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KNOWLEDGE FOR A SUSTAINABLE XXI CENTURY

Background paper[1]

Sustainability challenges and policies

The European Union and its neighbours have in recent decades achieved remarkable progress in socio-economic well-being and prosperity while taking actions that are cognisant of planet earth's ecological limits. At the same time, as it is widely acknowledged, Europe and the rest of the world still face fundamental environmental and sustainability challenges of unprecedented scale and urgency.

Furthermore, our knowledge base is increasing our understanding of the complex, systemic character of these challenges and the need for different solutions to those that currently prevail. For example, environmental pressures are growing fast, as an expanding global population shifts towards the resource-intensive consumption patterns of developed regions. The sheer size of the global population and the intensity of human activities has caused tremendous pressures on the Earth's life support systems through climate change, biodiversity loss, competition for natural resources and changes in the chemical composition of the atmosphere, oceans and soil. Other megatrends such as rapid urbanisation and technological change are also shaping production and consumption patterns.

Overall, human development patterns and economic activities have caused **unprecedented pressures on planet Earth**. For example, the last 50 years have witnessed a massive degradation and loss of Earth's ecosystems and biodiversity (IPBES, 2019[2]). The abundance of wild species has declined drastically, both globally and in Europe — a phenomenon referred to as the 'Anthropocene defaunation' — and evidence suggests that the sixth mass extinction of Earth's biota is already under way. Likewise, many of the observed changes in the global climate system since the 1950s are unprecedented over decades to millennia. Human activities are estimated to have caused a global warming above pre-industrial levels of about 1.0°C (IPCC, 2018[3]). The last four years are, collectively, the warmest years on record (C3S, 2019[4]). Without drastic emission abatement measures in the coming two to three decades, continued global warming will increase the likelihood of severe, pervasive and irreversible consequences such as the collapse of natural ecosystems (the Arctic, coral reefs, the Amazon forest) and the erosion of global food security or displacement of people at unprecedented scales (IPCC, 2018[3]).

In Europe and globally, to maintain current progress while advancing towards **achieving sustainability will require fundamental and far-reaching societal change, engaging all sectors of the economy and society**. For example, achieving the goals set out in the Paris Agreement requires transformational changes leading to deep reductions in greenhouse gas emissions. Tackling the escalation of global resource consumption requires a fundamental decoupling of resource use and associated environmental impacts from economic development. Achieving this will require the transformation of key societal systems — especially the energy, food, mobility and urban and housing systems – supported by money sourced from reconfigured finance and fiscal systems.

The need for such **far-reaching change is already reflected in key EU policy documents**, such as the European Commission's long-term vision for a climate-neutral Europe and its reflection paper on the UN Sustainable Development Goals (SDGs), 'Towards a Sustainable Europe by 2030'. The new 'Political guidelines for the next European Commission 2019-2024', presented to the European Parliament on 16 July 2019 by the President-elect, Ursula von der Leyen, likewise emphasise the need for ambitious, green transformative change in the next five years and the huge opportunities that this would create for Europe.

[1] This document represents the views of its authors, not the official position of the EEA or the European Commission.

[2] IPBES, 2019, Global assessment report on biodiversity and ecosystem services, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, (www.ipbes.net/global-assessment-report-biodiversity-ecosystem-services)

[3] IPCC, 2018, Global warming of 1.5 °C, Intergovernmental Panel on Climate Change (www.ipcc.ch/report/sr15/)

[4] C3S, 2019, Last four years have been the warmest on record - and CO2 continues to rise. Copernicus Climate Change Service (www.climate.copernicus.eu/last-four-years-have-been-warmest-record-and-co2-continues-rise)

From challenges to solutions: the what and how of knowledge for action

Knowledge has for decades played a crucial role in enabling informed decision-making in the European Union at all levels of governance and in empowering action across society. **There have been two prominent pathways for producing knowledge for action**. The first has been through regulatory policies that stimulate knowledge developments by creating constraints that drive innovation. The second has been to encourage new ideas, thinking and innovation, and hence new knowledge, by expanding research horizons, for example, through EU framework research programmes.

It is increasingly acknowledged that **the knowledge generation through regulations and research alone are insufficient to** guide the societal transformations necessary to achieve the UN 2030 Agenda for sustainable development. More effective, fast and adaptive science-policy-society interfaces are needed to ensure that knowledge is understood and used as the basis for taking actions. Researchers, practitioners, decision-makers, funding bodies and civil society can work together through active public participation in environmental protection and transition processes[5]. **Transition processes call for paradigm shifts in knowledge creation, organisation and use.**

Many of the most pressing sustainability challenges for Europe and globally are highly complex wicked problems, associated with **substantial uncertainty, ambiguity and conflicts of interests**. There are important knowledge gaps in diverse areas, ranging from marine ecosystems and planetary environmental tipping points, through drivers of resource consumption and effects of exposure to chemicals, to the functioning of complex systems of production and consumption and establishing fair, societal-wide transformation outcomes.

The current climate of populism, 'post-truth', 'fake news', fragmentation" of knowledge, and diminishing societal trust and confidence in public institutions adds further layers of complication and raises **questions regarding inclusiveness, accountability and the plurality of viewpoints**.

Nevertheless, the increasing abundance of information and the pace of change, alongside new governance models and digital technologies, could together create **opportunities for transforming knowledge developments and uses**. For example, artificial intelligence technologies could be deployed to speed up new knowledge generation as well as harvest knowledge archives to inform pathways for sustainability transitions. Also augmented intelligence systems use artificial intelligence to help people understand transition pathways towards an uncertain future by examining scenarios and adapting them transparently in line with stakeholder interests[6].

These challenges have been assessed in the EEA's forthcoming five-yearly assessment of Europe's environment **'The European Environment – State and Outlook 2020'** (SOER 2020). The SOER 2020 report draws on the knowledge base available to the EEA and the European Environment Information and Observation Network (Eionet), which is the partnership network between the EEA's 33 member countries and six cooperating countries. The report's development has evolved over the last 25 years, with an increasing recognition that environmental issues are deeply entangled with most aspects of European and global society, with implications for the overall long-term sustainability outlook. The SOER 2020 report suggests that stakeholders need to use existing knowledge in a more effective and targeted way and that there is a need for new types of knowledge to underpin their actions.

The findings of the SOER 2020 report are complemented by many other recent assessments, scientific articles, networking approaches, and institutional political initiatives that point to the need for new types of knowledge for sustainability. For example, the Sustainable Development Report 2019[7] suggests that sustainability science is still a niche field.

The European Commission's 'Horizon Europe' – an ambitious €100 billion research and innovation programme – aims to respond to these realities through its enhanced sustainability orientation, focused missions, greater co-creation, citizens' involvement and harnessing of digital technologies.

Aims and objectives of the workshop

The workshop aims to reflect on Europe's unprecedented sustainability challenges from a knowledge and environment perspective. As such, it provides a **platform to facilitate a dialogue between several of the actors** mentioned above, such as European Union institutions, agencies, science advisory councils, funding organisations and academia.

The objective is to contribute to the identification of knowledge needs for environmental sustainability and to reflect on innovations in knowledge development, exchange and use practices at the science-policy-society interface so that knowledge better supports policy and action.

The EEA's upcoming SOER 2020 report serves as an entry point for doing that. More specifically, the workshop will use **two complementary but interconnected guiding questions** to explore the knowledge base on environmental sustainability at the science-policy-society interface. The remainder of this paper will briefly explore each of the two questions taking the upcoming SOER 2020 report as framing.

1. Identification of knowledge needs (WHAT):
What knowledge is needed to respond to Europe's sustainability challenges?

2. Reflection and discussion on innovations in knowledge development, exchange and use (HOW):
What needs to change in the way knowledge for sustainability is developed and used?

[5] Nature Sustainability comment (2019) on 'Expansion of sustainability science needed for the SDGs' by Messerli et al.
[6] PWC, 2018, Fourth Industrial Revolution for the Earth: Harnessing Artificial Intelligence for the Earth, PricewaterhouseCoopers report.
[7] Sustainable Development Report, 2019, Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN) (https://sdgindex.org/reports/sustainable-development-report-2019/)

What knowledge is needed to respond to Europe's sustainability challenges?

Many 'lists' exist about research and knowledge priorities to support sustainability transitions in Europe and globally, and all of them are valid. For example, the new DG RTD Horizon Europe programme prioritises five mission areas for research action: 'Climate change, including societal transformation', 'Cancer', 'Healthy oceans, seas, coastal and inland waters', 'Climate-neutral and smart cities' and 'Soil health and food'. Another example is the Sustainable Development Report 2019, which identifies six areas of transformation: human well-being and capabilities, sustainable and just economies, food systems and healthy nutrition patterns, energy decarbonisation and universal access to energy, sustainable urban and peri-urban development, sustainable global environmental commons.

For the purpose of this workshop, **five major clusters of knowledge needs** have been selected from the SOER 2020 assessment in view of their relevance and complexity.

- **Geographical interconnectedness:** the global-European-national interconnectedness from an environmental perspective
- **Human-environmental systems interactions:** the individual and cumulative impacts of pressures on ecosystems
- **Risks and well-being:** environmental risks to health and well-being
- **Societal systems:** the structure, drivers and dynamics of production-consumption systems
- **Governance for sustainability transitions:** the knowledge system as a key enabler

Geographical interconnectedness

Europe is today intertwined with the rest of the world in multiple ways, for example, through trade, financial flows or geopolitical processes. This means that Europe and its environment are influenced by multiple driving forces. Some are global megatrends, others are more European-specific or emerging trends. Regardless of their character, most of them are of key importance for European policymaking aimed at addressing today's systemic sustainability challenges. Yet, many driving forces, their interconnectedness and implications for Europe are still not well understood.

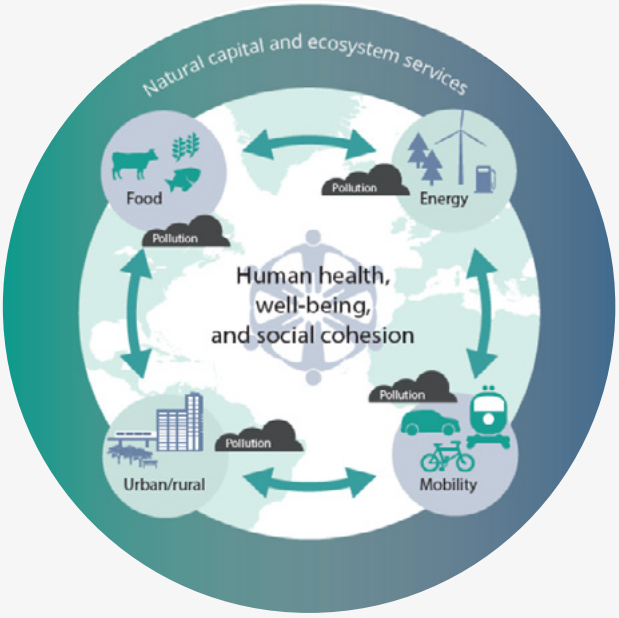
In turn, European production and consumption patterns have implications for environmental degradation in other parts of the world. Key production-consumption systems such as energy, mobility and food operate across and beyond European borders. Progress has been made in quantifying the pressures by European consumption exerted elsewhere in the world, for example through footprinting approaches. However, a much better understanding is needed about where European activities have an impact and who they affect.

Human-environmental systems interactions

The complexity of environmental systems can cause a considerable time lag between reductions in environmental pressures and a sufficient reduction in environmental impacts. A complex mixture of factors determines environmental outcomes. Improved understanding of systemic interactions between human and environmental systems would support more integrated management approaches and nature-based solutions that can address multiple sustainability challenges while restoring environmental systems.

Better understanding is needed regarding the individual and cumulative impacts of pressures on ecosystems (both terrestrial and marine) and how environmental systems respond to pressures including the identification of tipping points and critical thresholds. Improved knowledge of the interactions between environmental and societal systems (Figure 1) is also needed and how approaches such as the resource nexus can strengthen the knowledge base.

Figure 1: *Interactions between environmental systems and societal systems.*



- European societies' cohesion, well-being and economic performance are highly dependent on natural capital.
- Sustained actions are needed to address human health impacts and natural capital degradation.
- Transition and sustainability for food, energy, mobility and urban systems should be the focus for such actions.
- Such transitions can be accelerated by fiscal and finance policies that support environment and climate objectives and take account of Europe's ageing society.
- The UN 2030 agenda and SDGs offer a framework for more ambitious European actions globally.

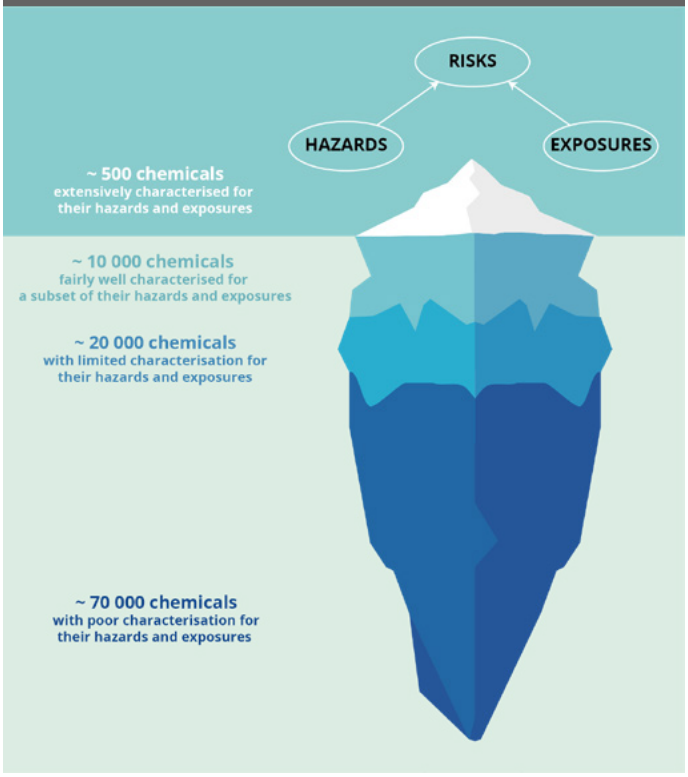
Source: EEA

Risks and well-being

Safeguarding human health and well-being is an important driver for environmental policy and it is reflected as a priority objective in the 7th Environmental Action Programme (7th EAP) of the European Union. People are still affected by exposure to air pollution, noise, hazardous chemicals and increasing risks from climate change. Environmental risks to health do not affect everyone in the same way, with differences in vulnerability and exposure to health hazards across Europe.

Developing a stronger framework integrating environment and health requires a more holistic approach in which environmental risks to health are managed by considering hazard, exposure and vulnerability. This requires a stronger knowledge base that addresses important gaps such as the effects of exposure to chemicals (Figure 2), particularly mixtures, and the interaction between systemic risks and other health determinants, along with early identification of emerging issues.

Figure 2: *Exposure to chemical risks*



Source: EEA

Societal systems

Navigating transition processes requires detailed knowledge about the societal systems driving environmental and sustainability challenges. This includes evidence about the structure, drivers and dynamics of production-consumption systems at different scales – such as the energy system, the mobility system and the food system – and how these relate, for example, to policy objectives on circular, bio- and carbon neutral economy. It also includes knowledge about cross-system interactions and the individual and cumulative impacts of systems on ecosystems and social well-being. And it includes information about the interactions, lock-ins, feedbacks and tipping points that influence sustainability outcomes, and the social acceptance and political feasibility of systemic change.

At present, Europe's knowledge systems are not geared towards providing these kinds of insights into societal systems. There are many knowledge gaps and available evidence is often dispersed across society, held by research, businesses, public administrations or communities. The partial and siloed knowledge system that currently informs governance makes it hard to understand and communicate about the systemic challenges that we face, and how to respond to them.

Governance for sustainability transitions

There is an increased acknowledgement for the need to promote diverse forms of innovation that can help trigger changes in lifestyles and values. This points to the knowledge system as a key enabler - a knowledge system that enables society to learn from successes and failures, to replicate and upscale promising initiatives, to identify unexpected consequences, and to avoid lock-ins to unsustainable innovation pathways. Governments and public institutions can accelerate systemic change by fostering such societal innovation and networking, by reorienting financial flows towards sustainable investments and by investing in relevant knowledge systems and skills.

Orienting society-wide processes of systemic change towards sustainability objectives also requires the articulation of visions and pathways, involving trade-offs between alternative futures. This requires knowledge about the interests and preferences of different groups and their visions for the future.

What needs to change in how knowledge for sustainability is developed and used?

Changes in the types of knowledge required to respond to Europe's sustainability challenges, such as emerging widely accessible data sources (e.g. remote sensing data), call for new strategies to bring about innovations in knowledge creation. Such innovations will not emerge by replicating the same modus operandi. The praxis of creation of knowledge needs to be questioned and transformed to fit new realities.

Knowledge creation in this respect is therefore understood as the practice of generating knowledge to support policymaking – often referred to as 'usable' or 'actionable' knowledge. Recent research points to different types of innovations required within the sustainability science-policy-society interface. Three of those refer to the need for **(1) enhanced co-creation and trans-disciplinarity, (2) greater reflexivity and (3) more experimentation**.

Enhanced **co-creation** calls for a type of knowledge that is generated through interactions between different actors, from different personal, professional, organisational or institutional backgrounds or sectors. It involves knowledge agents such as academics, practitioners, civil-servants, decision-makers and end-users, amongst many others. Networks, partnerships and collaborative platforms are key features permeating open knowledge systems, beyond scientific research. Even if this approach can bring many benefits it also takes more time and engenders diffused responsibility.

Such an approach can also deliver **transdisciplinary** knowledge, new knowledge which is not confined by existing disciplinary boundaries. It creates additional knowledge beyond what is generated through interactions between different disciplines (interdisciplinary). Transdisciplinary knowledge creation seeks for sources of knowledge in areas that are not necessarily defined by specific disciplines – it takes into account and develops what is between, across and beyond all disciplines.

Greater **reflexivity** requires knowledge to be generated out of constant reflexive learning loops, through which values, beliefs, mental models and worldviews of the knowledge broker are questioned. In this regard, knowledge and learning are imminently experiential and self-consciousness is instrumental. Transparency is a key criterion to be followed in reflexive knowledge creation.

Experimentation in knowledge creation is instrumental to generate possible responses (possible futures) to the challenges addressed. Such type of (usable, action-oriented) knowledge is meant to be transformative, point to action and promote change. Experimentation in knowledge creation requires processes that are mostly inductive, tentative and transient – and therefore intrinsically non-predictive and non-prescriptive. Design thinking and prototyping are key components in such iterative learning processes.

Therefore, developing and using new forms of knowledge often require that policymakers and other actors have access to relevant **competencies** and **institutional conditions** or **capabilities**. These include, for example, skills in participatory foresight techniques, stakeholder engagement skills and platforms, and a governance culture and regulative and financial support that promotes experimentation and learning.

FURTHER READING

- Sustainability transitions: policy and practice (EEA. 2019)
- Making sense of science under conditions of complexity and uncertainty (SAPEA, 2019)
- Understanding our Political Nature: How to put knowledge and reason at the heart of political decision-making (Mair et al., 2019)
- White paper from Future Earth and the Belmont Forum (2019) on knowledge gaps and research priorities for 'Systems of Sustainable Consumption and Production'
- Nature Sustainability comment on the 'Expansion of sustainability science needed for the SDGs' by Messerli et al. (2019)