemicals due to treated wastewater irrigation (EEA, 2021a; Dingemans, et al., 2020). Although polluting particles are mostly removed from wastewater through proper treatment, the residual sludge is used in agricultural practices, resulting in the diffusion of microplastics into water bodies (EEA, 2021a). Therefore, it is crucial that the treatment of wastewater for reuse is appropriately assessed, with the aim of mitigating risks of wastewater reuse for surface and groundwater bodies, soil, and other natural ecosystems (EC, 2016).

It is essential, considering their interlinked nature, that the reuse of water, wastewater, and nutrient management are considered together, as they indeed are under the CEAP. The potential to treat wastewater and loop it back into use for agricultural and industrial processes would be a significant step towards alleviating the pressure on freshwater resources, as well as addressing harmful runoff resulting in nutrient loss and overall pollution. The potential to save water as a precious resource is great, as many of the sectors described and tackled in the CEAP are highly resource and water-intensive; namely, food, housing, transport, and textiles.

According to the Ellen MacArthur Foundation (2021b), over 4% of global freshwater withdrawal is linked to the textiles industry, with conventional cotton cultivation being especially water-intensive and often located in already water-stressed regions. Conventional cotton production, not to mention conventional agriculture, uses significant amounts of water, pesticides, and fertilizer. This leads to the pollution of surface and groundwater, and to the disruption of nitrogen and phosphorus cycles, which negatively impacts nature and biodiversity. Industrial processes exert further stress on the environment via pollution by toxic chemical compounds.

Thus, as with the other aspects of the *Food, water and nutrients* part of the CEAP, it is again pertinent to look higher up the waste hierarchy, to prevention; treating waste will continue to be enormously important, but preventing the overuse of nutrients and the use of harmful substances in our agricultural and industrial processes is also a key opportunity for the circular economy.

Although often overlooked, Nature-based Solutions could prove extremely useful in implementing nature-positive water management practices, in more efficiently using wastewater, and in improving water quality overall. An expanding body of knowledge (Nature-Based Solutions Initiative, 2022; NetworkNature, 2022) testifies to this, with projects all over the world focusing on integrated water management, the pivotal role of wetlands, and other green infrastructures (see *BOX 15: Using Nature-based Solutions for wastewater management*).

Linking back to the commitments in the Biodiversity Strategy for 2030

The measures to tackle water reuse, wastewater management, and sustainable nutrient management will contribute directly to specific commitments under the Biodiversity Strategy largely through the elimination of pollution, and indirectly through the decrease in the need for freshwater and virgin resources and nutrients as inputs into agriculture and industrial processes.

These measures, whether considered individually or together, would help contribute to the targets of restoring degraded ecosystems and preventing the further deterioration of habitats and species, indirectly reducing the risk and use of chemical and hazardous pesticides, reducing the losses of nutrients from fertilizers, remediating contaminated soil sites, and restoring free-flowing rivers in Europe through restoring freshwater ecosystems and the natural functions of rivers.

However, should efforts extend beyond increasing reuse to include decreasing the use of water and nutrients overall – for example through the application of sustainable agricultural approaches and practices – then this would not only boost the achievement of the above-outlined targets but also support several others, including increasing the uptake of agroecological practices and land under organic farming management, ensuring chemical pesticides are not used in sensitive areas such as EU urban green areas, and directly contributing to the reduction of the use of chemical and hazardous pesticides and fertilisers.

Conclusions

Although the CEAP does not touch much upon fisheries or marine ecosystems, it does have this focus on water reuse and wastewater management. The need for this is made clear in the Biodiversity Strategy (EC, 2020b), highlighting that greater efforts are needed to achieve the objectives of the Water Framework Directive. The actions in the CEAP to eliminate pollution should help to restore freshwater ecosystems and the natural functions of rivers. Through facilitating the reuse of water for agriculture and industrial processes, it should support activities related to water abstraction and achieve better quality for all surface waters and groundwater. The CEAP can thus support the implementation of the Water

Framework Directive, despite the fact that it makes no mention of it.

For water reuse to be an effective measure against water scarcity, it is crucial for wastewater treatment to be in accordance with the Water Framework Directive, to ensure the preservation of healthy water bodies and to mitigate the diffusion of polluting particles in groundwater (The Umweltbundesamt, 2021). Furthermore, it is necessary that the conservation status of species and habitats, in coherence with the Nature Directives, is respected in water reuse strategic policy, through the preservation of ecological flows of water bodies (EC, 2016). It is also relevant to foster sustainable integrated water sources, as well as efficient water (re)use, that allows for both availability and quality, and protection and regeneration of the water environment (EC, 2016). Hence, it is recommended that the environmental objectives outlined by the EC in the Water Framework Directive and the Nature Directives are adhered to when addressing water reuse in an environmental context.

With regard to the significant cost of water reuse infrastructure, it should be possible to address the low degree of wastewater reuse in the EU by promoting innovative schemes and economic incentives to target the costs and the socioeconomic and environmental benefits of water reuse (Regulation (EU) 2020/741, 2020).

Nature-based Solutions also present ways to foster water reuse in a natural and cost-effective way, with direct benefits for biodiversity (see *BOX 15: Using Nature-based Solutions for wastewater management*). Not only can NbS be natural, low-tech, and cost-efficient actions like protecting or restoring mangroves to manage flooding, but they can save billions in preventing damage – 57 billion USD in flooding damages is averted by mangroves in China, India, Mexico, US and Vietnam each year (IUCN, 2020e). Implementing NbS, such as constructed wetlands, in water reuse systems can be key to mitigating risks (Dingemans, et al., 2020).

For the sustainable management of nutrients, some considerations have been proposed by the Phosphorus Platform (European Sustainable Phosphorous Platform, 2020), which include a call for the planned Integrated Nutrient Management Plan to:

> *"Address nutrients across all existing areas of EU policy (environment, water, air, industrial emissions, waste legislation, circular economy, agriculture, food and diet, animal feed, fertilisers, raw materials, climate change …); - cover all nutrients: nitrogen, phosphorus, other nutrients and micro-nutrients and soil organic carbon; and - integrate existing policies and implementation structures (e.g. water basin management organisations, agricultural funding and rural development …) in order to be realistically implemented by companies and by local/regional territories"* (European Sustainable Phosphorous Platform, 2020, p. 2).

This highlights the need to closely align with other elements of the European Green Deal and relevant EU policy. Within the CEAP, beyond considering different forms and sources of waste, it will be important to closely align with the areas concerned with agricultural production and industrial

processes, such as the commitments for food and textiles. In the broader context of the European Green Deal, it will be also important to align with the Zero Pollution Action Plan (EC, 2021a), which can connect the dots between relevant initiatives and sectors linked to pollution. Notably, however, special attention will need to be paid to ensure policy coherence with the Farm to Fork Strategy; as one of the key components of the European Green Deal, it aims to significantly reduce the agricultural use and risk of chemical pesticides as well as the use of antibiotics and fertilizer losses to the environment. The Biodiversity Strategy (EC, 2020b) includes these very same commitments concerning pesticides and fertilisers, and mentions the development of such an integrated nutrient management action plan:

> *"The Commission will also promote the goal of zero pollution from nitrogen and phosphorus flows from fertilisers through reducing nutrient losses by at least 50%, while ensuring that there is no deterioration in soil fertility. This will result in the reduction of use of fertilisers by at least 20%. [...] To this end, the Commission will work with Member States to develop an Integrated Nutrient Management Action Plan in 2022"* (EC, 2020b, p. 13).

Ensuring efficient water use and reuse, and the closing of nutrient loops, will need closer alignment with EU legislation governing the most critical sectors in this respect. For instance, for agriculture, this would entail ensuring links with the Common Agricultural Policy. The Biodiversity Strategy (EC, 2020b) also calls for close integration with the Water Framework Directive (Council EU, 2000), Floods Directive (Council EU, 2007) and Marine Strategy Framework Directive (Council EU, 2008a) - the basis for clean and healthy waters and seas in the EU.

The following initiatives, outlined in the box below, highlight some positive ways forward, with nature as a core priority.

BOX 15: Using Nature-based Solutions for wastewater management

IUCN defines Nature-based Solutions (NbS) as 'actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature' (IUCN, 2022c).

NbS for wastewater treatment have a great potential to address the current challenges in this field, by protecting the environment and generating socioeconomic benefits - for example, green walls (Rysulova, et al., 2017), also known as living walls, in buildings where plants can directly treat greywater. To better understand how their implementation would be most effective in different contexts, several initiatives are doing exploratory and testing work.

Some examples of NbS include the Aquafarm project (Wageningen University & Research, 2017) from Wageningen University. Aquafarm is a comprehensive nature-based water treatment system that uses different organisms in several steps of water treatment. Inputs produced in the different stages are reused during the process or can be used as inputs for other activities such as agriculture.

The NICE project (NICE, n.d.) is a Horizon 2020 project which aims to promote the use of NbS for circular urban water management. New approaches to wastewater collection, treatment, and repurposing will be developed and tested in labs located in different cities around the world.

NbS for wastewater treatment can also be implemented in agriculture, such as constructed wetlands and infiltration basins (Volkan Oral, et al., 2020). Examples can be found in the NetworkNature portal, with constructed wetlands as a multipurpose green infrastructure in the Gorla Maggiore case study (NetworkNature, 2022). This green infrastructure included a pollutant removal area with a grid, a surface flow constructed wetland with multiple roles, such as maintenance of biodiversity and a recreational park.

Further linkages between circular economy and biodiversity policy

Aside from land use – a term the CEAP does not mention – it will also be important to carefully plan out how different areas of land can best be interlinked, so as to ensure protected areas do not end up as isolated patches and ecological connectivity is enabled. The Biodiversity Strategy (EC, 2020b) suggests the restoration of high diversity landscape features outside protected areas, such as buffer strips, fallow land, coppices, ponds, hedgerows, creating buffer zones, or using other measures to improve the permeability of the landscape, as part of its ambition to ensure a coherent Trans-European Nature Network. These practices are very similar to those the Strategy suggests for improving and bringing nature back to agricultural land.

When it comes to renewable energy, the Biodiversity Strategy (EC, 2020b) states that the EU will prioritise win-win solutions for biodiversity and renewable energy, and that the Commission will assess EU and global biomass supply and related sustainability, to better understand and monitor potential climate and biodiversity risks. Here, the Biodiversity Strategy links to the Renewable Energy Directive, the Emissions Trading Scheme, and the Regulation on land use, land use change, and forestry (LULUCF) – notably, the CEAP references none of these. The Biodiversity Strategy goes on to outline plans to develop new sustainability criteria on forest biomass for energy, and to review the data on biofuels with high ILUC risk, establishing a trajectory for their phase-out by 2030.

The CEAP has an important focus on the elimination of pollution. The Zero Pollution Action Plan for Air, Water, and Soil will include measures to tackle soil pollution, and the zero pollution ambition is mentioned in both the Biodiversity Strategy (EC, 2020b) and CEAP (EC, 2020a). The latter aims to address soil health mainly through the actions under its key value chain *Construction and buildings*, promoting "*initiatives to reduce soil sealing, rehabilitate abandoned or contaminated brownfields and increase the safe, sustainable and circular use of excavated soils*" (EC, 2020a, p. 11) as part of the Strategy for a Sustainable Built Environment. The same initiatives are outlined in the Biodiversity Strategy (EC, 2020b), alongside the target to make progress in the remediation of contaminated soil sites.

Also in line with the zero pollution ambition, both the CEAP and Biodiversity Strategy emphasise the need to improve nutrient retention and cycling, and the aim to set up an Integrated Nutrient Management Plan. Elsewhere in the CEAP, however, pollution is mainly linked to plastic.

The Biodiversity Strategy also includes targets to "*reduce the adverse impacts of fishing, extraction and other human activities, especially on sensitive species and seabed habitats,*" and that "*the by-catch of species threatened with extinction must also be eliminated or reduced to a level that allows full recovery*" (EC, 2020b, p. 11). The circular economy has the potential to apply its principles not only to the production of food on land, through aligning more closely with the Common Agricultural Policy and the Farm to Fork Strategy, but also to fisheries and other extraction activities impacting our marine habitats. For instance, there is potential to build a circular fisheries economy by designing production systems that are truly regenerative and do not deplete fish stocks or damage aquatic ecosystems (EC, et al., 2019). The Biodiversity Strategy (EC, 2020b) aims to propose a new action plan to conserve fisheries resources and protect marine ecosystems, including limiting the use of fishing gear most harmful to biodiversity – the CEAP aims to support this point on fishing gear, but it could go beyond that. Circular economy policy could align more with the Marine Strategy Framework Directive, for example through ensuring that marine resources are harvested sustainably – a directive to which the CEAP does not make a reference.

The Biodiversity Strategy (EC, 2020b) also includes the aim of bringing nature back to cities and to reward community action towards this, calling on cities to develop Urban Greening Plans including actions to support biodiversity. The Green City Accord will be helpful in this context, while another key area of the Accord will be the circular economy, as mentioned in the CEAP.

The CEAP and Biodiversity Strategy both include commitments to boost investment, political prioritisation, and global partnerships for the two areas. For the two to help reinforce one another, there is great potential in linking these commitments.

Finally in the context of sustainable investments, in March 2022 the Platform on Sustainable Finance (2022a), providing the EC with advice on the development of the Taxonomy (see more information in the box below), published its recommendations for a number of environmental priorities, including the transition to a circular economy and the protection and restoration of biodiversity and ecosystems. In defining criteria for the transition to a circular economy, the Platform states that it is one of the most challenging environmental objectives because it is a relatively new concept in scientific literature (Platform on Sustainable Finance, 2022a). While activities falling under the circular economy, if in line with the proposed rules for the Taxonomy, can make a positive contribution to the environment, the recommendations note that this positive contribution is indirect, namely that "*no activity supporting the transition to a circular economy is considered to improve the state of the environment directly because the environmental objective represents a response to reduce the environmental impact of an activity. Indeed, activities are deemed circular by comparison with the linear model and only act relatively to this baseline by reducing the pressure (or enabling such reduction)*" (Platform on Sustainable Finance, 2022a, p. 48). In

relation to activities potentially contributing to the objectives of protecting and restoring biodiversity and ecosystems, the Platform states that: "*reducing pressures on ecosystems is an important activity that should be supported through the Taxonomy, but only where a substantial and genuine state change is realised, rather than small, incremental changes that do not deliver on the headline ambition level*" (Platform on Sustainable Finance, 2022a, p. 60).

As a general conclusion, in order to better support the fulfilment of the commitments outlined by the Biodiversity Strategy, circular economy policy would strongly benefit from a stronger alignment with the policies and strategies crucial for nature in Europe, including: the Birds and Habitats Directives (the Nature Directives), the Water Framework Directive, the Marine Strategy Framework Directive, the new Forest Strategy, the LULUCF Regulation, the Renewable Energy Directive, and the Invasive Alien Species Regulation, as well as ongoing and upcoming policy developments such as those related with sustainable investments.

BOX 16: The EU Taxonomy on Sustainable Investments' focus on biodiversity and the circular economy

The EC has recently approved the framework to facilitate sustainable investment (EU, 2020b), also and hereafter known as the "Taxonomy". In order to direct investments towards sustainable projects and activities, and to meet the targets and objectives of the European Green Deal, the Taxonomy aims to provide a common language and a clear definition of what is 'sustainable' (DG Communication, n.d.). The Taxonomy lists six environmental objectives, among them the "*transition to a circular economy*" and the "*protection and restoration of biodiversity and ecosystems*", thus providing another important piece of legislation to link the two priorities.

As included under the definitions for a circular economy earlier in the report (see *Theoretical overview*), the Taxonomy includes the first EU legal definition for the term "circular economy" (Lingl & Marcó, 2019), focused on 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, reducing the environmental impact of their use, and the application of the waste hierarchy. The Taxonomy underscores that the transition to a circular economy should be interpreted in accordance with relevant Union law in the areas of the circular economy, waste, and chemicals, explicitly referring to regulation concerning waste and chemicals, but also other pollutants, hazardous substances, industrial emissions, vehicles, batteries, electronic equipment, packaging, plastic, and similar.

The Taxonomy, in this respect, also links back to the EU's CEAP and its content quite closely. The focus here, as in the CEAP, is largely on the 'technical cycle' of the circular economy, and not so much on the 'biological cycle'. Like the CEAP, the Taxonomy does not refer to key EU environmental legislation, like the Nature Directives, in the context of the transition to a circular economy. In terms of economic activities that can contribute substantially to the environmental objective of transitioning to a circular economy, the one with the clearest reference to the 'biological cycle' concerns food waste. There is also the aim for a reduction in the use of resources through design and choice of materials, which is positive.

The Taxonomy outlines certain conditions for economic activities that would make them qualify as contributing substantially to the transition to a circular economy. Most relevant for nature and biodiversity is the condition that 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." (EU, 2020b)

While the objective to 'reduce' the use of primary raw materials is commendable, the effect of this is somewhat reduced by the alternatives, to instead ("or") increase the use of by-products and secondary raw materials or focus on resource and energy efficiency measures.

The Taxonomy also outlines the nature of activities that would pose significant harm to the environmental objective of the transition to a circular economy. Aside from the harmful disposal of waste or the significant increase in waste, this would include any activity that "*leads to significant inefficiencies in the use of materials or in the direct or indirect use of natural resources*" (EU, 2020b). Notably, this focuses on 'inefficiencies', and not necessarily on potential increases.

The Taxonomy outlines, in the same way, a framework for the achievement of the other relevant environmental objective: the protection and restoration of biodiversity and ecosystems. To qualify under the Taxonomy, activities cannot be "*significantly detrimental to the good condition and resilience of ecosystems*" or "*detrimental to the conservation status of habitats and species*". Activities that can substantially contribute to the achievement of this objective include – besides nature and biodiversity conservation – sustainable land use and management, sustainable agricultural practices, and sustainable forest management. This is a clear indication of the significance to biodiversity of activities pertaining to the 'biological cycle' of the circular economy.

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The way forward

Following the previous analysis, several issues and questions arise. Although the analysis focused on the EU context, the issues raised below are relevant beyond the scope of EU policy, and similar suggestions may be applied more broadly.

In establishing a circular economy that works for biodiversity, with nature at its core, **it is important to begin with how the circular economy is understood**, including how it is defined to better serve biodiversity.

> As touched upon earlier in this report, the circular economy has been defined many times, in different ways, with over 100 definitions to date (Kirchherr, et al., 2017). Yet as the circular economy has climbed the policy agenda, there is also a growing understanding that it should be designed and implemented in full alignment and support of other political and societal priorities of our time, such as the conservation of nature. Further to this, recent research (EMF, 2021b; Sitra, 2022) has revealed the immense potential for the circular economy to halt or even reverse biodiversity loss. This opportunity must be taken.
>
> However, not all activities that might be considered part of the circular economy automatically serve nature. As has been explored in this report and others, *certain solutions related to the circular economy, if not implemented with nature in mind, could lead to greater pressure on land, with negative consequences for biodiversity*. This refers especially to those linked to the 'biological cycle' of the circular economy, for example a potential shift from plastic to bio-based products in response to the issue of plastic waste.

One way to ensure that the circular economy truly serves nature would be to more closely embed nature into its core definition. *Modern definitions are already being adjusted to account for this*; if we consider current definitions from the Ellen MacArthur Foundation, the Finnish Innovation Fund Sitra, and the French National Institute for Circular Economy (INEC), nature and biodiversity are included as central concepts in their core understanding of the circular economy. With its Taxonomy, the EC has made important strides towards a more definitive understanding of what activities can be considered to make a substantial contribution to the transition to a circular economy and to the protection and restoration of biodiversity and ecosystems, and what activities might pose significant harm to these objectives.

However, as examined in the previous section, the understanding of the circular economy as outlined in the Taxonomy, much like that in CEAP, shows an important gap: in the

definition and overall content there is a focus on the 'technical cycle' of the circular economy, and not as much consideration for the 'biological cycle'. This is especially relevant considering the 'biological cycle' is the most impactful for nature and biodiversity, and that the two cycles are inextricably intertwined components together comprising the whole economy. As an example, for the hugely impactful sector of food and agriculture, much like in the CEAP, the Taxonomy also limits its link to the circular economy to the reduction of food waste.

A key lesson to carry forward would be to *ensure that circular economy policy moves beyond a focus on the 'technical cycle', embedding also the 'biological cycle'*. Central to much of this is ensuring that the bioeconomy is developed in a sustainable and circular way, with full respect of its ecological boundaries. An important lesson to be learned from the circular economy is that, in accordance with its principles, biomass should in principle not be used directly for energy.

Furthermore, to help frame this improved understanding of the role of nature in the circular economy and vice versa in the policy debate, *it would be helpful to keep in mind Rockström's and Sukhdev's "wedding cake model" of the Sustainable Development Goals* (Stockholm Resilience Centre, 2016), which appropriately positions nature as the foundation for the achievement of all of our societal priorities.

Finally, also in the context of better defining and understanding the circular economy, as well as putting into practice, *it will be important to consider appropriate metrics, indicators, and tools*. Several frameworks for monitoring the transition to a circular economy already exist, such as those of the EC (Eurostat, n.d.) or of the OECD (2020). While these frameworks touch upon production and consumption, their indicators are mainly concerned with waste, which leaves room for improvement. The EC is currently revising the set of indicators, adopted in 2018, to assess progress towards a circular economy. Expected to be completed later in 2022, the revision aims to better cover production, as well as the links between circularity, climate neutrality, and zero pollution (EC, n.d. b). To link the circular economy more closely with biodiversity, it would be important to have a common framework for measuring the impact and effect on nature of sustainable agriculture and forestry activities, for example.

The Science Based Targets Network is focusing on targets for nature to follow those on climate, and is doing important work to establish "*measurable, actionable, and time-bound objectives, based on the best available science*" (Science Based Targets Network, 2020, p. 5). These would allow companies and cities to align their activities with the Earth's ecological limits and to contribute to societal sustainability goals. A set of methods is expected by the end of 2022, and widespread adoption of science-based targets on water, land, biodiversity, and ocean is aimed for by 2025 (Science Based Targets Network, 2020).

Recent research (Sitra, 2022) has shown that **certain sectors, such as food and agriculture as well as forestry**, **hold significant potential benefits for nature and biodiversity if these were to become fully circular**.

Land use needs to be of central concern for circular economy policy, especially by supporting sustainable land use in agricultural and forestry practices, limiting the further expansion of land under cultivation. More attention will need to be paid to extraction and production, encompassing the whole life cycle, and not only to the end of life stage e.g. waste. Ultimately, even keeping in line with the circular economy in terms of the waste hierarchy, much can be achieved through tackling consumption. Prevention is the first priority, so in this respect *the circular economy should also align more closely with policies tackling production and consumption*, such as the Farm to Fork Strategy.

In this context, and keeping in mind the key goal of achieving the needed transformation of key land use sectors such as agriculture and forestry, *Nature-based Solutions can be a very helpful tool*. Aside from water reuse and sustainable nutrient management, as was explored earlier in the report, NbS can be applied in many situations, in many different areas. This includes the urban environment, through the management of urban forests, rivers, parks and wetlands, providing habitat for a range of species, reducing air pollution, limiting flooding, improving water quality, storing carbon, and improving city-dwellers' health and wellbeing. They can be applied to the marine environment, through the preservation of coral reefs, mangroves, and other wetland ecosystems, to manage and reduce the impact of storms and floods. They can also assist in the restoration of forests, to help retain and filter water, hold soils intact, store carbon, provide habitat for biodiversity, and goods and services for people (Cohen-Shacham, et al., 2016).

Many of the activities that can be associated with the development of a circular economy that supports nature and biodiversity can, in fact, also be NbS. With growing interest from business, governments, civil society, and other stakeholders to apply NbS, IUCN has developed the IUCN Global Standard for Nature-based Solutions (IUCN, 2020c). The Standard seeks to help stakeholders consistently design effective NbS that are ambitious in scale and sustainability, as well as create a shared language and framework for innovative partnerships.

In this context, IUCN has been engaging in NbS as means to address major societal challenges, and is committed to continue doing so. The IUCN Global Standard for Nature-based Solutions, especially when taken up by policy, can be an important tool to help facilitate investment – donors and financiers can invest in NbS with the confidence that the Standard provides a benchmark, minimising risks and adding assurance (IUCN, 2020c). At IUCN's World Conservation Congress held in 2021, the Union approved several motions to further advance the role of NbS in tackling the biodiversity and climate crises. These include: WCC-2020-Res-007-EN – Developing agroecological

practices as nature-based solutions, WCC-2020-Res-031-EN – The implementation of nature-based solutions in the Mediteríranean Basin, and WCC-2020-Res-060-EN – Promotion of the IUCN Global Standard for Nature-based Solutions.

Another key tool by which to bring the circular economy closer to nature would be through the use of the natural capital concept. Furthermore, many solutions to tackling nature loss and climate change will require some investment, with **sustainable finance being a key priority for the transition to a circular economy that embraces biodiversity**.

It is important to remember that, while investing in nature pays off even in the short term, the long-term return on preserving and regenerating nature and biodiversity can be exponential. It can also be argued that, precisely due to the intrinsic value of nature, it can be difficult to measure just how substantial these gains may be.

Natural capital is a concept that helps to value, though not necessarily monetarily, natural assets and ecosystem services. It provides an important, missing link between the economy and the environment, or between financial capital and natural capital. Not accounting for natural capital in decision-making and business strategy has been detrimental to nature. For decades we have grown financial capital in large part through the use, exploitation, and degradation of natural and social capital (Natural Capital Coalition, 2016). Assigning a monetary value to nature has, in general but also in the context of the circular economy, received its share of criticism (Büscher & Fletcher, 2016). Essentially, some believe that doing this reconceptualises nature into a commodity that can be traded, leading to further destruction rather than the conservation of nature. The notions underpinning this criticism have been examined and addressed in turn (Groeneveld, 2016), although the limitations to putting a price on something with intrinsic and immeasurable value, such as nature, cannot be overlooked. Nonetheless, while it may be imperfect and might risk being misused, *natural capital accounting is a crucial tool and an important step forward from the alternative: treating nature as if it has no value and no limits*. Many more find natural capital accounting to be a necessary component of transitioning to an economic system that works for nature and biodiversity (ESP, 2020).

There have been some important developments on this front, especially in the EU. The EC proposed a new module on natural capital accounting in 2022, fully consistent with the UN framework (EC, 2022g). Beyond this development, the EC already produces EU statistics and trends on the extent of different ecosystems, their condition, and ecosystem services; compliant with the new framework for natural capital accounting (Vysna, et al., 2021). It is also important to note that, as outlined by the European Environment Agency, a number of EU laws help protect natural capital. This includes: the Water Framework Directive, the Marine Strategy Framework Directive, the Air Quality Directive, and the Nature Directives. A wide range of EU policies also affect natural capital,

including the Common Agricultural Policy and the Common Fisheries Policy (EEA, 2020a). This is strongly supported by a key recommendation in this report to enhance policy coherence, in particular to more closely link EU circular economy and nature conservation policies.

Internationally, in 2021 the UN adopted a new framework, the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA) (UN et al., 2021), to help integrate natural capital in economic reporting. There are also some important developments, such as the Natural Capital Protocol: a framework designed to help businesses identify, measure, and value their direct and indirect impacts and dependencies on natural capital (Natural Capital Coalition, 2016). Finally, at the World Conservation Congress in 2021, IUCN members approved a number of relevant motions to advance in this area, including: WCC-2020-Res-120-EN - Towards a Policy on Natural Capital and WCC-2020-Res-057-EN - Accounting for biodiversity: encompassing ecosystems, species and genetic diversity.

In relation with sustainable finance, businesses and policymakers are beginning to lead the way in terms of investments in and commitments for nature. Launched in 2019 at the UN Climate Action Summit, One Planet Business for Biodiversity (OP2B) (One Planet Business for Biodiversity, 2022) is a unique international cross-sectorial, action-oriented business coalition on biodiversity with a specific focus on agriculture. In 2020, an initiative to bring together a Taskforce on Nature-related Financial Disclosures (TNFD, 2022b) was announced, with funding pledged by governments, the UN, philanthropic foundations, and the private sector. The Finance for Biodiversity Pledge (2022) is another initiative, backed by financial institutions. In 2021, the New York Stock Exchange co-launched a new tradeable asset class based on sustainable enterprises that hold the rights to ecosystem services. These "natural asset companies" (NACs) will be listed and traded on the exchange, "*creating a new market whose assets generate trillions of dollars in ecosystem services annually*" (Mccrank, 2021). In the EU context, as explored in previous sections, *the EC's Taxonomy is also an important policy initiative currently under development to help steer sustainable investments*. Not least to maintain the credibility of this fundamental process, it will be crucial that the discussion on what constitutes a green investment has the broadest consensus possible, especially according to the environmental experts and main stakeholders.

To support the transition to a circular economy with nature at its core, it is fundamental to enhance policy coherence.

While *the European Green Deal is a step in the right direction in placing both priorities under the same umbrella*, *circular economy policies can benefit from clearer references to environmental legislation*. This is especially relevant for the Nature Directives and the Marine Strategy Framework Directive, which are so closely linked to the natural capital discussion,

as well as the upcoming Nature Restoration Law. The Taxonomy could also do more to explicitly link the circular economy objective to relevant environmental legislation, which unfortunately makes for a crucial gap. As outlined in the conclusions stemming from the policy analysis, there is potential for circular economy policy to be much more closely integrated with the policies governing key relevant sectors. Examples include (in the EU) the Common Agricultural Policy, Farm to Fork Strategy, Sustainable Food Systems Framework Initiative, Regulation on LULUCF, Renewable Energy Directive, Emissions Trading Scheme, Forest Strategy, Water Framework Directive, Marine Strategy Framework Directive, Floods Directive, Invasive Alien Species Regulation, and others.

Enhanced policy coherence will not only help boost investment in all the right areas and support the uptake of helpful initiatives and tools, *but also help create the enabling conditions for this needed transition*. Coherence will also be important in terms of funding lines, where the Common Agricultural Policy, for instance, will have a critical role to play in the development of a circular economy in agriculture and forestry.

Although the current draft of **the Post-2020 Global Biodiversity Framework does not include the term circular economy, we would expect this to be different in its final version**.

> References to the circular economy in the Post-2020 Global Biodiversity Framework are implicit through targets on production, consumption, and pollution. However, a more explicit inclusion of the circular economy in the Framework could also be an important way of establishing an understanding of a nature-based conceptualisation of the term. Should this happen, it would be helpful that such an understanding of the circular economy considers all the linkages with, and the potential for, nature and biodiversity.

As mentioned, the European Green Deal is a step in the right direction, as it helps to integrate relevant environmental policies under the same umbrella. **The timely and coherent implementation of its key strategies and initiatives will be crucial to maintain the EU's leadership on key environmental aspects such as the fight against biodiversity loss and the transition to a circular economy.**

Conservation and restoration will remain crucial activities in the fight against the interdependent crises of biodiversity loss, ecosystem degradation, and climate change. However, the transition to a circular economy that both begins and ends in nature, and that transforms our unsustainable production and consumption systems, is an invaluable tool to help us achieve our fast-approaching environmental targets.

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