# 15. Sustainability through a system lens

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# Summary


- The EU has committed to ambitious, long-term environmental and climate goals with the aim of 'living well, within the limits of our planet', but current measures are insufficient to achieve these goals.

- Many global megatrends continue to intensify persistent environmental problems, while emerging trends are increasingly influential in shaping environmental outcomes. They embed both risks and opportunities for Europe and its environment, as illustrated by recent social and technological innovations.

- Overall, Europe can act on these drivers of change to shape a sustainable future.

- Persistent environmental and climate problems resist traditional policy responses. They cannot be fully resolved without addressing broader sustainability issues that address environmental, social, economic and governance dimensions at the European and global scales.

- The Sustainable Development Goals (SDGs) framework exemplifies the systemic nature of sustainability issues. Achieving the SDGs and other long-term sustainability goals requires considering their interactions, including trade-offs, co-benefits and transboundary effects between Europe and the rest of the world. Designing policy frameworks that pursue these goals requires systems thinking.

- While many systems perspectives exist, *The European environment — state and outlook 2020* (SOER 2020) focuses on three key systems — those meeting European demand for food, energy and mobility — while providing relevant insights on other societal systems.

# 15.

# Sustainability through a system lens

## 15.1 From environment to sustainability

### *15.1.1 The EU has committed to ambitious environmental and climate goals*

In recent decades, Europe has increasingly recognised the significance of many environmental and climate challenges at both European and planetary scales. In particular, it has become aware of the increased risks — environmental, social, economic and geopolitical — for Europe and the world in relation to transgressing global ecological limits related to climate, resource use, pollution, biodiversity loss and ecosystem degradation (EU, 2013; EC, 2019). For example, it has acknowledged that, without strong measures to curb greenhouse gas (GHG) emissions, continued global warming will substantially increase the likelihood of severe, pervasive and irreversible consequences such as the collapse of natural ecosystems (Arctic, coral reefs, Amazon forest), erosion of global food security or displacement of people at unprecedented scales. Likewise, it has recognised that accelerated depletion and degradation of ecosystems continuously erodes nature's capacity to deliver the services that underpin almost every aspect of human well-being and thereby jeopardises sustainable development (Chapter 1).

'Living well, within the limits of our planet' is the EU's sustainability vision for 2050.

Against this backdrop, the EU has set itself an ambitious vision for 2050 with the aim of 'living well, within the limits of our planet' and a focus on three key objectives: (1) protecting natural capital; (2) achieving resource efficiency and decarbonisation; and (3) safeguarding against environmental pressures and risks to health and well-being (EU, 2013). In line with this vision, the EU and its Member States have adopted ambitious environmental and climate targets and objectives. These include the legally binding objective to cut GHG emissions to at least 40 % below 1990 levels by 2030 (European Council, 2014), and the ambition to cut GHG emissions by 80-95 % by 2050 (EC, 2011a). In 2018, the European Commission published its strategic long-term vision for a prosperous, modern, competitive and climate-neutral European economy by 2050, which shows how Europe can lead the way to climate neutrality while ensuring a socially fair and just transition (EC, 2018a).

Other long-term objectives include achieving no net land take by 2050, halting the loss of biodiversity and the degradation of ecosystem services, and producing and using chemicals in ways that minimise significant adverse effects on human health and the environment. Recognising that 'many environmental challenges are global and can only be fully addressed through

a comprehensive global approach' (EU, 2013), it has also promoted, shaped and endorsed two major, highly significant, long-term global, agreements. The United Nations (UN) 2030 agenda for sustainable development includes long-term goals and targets covering all critical environmental and climate issues, while the Paris Agreement establishes the international goal of limiting global warming to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels (Chapter 2).

### *15.1.2 Despite progress, the EU is not on track to reach many environmental goals*

Viewed together, the thematic and sectoral assessments in this report (Chapters 3-13) present a worrying outlook for Europe's environment in the coming decades. They lead to the conclusion that many long-term EU environment and climate targets will not be met with existing policy interventions if current trends continue (Chapter 14). This applies, for example, to the EU's ambitious objectives to reduce GHG emissions. Although these targets are in line with the global goal set by the Paris Agreement, the projected pace of reducing GHG emissions after 2020 is clearly insufficient to achieve them (Chapter 7).

More short-term objectives and targets will not be met for a range of environmental issues related to natural capital and environmental impacts on health and well-being. For example, Europe will not achieve good environmental status for all of its water bodies and regional seas by 2020, nor will it achieve sustainable soil management. It is not on track to minimise significant adverse effects of chemicals on the environment by 2020. The health and well-being of European citizens still suffers substantially from exposure to air pollution, noise, hazardous chemicals and, increasingly, risks resulting from climate change (Chapter 14).

Many long-term EU environment and climate targets will not be met with existing policy interventions.

In fact, some objectives and targets have been renewed over the years, without signs of significant progress. For instance, the EU first set the target of halting biodiversity loss in the EU by 2010. When this was not achieved, it set the same target for 2020 (EC, 2006, 2011b). Despite many local conservation successes, for instance through the extension of the Natura 2000 network of protected areas, the mid-term review of the EU biodiversity strategy to 2020 reported 'no significant progress' towards the headline target (EC, 2015), an assessment further supported by the analysis in Chapter 3.

### *15.1.3 Persistent environmental problems resist traditional policy responses*

While some explanation for these shortfalls can be found in implementation deficits or time lags between implementation and measurable ecological changes (Chapter 14), this diagnosis triggers more fundamental questions. Have we truly recognised the scale of change required to achieve Europe's environmental goals? Have we fully understood the reasons for the persistence of environmental and climate problems?

As emphasised in Chapter 1, the very same human activities that have delivered major improvements in living standards and well-being since the 1950s have been the source of unprecedented environmental degradation in Europe and worldwide and of anthropogenic changes to the climate system. If environmental problems, such as biodiversity loss and climate change, have been resistant to policy interventions over several decades, it is mainly because their underlying causes have been insufficiently or ineffectively tackled.

Ultimately, the environmental pressures related to energy use, extraction of natural resources, chemical use, land use, waste generation, and so on, originate from the same production and consumption processes that provide societal needs such as food, mobility, heating and shelter (EEA, 2015). As research and policy increasingly acknowledge, resolving persistent environmental problems will require more ambitious, upstream and comprehensive responses than those provided by past environmental policy interventions (Chapter 2). The scale and complexity of the challenge for governance is augmented by the impacts of global megatrends on Europe and its environment.

### *15.1.4 Many global megatrends continue to intensify environmental problems*

There is widespread consensus that many global megatrends — large-scale, high-impact and long-term trends — are likely to affect Europe and its environment strongly in the coming decades (EEA (forthcoming), 2020b). A growing global population and the emergence of an affluent middle class across the world, is accelerating global demand for materials, land, water and energy, with cascading effects on ecosystems and climate change (Chapter 1). With European industrial regions already facing a number of challenges regarding access to both

primary and secondary raw materials (EC, 2017a), these trends put Europe at further risk of supply shortages. This could result in increased pressures on natural resources in Europe (EEA (forthcoming), 2020b).

Turning to a technological perspective, the widespread digitalisation of economies and societies worldwide is expected to continue shaping European production and consumption profoundly (Chapter 1). While digitalisation creates a wide range of opportunities for society, the overall implications for the European environment are uncertain. Digitalisation can foster product traceability (e.g. blockchain — see Box 15.1) and efficiency gains in production processes. However, the exponential increase in personal connected devices and sensors (e.g. related to the Internet of Things) requires increased infrastructure deployment and energy consumption, leading to additional environmental pressures (EEA (forthcoming), 2020b). Moreover, the increasingly short lifespan of such devices contributes to a rapid increase in waste electrical and electronic equipment (WEEE) and associated problems of recycling and disposal.

From a geopolitical perspective, increased volatility and tensions in the global multilateral system (EPSC, 2018; MSC, 2019) may jeopardise the implementation of existing global agreements, such as the Paris Agreement, and compromise further concerted international action on other environmental issues (EEA (forthcoming), 2020b). With key countries tempted to turn their backs on multilateral agreements, 'Europe will have to deploy environmental diplomacy in a hitherto unseen way' (ESPAS, 2019).

### *15.1.5 Drivers of change embed both risks and opportunities*

Many global megatrends have worrying implications for Europe's environment. But other drivers of change, such as more Europe-specific trends and emerging trends, suggest a more open and nuanced outlook. For instance, in contrast to many world regions, stagnating population trends in Europe potentially offer a more favourable context for decreasing the environmental pressures resulting from European consumption (Chapter 16). On the other hand, ageing population trends in Europe could lead to higher domestic energy demand, for example due to increased heating and cooking linked to a higher proportion of smaller households (Bardazzi and Pazienza, 2017). They may also bring substantial challenges for fiscal and financial sustainability (EEA (forthcoming), 2020a). Ultimately, much depends on how much individual consumption levels and patterns can change in Europe.

Global megatrends are likely to have major impacts on Europe and its environment.

To assess this, it is essential to pay more attention to emerging trends that carry the seeds of change. For instance, promising social innovations originating from citizens, cities and communities, such as collaborative consumption, have recently emerged as new ways of consuming (EEA, 2015). While these more sustainable behaviours remain niche for the time being, their mainstreaming into everyday practice could decrease environmental pressures from consumption, particularly if accompanied by changes in product design (EEA, 2017) and lower standards of material consumption in European lifestyles (e.g. through sufficiency). Similarly, many emerging trends related to technological innovation, such as blockchain technology, synthetic biology, artificial meat or drones, bring new opportunities for Europe and its environment, as well as new risks (Box 15.1). Amid this uncertainty, one conclusion emerges: the future is open and it can be shaped. Europe can either be carried along by ongoing trends or it can seek to bend them towards a more sustainable trajectory. As agents of change who can shape or adapt to drivers of change, the EU and European citizens are not powerless in their efforts to live well, within the limits of our planet.

### *15.1.6 Environmental issues are inseparable from broader sustainability issues*

The scale of environmental challenges and the implications of global megatrends together imply the need for fundamental and urgent changes in our societies and economies, with significant consequences for lifestyles, jobs, habits, and so on. Resolving environmental problems inevitably implies the need to address broader sustainability issues. It raises questions about 'how our system of prosperity [can] be maintained' within local and global ecological limits (Hajer, 2011). This presents a fundamentally different challenge from those of the 1970s or 1980s, when specific environmental problems could be tackled with targeted instruments. The complex and systemic character of today's sustainability challenges requires a different policy response.

First, policy interventions must be designed to consider the environmental, social, economic and governance dimensions of human activities, which are interconnected in many ways. Significant changes in any one dimension (e.g. environmental) will affect the others (e.g. socio-economic) in ways that are sometimes beneficial,

**BOX 15.1 Emerging trends: four examples related to technological innovation**

Assessing prospects for the environment in a fast-changing world requires considering not only environmental trends and global megatrends but also emerging trends. Although fewer data are available to characterise these societal, technological, economic and geopolitical developments, it is crucial to anticipate their potential implications as early as possible. In the field of technological innovation, for instance, there are some rapidly emerging trends that are likely to have significant impacts on the environment, as well as on society and the economy (EEA and FLIS, 2019). Examples include:

**Blockchain**, which consists of an open, distributed and public computer-based ledger for transactions, illustrates the new opportunities offered by digitalisation. Its applications, such as cryptocurrencies (e.g. bitcoin) and decentralised autonomous organisations, could radically transform existing governance arrangements, electoral procedures and financial transactions. Environmental protection could benefit, for example, from increased traceability and accountability in supply chain management (Kouhizadeh and Sarkis, 2018). However, mainstreaming of blockchain also raises concerns in relation to climate change mitigation, as the current processes for transaction verification, or 'mining', are highly energy intensive.

**Synthetic biology**, which involves the assembly of entirely new sequences of DNA and entire genomes, is already being applied in the pharmaceutical, chemical, agricultural and energy sectors. Promising uses for environmental protection include bioremediation of polluted industrial sites, pollution detection, protection of species at risk, and bio-based products (Science for Environment Policy, 2016). Nevertheless, its application to control disease vectors, for example by genetically engineering mosquitoes to prevent the spread of malaria, could disrupt ecosystems in unexpected ways and lead to biodiversity loss (CBD, 2015).

**Artificial meat**, which refers to meat cultivated *in vitro* from stem cells of living animals, may offer an alternative and novel solution to the rising global demand for meat consumption (especially in Asia). Its mainstreaming could help to decrease greenhouse gas (GHG) emissions from livestock, which account for a significant proportion of all anthropogenic emissions, i.e. 14.5 % according to the United Nations Food and Agriculture Organization's global life cycle approach (Gerber et al., 2013). Even if the production costs of artificial meat decrease in the coming years, its mainstreaming will remain largely dependent on its societal acceptance (e.g. cultural and psychological barriers) as well as on reliable food safety protocols.

**Drones** are increasingly used for delivery by e-commerce and the logistics industry, potentially providing a significant contribution to reducing GHG emissions from the transport sector. Indeed, recent research shows that delivery drones can outperform conventional delivery trucks (Goodchild and Toy, 2018), diesel vans (Figliozzi, 2017) and motorcycles (Park et al., 2018) in terms of GHG emissions. However, an assessment of the whole life cycle of drones (including extra warehousing, battery use, etc.) has yet to be performed. The mainstreaming of delivery drones would also bring new threats to wildlife, especially birds, and create additional noise and visual impacts in urban environments. ■

The complex nature of the sustainability challenge requires a new policy response.

sometimes detrimental, and often uncertain (Chapter 16).

Second, the roots of environmental degradation and climate change are so intrinsically linked to the structure and functioning of our societies and economies — in Europe but also in most advanced economies throughout the world — that our long-term environment and climate goals will not be achieved without fundamental transformations in the ways we consume and produce. This provokes questions about how policy can trigger systemic change that engages society as a whole (Chapter 17).

Third, patterns and mechanisms of consumption and production co-evolve with each other not only at the European scale but also internationally through trade, communication, policy and knowledge transfers (see Section 15.2). This means that the response to sustainability issues affecting Europe is generally not just a European

response but one that requires strong coordination among the international community. For instance, achieving climate neutrality in Europe by 2050 will have only a limited effect on climate change mitigation (and its impacts) if other countries do not take similar action. The Paris Agreement and the 2030 agenda for sustainable development are encouraging signs of this international alignment.

## 15.2 The systemic nature of sustainability issues

### *15.2.1 The Sustainable Development Goals cannot be pursued successfully in isolation*

The SDGs framework offers the most comprehensive and widely shared view of our common sustainability challenges worldwide (see Figure 2.1 in Chapter 2 for a description of the SDGs). The 2030 agenda for sustainable development calls on governments and other stakeholders to achieve 17 SDGs and 169 associated targets, bringing together economic, social and environmental considerations in ways that mutually reinforce each other. The UN has stressed that the agenda should be viewed as an indivisible whole in which all targets are equally important. As the goals are closely interlinked, however, pursuing them concurrently implies the need to consider their interactions. This brings both challenges and opportunities for policies and implementation.

Some of these interactions are now well known and have been acknowledged (sometimes after a delay) by policymakers. For example, the case of first-generation biofuels has made it clear that the goal of increasing bioenergy production (SDGs 7 and 13) can easily enter into conflict with the goal of fostering food security (SDG 2),

Achieving the SDGs implies a need to consider their interactions, trade-offs and co-benefits.

as both require the use of agricultural land, which is an increasingly scarce resource (Chapter 16). However, there is growing recognition of the multiple co-benefits that protecting, conserving, enhancing and restoring natural capital (SDGs 14 and 15) provide for health and well-being objectives (SDG 3). For instance, ecosystem-based approaches, such as green infrastructure and nature-based solutions, can fulfil several functions on the same piece of land such as helping to reduce air pollution, mitigating heat stress, reducing noise in urban environments and providing opportunities for increased physical activity and improved mental health (Chapters 3, 6 and 17).

Studying the interactions between different societal goals is not something new. It is at the core of research on sustainability. Indeed, policy integration and coherence has been on the agendas of international organisations (e.g. Organisation for Economic Co-operation and Development, UN Environment) and European and national institutions for some time (Chapter 2). At the EU level, all proposed legislation goes through an impact assessment, which needs to include a description of potential environmental, social and economic impacts. Although such assessments are valuable, they are insufficient to address sustainability issues, which require an awareness of the systemic interactions between the societal outcomes pursued by various policies. Indeed, pursuing any single SDG target does not affect other targets in a binary way but rather systemically, potentially triggering cascading effects. Box 15.2 outlines a systemic approach that aims to unpack these interactions in a manner that supports more robust implementation strategies (EEA and SEI, 2019).

### *15.2.2 The SDGs highlight European-global interactions*

In addition to the interactions between different SDGs in Europe, the global character of the SDGs implies the need to acknowledge interactions with efforts to achieve them in other world regions. In line with the EU's commitment to 'foster the sustainable economic, social and environmental development of developing countries' (EU, 2007), progress towards the SDGs in the EU should not compromise progress in other regions but rather support it. This focus is at the core of policy coherence for sustainable development, which has been endorsed by the EU and applied in some areas. In particular, the EU has been a frontrunner in ensuring coherence between its trade and development policies, especially for the least developed countries (EC, 2018b). It is increasingly recognised that achieving the SDGs will now require the mainstreaming of this approach (OECD, 2018; EC, 2019).

This endeavour should start with a better understanding of the transboundary effects of EU measures to achieve the SDGs. Transmission channels are numerous and include financial flows, imports and exports of goods and services (especially through global value chains), diffusion of waste and pollution (e.g. to the EU's neighbourhood), migration (e.g. the 'brain drain') or knowledge transfers (OECD, 2017). As regards environment protection and climate action, the pursuit of SDG targets in Europe can potentially lead to the externalisation of the same environmental problems

### BOX 15.2 SDG interactions

In 2016, a framework for mapping and categorising Sustainable Development Goals (SDGs) interactions was proposed, using a seven-point scale to describe the nature of interactions. (Nilsson et al., 2016; Griggs et al., 2017). The methodology was further developed by the Stockholm Environment Institute (SEI) to assess SDG interactions in different contexts. By adding cross-impact analysis (Figure 15.1) and using network analysis techniques, it provides a systemic and contextual perspective on the SDGs (Griggs et al., 2017; Weitz et al., 2018). The results show, for example, which targets are most and least influential for making progress on the SDGs, where there are critical trade-offs and synergies, and where stakeholders have shared or conflicting interests. This is useful to guide priority-setting and cross-sector collaboration for implementing the SDGs.

When applying the analysis at the EU scale (EEA and SEI, 2019), the SDG framework reveals many synergies. However, the relationship between SDGs 12-15, crucial for environmental protection and climate action, and other SDGs (such as SDGs 1 and 7-11) potentially involve trade-offs. The main reason is that increased income (SDG 1), better access to energy (SDG 7), more economic growth (SDG 8), and industrial and infrastructure investments (SDG 9) tend to increase overall consumption and natural resource extraction. They therefore make it harder to achieve targets on efficient use of natural resources (target 12.2), better management of chemicals and waste (target 12.4), climate mitigation (target 13.2) and protection of terrestrial ecosystems and biodiversity (targets 15.1 and 15.5). Acknowledging these tensions more explicitly reinforces the call for alternative pathways for sustainable development.

The example of steel can illustrate how important the choice of interventions will be when trying to achieve societal goals that are potentially conflicting. Steel is a central component of an industrial society and thus for progress on SDG 9. The global demand for steel is expected to increase with increasing economic development, and steel production already accounts for about 7 % of global carbon dioxide emissions, which makes it the single largest sector in terms of industrial emissions (Pérez-Fortes et al., 2014). Thus, there is a clear tension with climate change mitigation (SDG 13). To meet the SDGs, the Paris Agreement and EU targets for reducing emissions from steel production to near zero by 2050, while promoting a thriving steel industry within the EU, a systemic change all the way from production to recycling is needed (Åhman et al., 2018). In Sweden, three companies focusing on iron ore mining, steel manufacturing and power utility have joined forces to develop a novel process for fossil fuel-free steel production (Åhman et al., 2018). Such an initiative moves beyond capture and storage of carbon dioxide as the approach for limiting climate impacts from heavy industry to avoiding emissions being generated in the first place. It tries to address fully the trade-off between SDGs 9 and 13 through better internalisation of negative effects from industrialisation and infrastructure development in the long term. ■

or the creation of other kinds of challenges in other countries, reducing their chances of achieving those SDGs. This 'burden shifting' could negatively affect the global achievement of the SDGs and could also feed back negatively on Europe in areas relating to the global commons (e.g. climate change mitigation, healthy oceans). Key externalities to be considered in the field of environment and climate action include (Lucas et al., 2016; OECD, 2017, 2018):

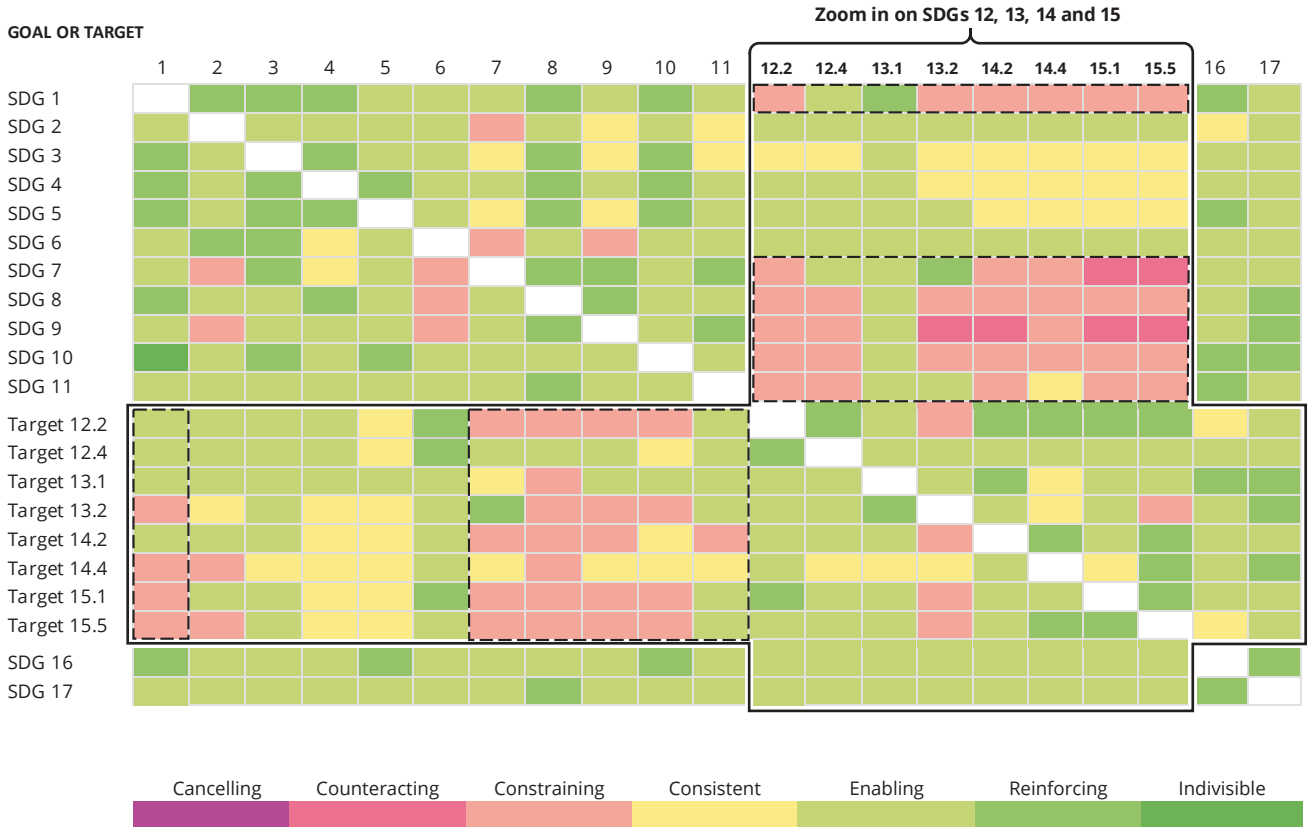
- environmental pressures (e.g. SDGs 6, 7, 12, 14, 15) on resources or conditions in other countries that are attributable to EU consumption (SDGs 8 and 12) (see Chapters 2 and 16 on footprint indicators), for example deforestation in producing countries resulting from EU imports (e.g. palm oil, soybean, exotic woods);

- adverse impacts of EU reliance on energy-intensive imports (SDG 7) on the decarbonisation efforts of other countries (SDG 13);

- unintended consequences of biofuel subsidies (SDG 7) on food prices through competition for land, possibly impacting the food security of the most vulnerable households in developing countries (SDG 2);

- shifting production abroad as a result of stringent EU policies on biodiversity conservation, reduced use of agricultural inputs or climate mitigation (SDGs 2 and 13-15), leading to a potential increase in unsustainable agricultural practices and polluting

**FIGURE 15.1 Visualising SDG interactions**




**Source:** EEA and SEI (2019).

industries in those countries (SDGs 2, 3, 14, 15);

- cross-border impacts of air and water pollution (SDGs 6 and 12).

There are obviously many positive externalities, especially those linked to trade, investments, official development assistance, diffusion of innovation and exchange of environmental information and knowledge. The EEA's cooperation with the EU's southern and eastern neighbourhood countries is a good example of the latter (EEA, 2018a, 2019).

### *15.2.3 The 2030 agenda aims for systemic transformation*

In addition to recognising systemic challenges, the 2030 agenda for sustainable development embraces the notion of transformation, as expressed in its main title *Transforming our world*

The 2030 agenda for sustainable development embraces the notion of transformation.

(UN, 2015). World leaders have declared that they are 'determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path' (UN, 2015). In recent years, this has been echoed and expanded on by a large number of international organisations and initiatives, which share the ambition of bringing 'transformative change', 'transitions' or 'system transitions' into the heart of their assessments. Such assessments include *The World in 2050* (TWI2050, 2018); the IPCC Special Report *Global warming of 1.5* °C (IPCC, 2018); Future Earth's work on *Transformations* (Future Earth, 2019); the *Global assessment report on biodiversity and ecosystem services* (IPBES, 2019); and *The Sixth Global Environmental Outlook* (UN Environment, 2019). For instance, *The World in 2050* highlights the need for 'bold and appropriate changes in values and deployment of policy instruments' to foster six key transformations related to human capacity and demography; consumption and production; decarbonisation and energy; food, biosphere and water; smart cities; and the digital revolution.

At the European level, the proposed long-term climate-neutral strategy stresses that the options it proposes 'will radically transform our energy system, land and agriculture sector, modernise our industrial fabric and our transport systems and cities, further affecting all activities of our society' (EC, 2018a). Similarly, the European Commission's reflection paper, *Towards a sustainable Europe by 2030*, acknowledges the need for 'a transition to a low-carbon, climate-neutral, resource-efficient and biodiverse economy in full compliance with the United Nations 2030 Agenda and the 17 SDGs' (EC, 2019). Both documents emphasise that the various dimensions of sustainability are inextricably intertwined. They acknowledge that transitions will have difficult implications for a number of sectors and regions, particularly those 'whose economies depend on activities that either are expected to decline or will have to transform in the future.' (EC, 2018a). They therefore stress the need for transitions that are socially fair, 'for the benefit of all, leaving no one behind, ensuring equality and inclusiveness' (EC, 2019).

SOER 2020 focuses on three critical societal systems: energy, food and mobility.

## 15.3 Understanding and responding to sustainability challenges

### *15.3.1 Achieving sustainability goals will require systems thinking*

As shown in previous sections and exemplified by the SDGs, sustainability challenges are systemic in nature and require systemic responses. Policies and decisions that take a systemic view of sustainability issues based on science-informed analysis have a better chance of long-term success. As stressed by the European Commission, 'isolated, piecemeal approaches have proven to be ineffective. We need to formulate strategies that are comprehensive and integrated.' In the EU, this implies, for example, a thorough consideration of the systemic interactions between the climate-neutral economy, the circular economy and the bioeconomy frameworks (Chapters 16 and 17).

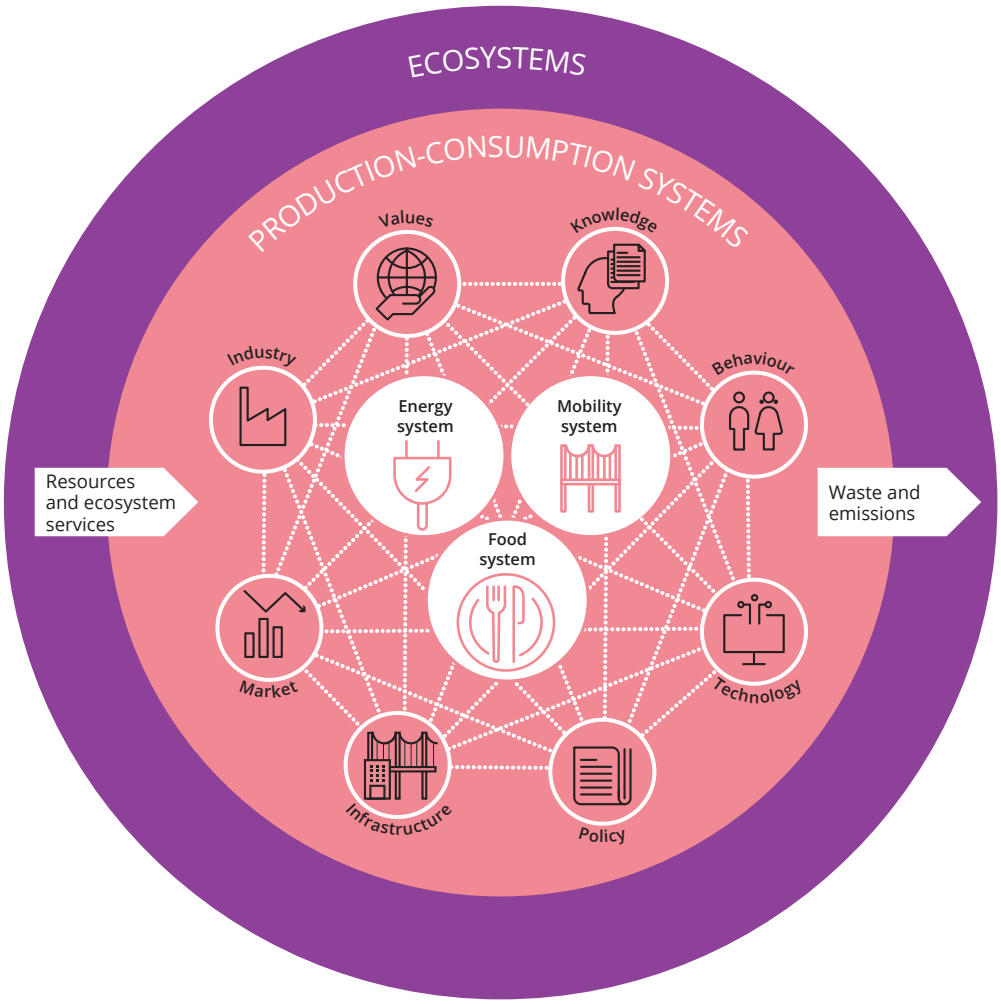
From a knowledge perspective, adopting a systemic view, also referred to as 'systems thinking', helps in approaching and reflecting on the complex or 'wicked' problems facing Europe. For example, 'recognising the food system as a complex adaptive system, which comprises multiple actors with diverse interests and values, provides a richer understanding of the system and the associated sustainability challenges' (EEA, 2016). It does so by mobilising systems lenses that allow the observation of natural and social phenomena at the right scale, by zooming in and out, and looking for underlying structures and patterns (Chapter 16). It also complements traditional modes of problem-solving with more solutions-oriented approaches (Chapter 17).

As systems are ultimately mental constructs, a variety of systems lenses can — and should — be used to shed light on sustainability issues, in order to draw on contrasting but complementary knowledge. Decades of research in academic fields such as complexity science, ecology, sustainability science, evolutionary economics or innovation studies have produced a variety of relevant systems approaches, providing insights into the environment, climate and sustainability challenges and possible responses. Among them, the socio-ecological, socio-technical and socio-economic approaches offer complementary perspectives on different kinds of interactions, as well as on different temporal and geographical scales (EEA, 2018b).

### *15.3.2 This report focuses on three key systems for transformation*

While the need for societal transformation is increasingly recognised in sustainability science and policy, the question of which systems need to be addressed is less settled. Following the conclusions of SOER 2015, *The European environment — state and outlook 2015*, the two following chapters focus in particular on three key systems: those meeting Europe's demand for energy, food and mobility. These are selected for attention because of their key role

**FIGURE 15.2 Ecosystems and production-consumption systems**




**Source:** EEA.

in supporting European societies, their substantial environmental impacts and their prominence in EU policy frameworks. The three systems also differ in character, illustrating contrasting challenges and varying degrees of progress in achieving transitions (Chapter 16). Collectively, they offer valuable insights for understanding other important production-consumption systems, such as those relating to housing, clothing or consumer goods. These production-consumption systems are considered within a broader frame, in which they are understood in relation to the ecosystems that they depend on — both as a source of natural resources and ecosystem services and as a sink for waste and emissions (Figure 15.2).

On this basis, the next two chapters provide more detailed assessments of the systemic challenges facing Europe and how the EU can respond. Chapter 16 illustrates how current configurations of key production-consumption systems (food, energy and mobility) and Europe's overall consumption patterns and levels relate to sustainability challenges. It emphasises the cross-cutting nature of those sustainability challenges, encompassing environmental, social and economic dimensions, and it reflects on knowledge needs, societal perspectives and policy approaches. Drawing on a growing body of research and practice increasingly recognised by international organisations (OECD, 2016; IPCC, 2018), Chapter 17 explores how European governments and societies can more broadly address systemic barriers to change and achieve fundamental transitions to sustainability.