European Environment Agency

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EEA Scientific Committee seminar
Ecosystems and their services: building the knowledge base for European assessments

background material

Copenhagen
01 October 2014

This document provides a collection of short papers and other material as background to inform the EEA Scientific Committee seminar on 01 October 2014 in Copenhagen.

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General information about the EEA and the seminar

About the European Environment Agency

The European Environment Agency (EEA) is an agency of the European Union. Our task is to provide sound, independent information on the environment. We are a major information source for those involved in developing, adopting, implementing and evaluating environmental policy, and also the general public. Currently, the EEA has 33 member countries and 6 cooperating countries.

The regulation[1] establishing the EEA (and the European environment information and observation network: Eionet) was adopted by the European Union in 1990. It came into force in late 1993, and work started in earnest in 1994. It was established with the aim to provide the Community and the Member States, and in particular the European Commission, with the objective information necessary for framing, implementing and evaluating sound and effective environmental policies and for keeping the public properly informed on the state of the environment.

In order to achieve this, the EEA undertakes a comprehensive range of integrated environmental and thematic assessments to support environmental policy in Europe. These include five-yearly state and outlook of the environment reports, thematic and sectoral assessments, analyses of the effectiveness of policy measures, forward studies and the impacts of globalisation on Europe's environment and resources. The EEA is an important source and custodian of environment related data and indicators and a key provider of environmental knowledge and information services.

Cooperation with government bodies and research institutions in Eionet plays a key role, representing two decades of investing in the creation and sharing of environmental information across Europe. The EEA also works closely together with EU institutions, especially the European Commission (DG Environment, DG Climate Action, and DG Joint Research Centre in particular), and in partnerships with agencies, government departments, and international conventions and UN bodies, including WHO, the scientific community, private sector and civil society.

The most recent five-year evaluation of the EEA confirmed that the EEA and Eionet are well established and well-functioning structures, delivering comprehensive and reliable outputs. The EEA will follow the recommendations of the evaluation to ensure it continues to be the most effective and efficient solution to providing credible information on the state of the European environment.

Key goals

- To be the prime source of knowledge at European level informing the implementation of European and national environment and climate policies;
- To be a leading knowledge centre supporting long-term transition challenges and objectives;

[1] Regulation (EC) No401/2009 of the European Parliament and of the Council of 23 April 2009 on the European Environment Agency and the European Environment Information and Observation Network (codified version)

- To be the lead organisation at European level facilitating knowledge-sharing and capacity-building in the field of environment and climate change.

The EEA's Multi-Annual Work Programme 2014-2018 (excerpt)

'Expanding the knowledge base for policy implementation and long-term transitions'

Policy developments

The EU is increasingly formulating its environmental and climate policies in a three step timeframe.

- The thematic policies each have their own timelines and deadlines for implementation, reporting and revision; many of them coinciding with the 2014-18 timeframe of this work programme.
- EU environmental and sectoral policies and ambitions are also 7formulated in the perspective of either more comprehensive policies (Europe 2020, 7th EAP), or specific 2020/30 targets for the environment and climate.

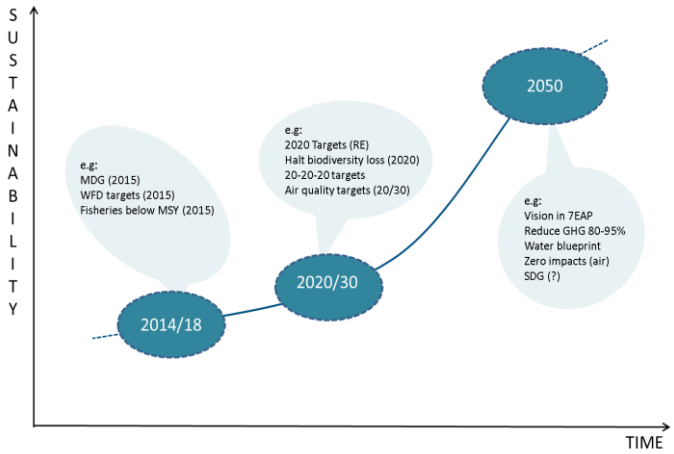
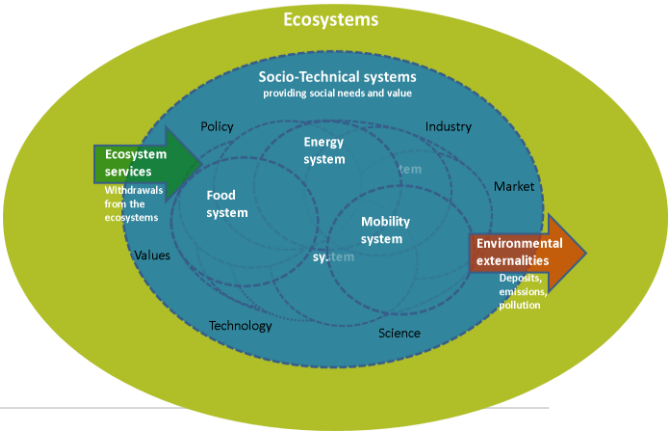


Figure - Long-term transition/intermediate targets

- In addition, the EU has formulated long term visions and targets, mostly with a 2050 societal transition perspective. (See Figure 1)

Environment and climate policies have evolved over the years in response to a deepening understanding of the issues. This understanding, as captured by the EEA State and Outlook Reports, recognises first of all that the environmental challenges we face today do not differ substantially from those of a decade ago. Thus, climate change, loss of biodiversity, unsustainable use of natural resources, and environmental pressures on health, prioritised by the 6th Environment Action Programme a decade ago, remain key issues of concern. While most environment and climate challenges remain, there is also an enhanced appreciation of the links between the different challenges, as well as the interplay with a wide range of global megatrends, all pointing towards increased complexity of problem definition, analysis, and response.



This growing understanding is set out in the Environment Action Programme to 2020 (7th EAP) entitled 'Living well, within the limits of our planet'. This programme is based on a 2050 vision centred on ecological limits, a circular economy and society's resilience. To move towards this vision, the programme sets out nine priority objectives.

Figure - Living within ecological limits

This programme recognises achieving existing objectives and targets in a mid-term perspective to 2020/30 with policies such as the Climate and Energy Package 2020 and associated roadmaps, the EU Strategy for Adaptation to Climate Change, Europe 2020 and the Resource Efficiency Roadmap, the Biodiversity Strategy to 2020, and specific legislation for water, waste, air etc. In addition, the 7th EAP promotes new ways of thinking and innovation in order to realise the 2050 vision beyond existing targets.

The overall aim is to step up the contribution of environment policy to the transition towards sustainability, with a resource-efficient, low-carbon economy in which natural capital is protected and enhanced, and the health and well-being of citizens is safeguarded. They are also the basis for EU involvement in global agendas such as Rio+20, the United Nations Framework Convention on Climate Change, the Montreal Protocol on Substances that Deplete the Ozone Layer and the Convention on Biological Diversity, as well as in wider European activities, which increasingly are framed in a 2050 perspective.

EEA strategic response

To secure the knowledge and evidence for this developing policy framework in line with Priority objective 5 of the 7th EAP, the MAWP is structured around four strategic areas (SA1–4):

Strategic Area 1: Informing policy implementation (SA1)
Providing feedback and input to long-established and emerging policy frameworks, objectives, and targets through reporting on progress in recognised environmental themes, including links to those sectors that are the primary sources of environmental pressures, and through reporting on the state of and trends in natural environment systems (atmosphere, oceans, territories) using the DPSIR assessment framework (Driver, Pressure, State, Impact, Response).

Strategic Area 2: Assessing systemic challenges (SA2)
Providing support to improving synergies and policy coherence across environmental, economic and social systems by applying established and experimental integrated assessment techniques and prospective analysis, with both a short-term and a long-term perspective. This work supports the long-term vision for 2050 set out in the 7th EAP. It underpins policy initiatives in the Europe 2020 Strategy, including the EU climate and energy package; the Roadmap for moving to a low-carbon economy in 2050; the EU Health for Growth programme; the EU Biodiversity Strategy to 2020; the Roadmap to a Resource Efficient Europe; and the Innovation Union Flagship Initiative.

Strategic Area 3: Knowledge co-creation, sharing and use (SA3)
Providing support to the work in the above areas by building and maintaining networks of people and information systems as the basis for sharing and co-creating content, whether that be data, indicators, or assessments, in a transparent manner with other actors at national, European and global levels. Communications, in the broadest sense of the word, will also play a major role in ensuring that information promotes a dialogue with a dialogue with stakeholders and reaches out to the society at large. Targeted information, communication and participation are important instruments for achieving significant and measurable improvement in Europe's environment, responding to emerging challenges and societal developments.

Environment, biodiversity and ecosystems angle

EEA overall objective to support and inform policy development and implementation in the area of biodiversity and ecosystems (natural capital); this includes marine, agriculture and forests ecosystems, as well as urban systems by means of data, information/indicators and assessments. Specifically:

- to collect, process, quality-assure and disseminate data and information on genes, species, habitats and ecosystems to support the Birds and Habitats Directives, the EU Biodiversity Strategy and related multilateral, regional and global policy agreements;
- to assist the European Commission and the Member States with the reporting of data towards the implementation of the nature directives;
- to further develop EEA and shared information systems, in particular the Biodiversity Information System for Europe (BISE), in support to the above;
- to use biodiversity and ecosystems data, information, and knowledge to inform and support the assessment of the implementation of related (agriculture, forests) and cross-cutting policy objectives (ecosystem-based management, water, marine, urban, regional) through topic assessments to track progress towards the achievement of biodiversity targets as defined in relevant EU and international policies through relevant indicators and assessments;
- to assess the status and trends of terrestrial and marine biodiversity, as well as pressures and possible impacts of measures related to biodiversity and ecosystems in relevant legislative instruments and policies (CAP and rural development, Forestry Strategy, and complementary to work in the areas on water and marine);
- to make use of Copernicus land-monitoring services to support the bio-physical mapping and assessments of ecosystems and their services.

Policy context

EU Biodiversity policy up to 2020 focuses on the Biodiversity Strategy (Commission Communication: Our life insurance, our natural capital: an EU biodiversity strategy to 2020 (COM(2011) 244)) that follows on from the 2006 Biodiversity Action Plan. This new strategy to halt the loss of biodiversity and ecosystem services in the EU by 2020 is in line with global commitments made in Nagoya in October 2010, in the context of the Convention on Biological Diversity and its set of twenty global targets on which progress should be evaluated at EEA level.

The EU Biodiversity Strategy to 2020 contains six main (interconnected) targets, and 20 actions:

• Full implementation of EU nature legislation to protect biodiversity

• Better protection for ecosystems, and more use of green infrastructure

• More sustainable agriculture and forestry

• Better management of fish stocks

• Tighter controls on invasive alien species

• A bigger EU contribution to averting global biodiversity loss.

The strategy sets the 2020 headline target of halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and the vision of protecting and restoring biodiversity and the ecosystem services it provides by 2050.

Performance indicators

- data reported by EEA member countries and other sources collected, processed, quality-assured, stored and disseminated according to the agreed deadlines in a timely and reliable manner;
- EEA member countries and Commission assisted effectively in their nature directives reporting activities, and capacity-building support provided as needed;
- EEA member countries and the European Commission supported in a timely manner with relevant analysis and compilations of reported information within a direct policy context;
- EEA information systems developed according to the policy needs as emerging from the nature directives, the EU Biodiversity and Global Biodiversity strategies. To this end, full development and implementation of BISE (linking to other systems — e.g. WISE and Climate-ADAPT — as appropriate);
- develop indicators and assessments based on sound, timely, and policy-relevant methodologies, including needs from policy effectiveness analysis, in particular concerning the mid-term review of the Biodiversity Strategy to 2020 and sub-global/regional ecosystems assessments, as well in support to policy-science interface platforms at European and global levels (IPBES).
- establish relevant partnerships with major operators in biodiversity monitoring, data gathering, and agriculture and forests ecosystems data and observation networks, in order to reinforce information provision as well as assessment capacities.

Output	**Time frame**
Upgrade and maintain BISE to support the implementation of the EU and global Biodiversity Strategies and broad expert public communication	Launch May 2014 then regular
Improved expert information systems on species and habitats and links to taxonomic services (EUNIS) with data producers-organisations and projects (e.g. Catalogue of Life, GBIF, LIFE Watch)	2014
Prepare Natura 2000 datasets, sufficiency assessments and Union lists according to EU legislation, support bio-geographic seminars towards good conservation status while supporting other pan-European designation processes	Annual
Analysis of the state, trends and conservation status of individual species and habitats, as required under the reporting of the Habitats and Birds Directives. Advice on streamlining the Water and Marine Directives, based on the experience with articles 12 and 17	2014–2015 (every 6 years)
Contribute to EEA indicator frameworks, including the core set, streamlined European biodiversity indicators (SEBI 2020), agri-environment indicators (AEI), to monitor progress towards the EU and global Biodiversity Strategy targets	2014 and regular
Contribute to bio-physical mapping and assessments of	2014–2020

ecosystems and their services, and related processes under the Biodiversity Strategy to 2020, and related actions based on produced data/information (restoration, green infrastructure, no net loss, natural capital accounting)	
Assess the impacts on biodiversity of agriculture and forests based inter alia on High Nature Value (HNV) concepts applied to farmland and forest as contributions to target 3 of the EU Biodiversity Strategy	2015 (and 2020)
Adapt the EU2010 Biodiversity Baseline to inform the mid-term review of the Biodiversity Strategy to 2020 (baseline associated to the outputs above)	2015
Reinforced cooperation with global and regional key partners including the Council of Europe (e.g. on data reporting by Contracting Parties to the Bern Convention on Emerald sites) and IUCN (e.g. on EU Red lists of species and invasive species)	Annual
Targeted contributions to and participations in relevant European and global processes contributing to Biodiversity governance, i.e. UN Convention on Biological Diversity, Sub-global ecosystems assessments and International platform for biodiversity and ecosystems (IPBES)	Regular
Eionet workshops and similar	Annual/regular

About the EEA and SC Seminar – objectives, organisation and outcomes

The overall objective of the seminar is to comment on the knowledge base developments for and structuring of assessments for *Ecosystems and their services*, from the triple perspectives of: policy; assessments; and research and monitoring.

Objectives

1. Clarify the *Ecosystems and their services* objectives of the EEA work and their relevance to the implementation and visions of relevant European Union policies, in particular the EU Biodiversity Strategy to 2020 and its Mid-Term Review planned for 2015.
2. Consider to this end the scoping and structuring of ecosystem assessments and their related knowledge requirements to support European assessments on *Ecosystems and their services* by EEA and partner institutions (ENV, JRC, Countries) and how to accelerate the development of this knowledge over the period 2014-2020.
3. Address the developments towards multiple interfaces between policy and science in the *Biodiversity, Ecosystems and their services* area, in particular the programme of work for regional assessments by IPBES (Intergovernmental Platform for Biodiversity & Ecosystems Services).
4. Discuss and identify strategic applied research gaps on the topic at stake and how knowledge can be further aligned to policy needs through Horizon 2020 strategic programming and activities and FP7 follow-up activities.

Organisation of the day (three modules)

- Clarifying the *Ecosystems and their services* nexus as a key focus to achieve the objectives of relevant EU policies: will explore the strategic policy landscape, the assessment landscape, and the science landscape relevant to the topic.
- Towards strategic research programming on *Ecosystems and their services* in Horizon 2020: will address the need for integrative, interdisciplinary, cross-cutting systems science in the context of Horizon 2020; it explore the EU research landscape and key dimensions of environment and health monitoring and research (EEA SC perspectives).
- Bridging the policy-science-assessments gaps**:** panel and general discussion will involve a dynamic exchange of views and ideas between the policy, science, research and assessment actors, seeking to identify pointers for future priority areas, cooperation and follow-up actions.

Outcomes of the seminar

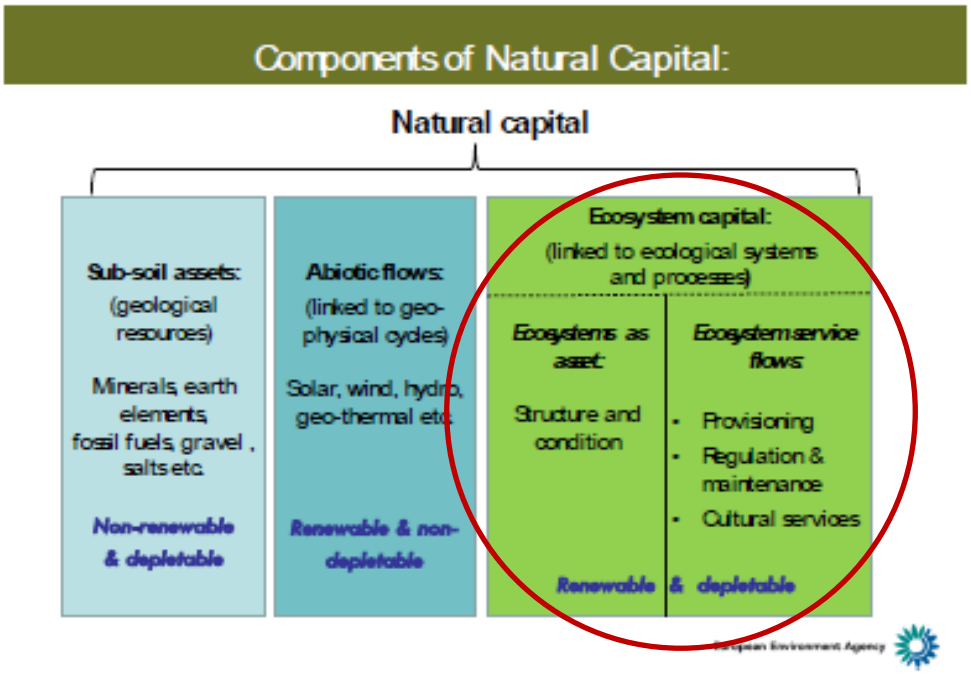
- a synthesis report including: a statement on importance of integrative approaches to *Ecosystems and their services* and corresponding strategic input for research, monitoring, assessments, etc.; an extensive summary of the discussions; and an outline of the main challenges in the area, including those related to research and innovation
- Follow-up actions on implications for research (RTD), assessments (EEA), other policy DGs (ENV, SANCO) and other partners (e.g. JRC,…) and with regular monitoring of progress through future EEA-SC meetings and H2020 Advisory Groups.

Policy landscape - key aspects of European and international policies

EU policy context

The European Union's economic prosperity and well-being is underpinned by its natural capital, i.e. its biodiversity, including ecosystems that provide essential goods and services, from fertile soil and multi-functional forests to productive land and seas, from good quality fresh water and clean air to pollination and climate regulation and protection against natural disasters. To live well in the future, urgent, concerted action should be taken now to improve ecological resilience and maximise the benefits environment policy can deliver for the economy and society, while respecting the planet's ecological limits.

The 7th EAP (Living well within the limits of our planet) reflects the Union's commitment to transforming itself into an inclusive green economy that secures growth and development, safeguards human health and well-being, provides decent jobs, reduces inequalities and invests in, and preserves biodiversity, including the ecosystem services it provides (natural capital), for its intrinsic value and for its essential contribution to human well-being and economic prosperity. Measures to enhance ecological and climate resilience, such as ecosystem restoration and green infrastructure, can have important socio-economic benefits, including for public health.



The Union has therefore agreed, according several key policies and strategies, to:

- halt the loss of biodiversity and the degradation of ecosystem services in the Union by 2020, and restore them in so far as feasible, while stepping up the Union contribution to averting global biodiversity loss.
- achieve good status for all Union waters, including freshwater (rivers and lakes, groundwater), transitional waters (estuaries/deltas) and coastal waters within one nautical mile of the coast by 2015.
- achieve good environmental status in all marine waters of the Union by 2020.
- strive to achieve a land degradation neutral world in the context of sustainable development.

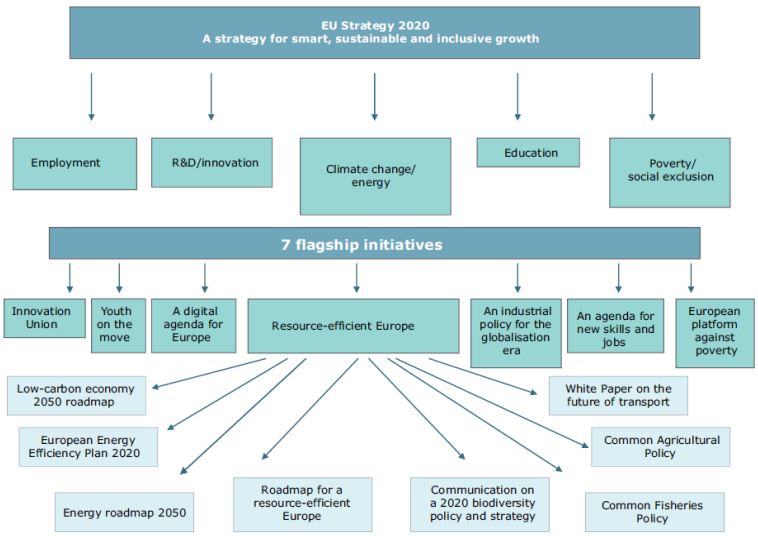
- support the aims of halting global forest cover loss by 2030 at the latest and of reducing gross tropical deforestation by at least 50 % by 2020 compared to 2008 levels.
- ensure that:
    - air pollution and its impacts on ecosystems and biodiversity are further reduced with the long-term aim of not exceeding critical loads and levels;
    - the nutrient cycle (nitrogen and phosphorus) is managed in a more sustainable and resource-efficient way.

The overall Europe 2020 strategy and a Roadmap to a Resource Efficient Europe

Europe 2020 is the European Union's ten-year growth strategy. It is about more than just overcoming the crisis which continues to afflict many of our economies. It is about addressing the shortcomings of our growth model and creating the conditions for a different type of growth that is smarter, more sustainable and more inclusive. To render this more tangible, five key targets have been set for the EU to achieve by the end of the decade.

The 5 targets for the EU in 2020

1. Employment - 75% of the 20-64 year-olds to be employed;
2. R&D - 3% of the EU's GDP to be invested in R&D;
3. Climate change and energy sustainability - greenhouse gas emissions 20% (or even 30%, if the conditions are right) lower than 1990, 20% of energy from renewables, 20% increase in energy efficiency;
4. Education - Reducing the rates of early school leaving below 10% at least 40% of 30-34–year-olds completing third level education;
5. Fighting poverty and social exclusion- at least 20 million fewer people in or at risk of poverty and social exclusion.



The strategy also includes seven 'flagship initiatives' providing a framework through which the EU and national authorities mutually reinforce their efforts in areas supporting the Europe 2020 priorities such as innovation, the digital economy, employment, youth,, industrial policy, poverty, and resource efficiency.

Figure – The EU 2020 strategy: a strategy for smart, sustainable and inclusive growth (based on Rappolder, 2012)

The Roadmap to a Resource Efficient Europe outlines how we can transform Europe's economy into a sustainable one by 2050. It proposes ways to increase resource productivity and decouple economic growth from resource use and its environmental impact. It illustrates how policies interrelate and build on each other.

Areas where policy action can make a real difference are a particular focus, and specific bottlenecks like inconsistencies in policy and market failures are tackled to ensure that policies are all going in the same direction. Cross-cutting themes in the spotlight include addressing prices that do not reflect the real costs of resource use and the need for more long-term innovative thinking.

The Roadmap sets out a vision for the structural and technological change needed up to 2050, with milestones to be reached by 2020. These milestones illustrate what will be needed to put Europe on a path to transforming the economy onto a resource efficient path.

This Roadmap builds upon and complements the other initiatives under the resource-efficient Europe flagship initiative. It should also be seen in the context of worldwide efforts to achieve a transition towards a green economy.

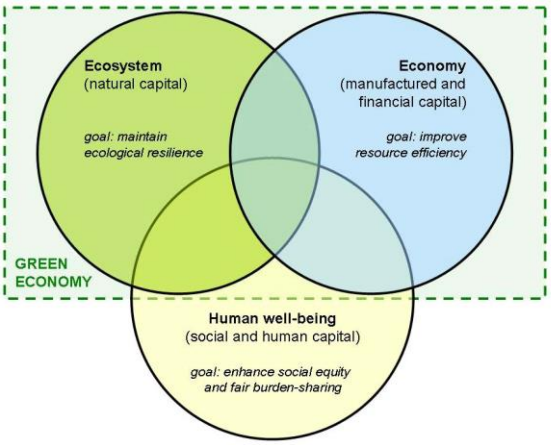


Figure – Improving resource efficiency in a green economy

7th Environmental Action Programme

In November 2013, a General Union Environment Action Programme to 2020 (also referred to as 7th Environmental Action Programme or 7th EAP) was signed by European Parliament and Council.

This 7th EAP is entitled "Living well, within the limits of our planet". It is based on the precautionary principle, the principles of preventive action and of rectification of pollution at source and the polluter-pays principle. Also, it aims at contributing to a high level of environmental protection and to an improved quality of life and well-being for citizens.

It focusses nine priority objectives. The three inter-related thematic priority objectives are:

1) to protect, conserve and enhance the Union's natural capital;
2) to turn the Union into a resource-efficient, green and competitive low-carbon economy;
3) to safeguard the Union's citizens from environment-related pressures and risks to health and well-being.

Achieving these priority thematic objectives requires an enabling framework, structured alongside four priority objectives:

4) to maximise the benefits of Union environment legislation by improving implementation;
5) to improve the knowledge and evidence base for Union environment policy;
6) to secure investment for environment and climate policy and address environmental externalities;

7) to improve environmental integration and policy coherence.

Two additional priority objectives focus on meeting challenges at different scales:

8) to enhance the sustainability of the Union's cities;
9) to increase the Union's effectiveness in addressing international environmental and climate-related challenges.

Research and innovation agenda - Horizon 2020

The European Union's Research and Innovation programme, Horizon 2020, is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Reflecting the policy priorities of the Europe 2020 strategy, Horizon 2020 addresses major concerns shared by European citizens. A challenge-based approach brings together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities. Horizon 2020 puts emphasis on excellent science, industrial leadership and tackling societal challenges. Natural resources and ecosystems functions / services features throughout several of the seven societal challenges:

- *Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bio-economy* - to support the transition towards an optimal, renewable use of biological resources and sustainable primary production and processing systems, capable of producing more food, fibre and other bio-based products with minimised inputs, environmental impact and greenhouse gas emissions, and with enhanced ecosystem services, zero waste and adequate societal value.[…]
- *Health, Demographic Change and Wellbeing* - to invest in better health for all; aims to keep older people active and independent for longer and supports the development of new, safer and more effective interventions. […]
- *Secure, Clean and Efficient Energy* - to support the transition to a reliable, sustainable and competitive energy system, [...] overcoming a number of challenges, such as increasingly scarce resources, growing energy needs and climate change.[…]
- *Smart, Green and Integrated Transport* - to boost the competitiveness of the European transport industries and achieve a European transport system that is resource-efficient, climate-and-environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society.[…]
- *Climate Action, Environment, Resource Efficiency and Raw Materials*: to help increase European competitiveness, raw materials security and improve wellbeing, at the same time assuring environmental integrity, resilience and sustainability with the aim of keeping average global warming below 2° C and enabling ecosystems and society to adapt to climate change and other environmental changes.[…]
- *Europe in a changing world – Inclusive, innovative and reflective societies*: to address challenges in reducing inequality and social exclusion; overcoming the economic and financial crisis and tackling unemployment, at the same time exploiting [...] opportunities provided, for example, by new forms of innovation and by the engagement of citizens, also in a global perspective. […]
- *Secure societies – Protecting freedom and security of Europe and its citizens*: to undertake research and innovation needed to protect citizens, society and economy as well as infrastructures and services, prosperity, political stability and wellbeing. […]

Horizon 2020 – example of related call: Improving the preservation and sustainable exploitation of Atlantic marine ecosystems

The North Atlantic is a key marine region that encompasses ecologically and biologically important and fragile ecosystems (e.g. deep cold-water corals) and provides goods and services essential for our well-being such as regulating climate. Furthermore, a decade long international investment in instrumenting and quantifying the Atlantic meridional overturning circulation provides a robust foundation upon which large process studies can be built to study the biogeochemistry and biodiversity that controls growth at the base of the ocean food web.

…Proposals should fill in knowledge gaps to deepen the understanding of the biogeographic patterns, biodiversity, biogeochemistry and ecosystem services and goods supported by different marine ecosystems at ocean basin and management relevant scales and the capacity to model, understand and predict shifts in the dynamics of North Atlantic ecosystems, thereby supporting preservation and unlocking the potential for the sustainable production of new products and industrial applications. Decision support tools and methodologies should be developed to support adaptive (ecosystem based) management approaches enabling good governance of the North Atlantic marine ecosystem by the bordering countries so as to secure the sustainable exploitation of the living resources whilst ensuring its preservation. […]

The EU Framework Programme for Research and Innovation will be complemented by further measures to complete and further develop the European Research Area. These measures will aim at breaking down barriers to create a genuine single market for knowledge, research and innovation.

Biodiversity and ecosystems policy

The EU adopted in 2011 'Our life insurance, our natural capital: an EU biodiversity strategy to 2020'. This strategy is aimed at reversing biodiversity loss and speeding up the EU's transition towards a resource efficient and green economy. It is an integral part of the Europe 2020 Strategy, and in particular the resource efficient Europe flagship initiative.

In March 2010, EU leaders recognised that the 2010 biodiversity target would not be met despite some major successes, such as establishing Natura 2000, the world's largest network of protected areas. They therefore endorsed the long-term vision and ambitious headline target proposed by the Commission in its Communication 'Options for an EU vision and target for biodiversity beyond 2010'.

2050 vision

By 2050, European Union biodiversity and the ecosystem services it provides — its natural capital — are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.

2020 headline target

Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.

The EU 2020 biodiversity target is underpinned by the recognition that, in addition to its intrinsic value, biodiversity and the services it provides have significant economic value that is seldom captured in markets. Because it escapes pricing and is not reflected in society's accounts, biodiversity often falls victim to competing claims on nature and its use. The Commission-sponsored international project on The Economics of Ecosystems and Biodiversity (TEEB) recommends that the economic value of biodiversity be factored into decision making and reflected in accounting and reporting systems.[2] In Nagoya, this recommendation was incorporated into a global target and forms one of several key actions of the current strategy.

Although action to halt biodiversity loss entails costs[3], biodiversity loss itself is costly for society as a whole, particularly for economic actors in sectors that depend directly on ecosystem services. For example, insect pollination in the EU has an estimated economic value of € 15 billion per year[4]. The continued decline in bees and other pollinators[5] could have serious consequences for Europe's farmers and agri-business sector[6]. The private sector is increasingly aware of these risks. Many businesses in Europe and beyond are assessing their dependency on biodiversity and integrating targets for sustainable natural resource use into their corporate strategies[7].

*The global mandate: t*he tenth Conference of the Parties to the Convention on Biological Diversity (CBD), in 2010, led to the adoption of a global Strategic Plan for biodiversity 2011-20208, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation (ABS Protocol), and a strategy to mobilise resources for global biodiversity.

The EU 2020 biodiversity strategy responds to both mandates, setting the EU on the right track to meet its own biodiversity objectives and its global commitments. Fully valuing nature's potential will as well contribute to a number of the EU's strategic objectives:

- A more resource efficient economy: The EU's ecological footprint is currently double its biological capacity. By conserving and enhancing its natural resource base and using its resources sustainably, the EU can improve the resource efficiency of its economy and reduce its dependence on natural resources from outside Europe.

- A more climate-resilient, low-carbon economy: Ecosystem-based approaches to climate change mitigation and adaptation can offer cost-effective alternatives to technological solutions, while delivering multiple benefits beyond biodiversity conservation.

- A leader in research and innovation: Progress in many applied sciences depends on the long-term availability and diversity of natural assets. Genetic diversity, for example, is a main source of innovation for the medical and cosmetics industries, while the innovation potential of ecosystem restoration and green infrastructure is largely untapped.

- New skills, jobs and business opportunities: Nature-based innovation, and action to restore ecosystems and conserve biodiversity, can create new skills, jobs and business opportunities. TEEB estimates that global business opportunities from investing in biodiversity could be worth US$ 2-6 trillion by 2050.

2 http://www.teebweb.org/

3 As set out in the accompanying Staff Working Paper.

4 Gallai et al, 2009.

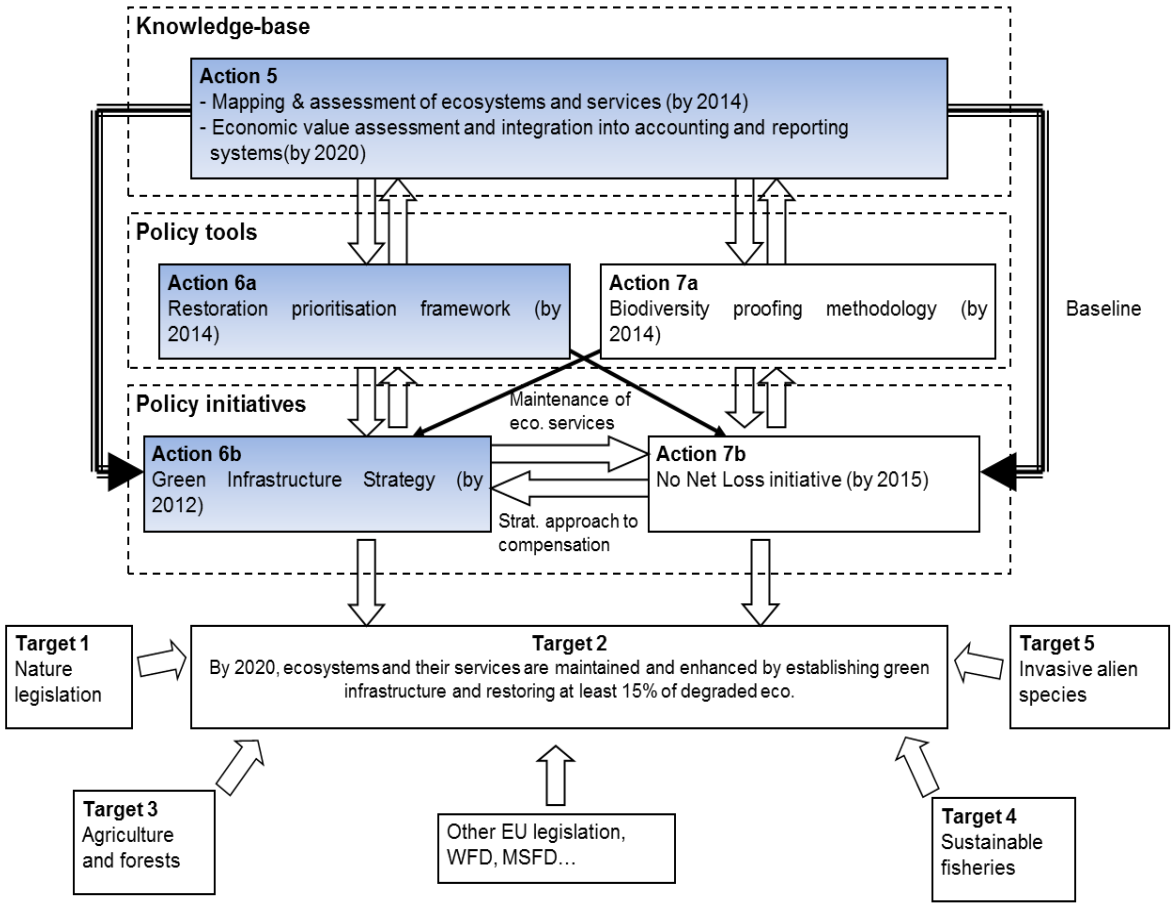
5 Grassland butterfly populations have declined by over 70 % since 1990.

6 Over 80 % of the EU's crops are estimated to depend at least in part on insect pollination ('Bee Mortality and Bee Surveillance in Europe', 2009).

7 'State of Green Business 2011', GreenBiz Group.

8 The global Strategic Plan 2011-2020 includes a 2050 vision, 2020 mission and 20 targets.

The policy framework of EU Biodiversity Strategy and setting of the assessment (shaded boxes)



Selected visions to 2050 in EU policies

*"Europe faces a **moment of transformation**. The crisis has wiped out years of economic and social progress and exposed structural weaknesses in Europe's economy. In the meantime, the world is moving fast and long-term challenges – globalisation, pressure on resources, ageing – intensify. The EU must now take charge of its future."*

*"Europe can succeed if it acts collectively, as a Union. We need a strategy to help us come out stronger from the crisis and turn the EU into **a smart, sustainable and inclusive economy** delivering high levels of employment, productivity and social cohesion. Europe 2020 sets out a vision of Europe's social market economy for the 21st century."*

Source: Europe 2020 Strategy

*"In 2050, **we live well, within the planet's ecological limits**. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a global safe and sustainable society."*

Source: 7th Environmental Action Programme

*"By 2050 the EU's economy has grown in a way that **respects resource constraints** and **planetary boundaries**, thus contributing to global economic transformation. Our economy is competitive, inclusive and provides a high standard of living with much lower environmental impacts. All resources are sustainably managed, from raw materials to energy, water, air, land and soil. Climate change milestones have been reached, while biodiversity and the ecosystem services it underpins have been protected, valued and substantially restored."*

Source: Roadmap to a Resource Efficient Europe

Selected targets and objectives to 2020 in EU policies

Water

- Implemented Water Framework Directive River Basin Management Plans;
- Good status (quality, quantity and use) of waters in all EU river basins in 2015;
- Water abstraction below 20% of available renewable water resources.

Marine and resource efficiency

- 'Good environmental status' be maintained or reached in the marine environment by 2020, according 11 descriptors..
- Each Member State must develop a marine strategy by 2012 that contains a detailed assessment of the state of the environment and define 'good environmental status' at the regional level, as well as establishing clear environmental targets and monitoring programmes.

Biodiversity and land use

- To halt loss of biodiversity in the EU and the degradation of ecosystem services and restored biodiversity, as far as feasible,
- To make the [agricultural] policy fairer, greener, more efficient, more effective and more understandable.
- EU policies take into account their direct and indirect impact on land use in the EU and globally, and the rate of land take is on track with an aim to achieve no net land take by 2050;

Air pollution in transport

- Efficiency in the transport sector will deliver greater value with optimal use of resources like raw materials, energy, and land, and reduced impacts on climate change, air pollution, noise, health, accidents, biodiversity and ecosystem degradation.

- Transport will use less and cleaner energy, better exploit a modern infrastructure and reduce its negative impact on the environment and key natural assets like water, land and ecosystems.

Chemicals

- Chemicals, including pesticides, are produced, handled and used in ways that do not pose significant threats to human health and the environment.

For a further overview of EU environmental policy targets and objectives 2010 to 2050, see EEA Report on 'Towards a green economy in Europe' published in 2013
http://www.eea.europa.eu/publications/towards-a-green-economy-in-europe

International policy context

Environment, health and well-being considerations feature in many international policies, including dedicated health and environment processes, policy frameworks addressing ecosystems and specific environmental issues, as well as sustainable development agenda.

UN Convention on Biological diversity (CBD)

The Convention on Biological Diversity (CBD) was signed at the Earth Summit in Rio de Janeiro, Brazil, in 1992 and entered into force on 29 December 1993. It is the first global agreement to cover all aspects of biological diversity: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources.

The tenth meeting of the Conference of the Parties, held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, adopted a **revised and updated Strategic Plan for Biodiversity**, including the Aichi Biodiversity Targets, for the 2011-2020 period. This plan provides an overarching framework on biodiversity, not only for the biodiversity-related conventions, but for the entire United Nations system and all other partners engaged in biodiversity management and policy development.

Parties agreed to translate this overarching international framework into revised and updated national biodiversity strategies and action plans within two years. Additionally, in decision X/10, the Conference of the Parties decided that the fifth national reports, due by 31 March 2014, should focus on the implementation of the 2011-2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets.

Some examples of the Aichi Biodiversity Targets are:

- At least halve and, where feasible, bring close to zero the rate of loss of natural habitats, including forests
- Establish a conservation target of 17% of terrestrial and inland water areas and 10% of marine and coastal areas
- Restore at least 15% of degraded areas through conservation and restoration activities
- Make special efforts to reduce the pressures faced by coral reefs.

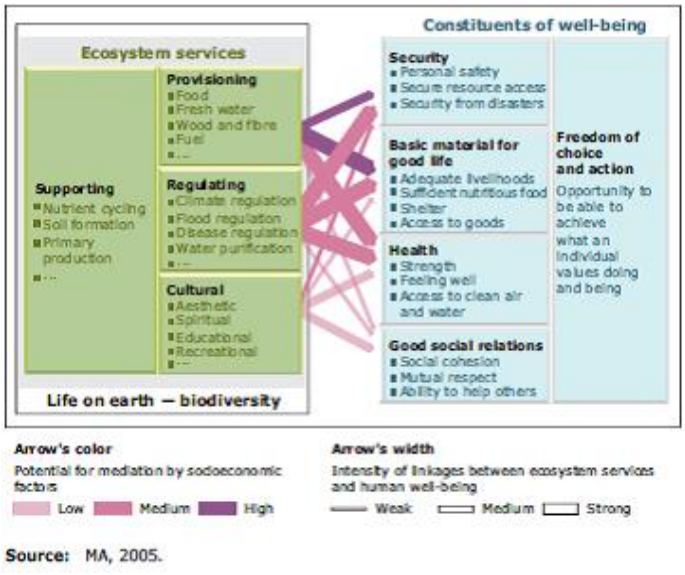
Millennium Ecosystem Assessment and its follow up Sub-Global Assessment

The 2005 Millennium Ecosystem Assessment (MA) provided a state of art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide, such as clean water, food, forest products, flood control, and natural resources, and the options to restore, conserve or enhance the sustainable use of ecosystems.

It has contributed greatly to understanding the consequences of ecosystem change for human well-being. It also focused on establishing the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being.

Unravelling the relations between natural capital and human well-being, MA distinguished between supporting, provisioning, regulating, and cultural services. Each of them contributes in diverse ways to the many aspects of human well-being, helping to provide the basic material for a good life, health, social relations, security, and freedom of choice and action.

The Sub-Global Assessment (SGA) Network seeks to create a common platform for practitioners (individuals and organizations) involved in ecosystem assessment at regional, sub-regional, national and sub-national levels (http://www.ecosystemassessments.net/index.html). The intention is to promote and facilitate improved capacity in undertaking and using assessments. Achievements of the SGA Network will support relevant global processes such as the Intergovernmental Science-policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Multilateral Environmental Agreements.



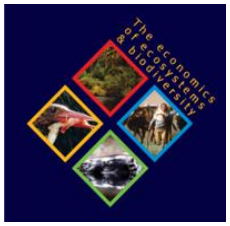
Ecosystem services – the link between natural capital and human well-being

Source: MA, 2005.

Other initiatives

http://ipbes.net/ The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is a new development that will act as an interface between the scientific community and policy makers. It is the result of three recent intergovernmental, multi-stakeholder meetings (Malaysia 2008, Kenya 2009, Republic of Korea 2010), addressing gaps in the science-policy interface and aims to act as a global mechanism for bridging these gaps. Established in April 2012, IPBES will

collect, synthesize and analyse information, building capacity for and promoting the use of science in decision making.



The Economics of Ecosystems and Biodiversity (TEEB) study is a major international initiative to draw attention to the global economic benefits of biodiversity, to highlight the growing costs of biodiversity loss and ecosystem degradation, and to draw together expertise from the fields of science, economics and policy to enable practical actions moving forward.

WAVES

Wealth Accounting and the Valuation of Ecosystem Services

Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is a global partnership that aims to promote sustainable development by ensuring that natural resources are mainstreamed in development planning and national economic accounts.

This global partnership brings together a broad coalition of UN agencies, governments, international institutes, nongovernmental organizations and academics to implement Natural Capital Accounting (NCA) where there are internationally agreed standards, and develop approaches for other ecosystem service accounts.

By working with central banks and ministries of planning and finance across the world to integrate natural resources into development planning through NCA, we hope to enable more informed decision making that can ensure genuine green growth and long-term advances in wealth and human well-being.

MESP
MARINE ECOSYSTEM SERVICES PARTNERSHIP

The Marine Ecosystem Services Partnership (MESP) is a virtual center for information and communication on the human uses of marine ecosystem services around the world. It was proposed in early 2010 to provide up-to-date and easily accessible data for the use of policy makers, environmental managers, researchers, and marine ecosystem stakeholders. It strives to act as a community of practice, through which data users and managers can work collectively to better integrate ecosystem services data with marine policy needs, with the overall mission of helping society to identify and sustainably manage the globe's ocean and coastal ecosystems, for the benefit of people and society, by understanding the value of these ecosystems and the services they produce.

Multilateral Environmental Agreements

In addition to CBD, six other international conventions focus on biodiversity issues: the Convention on Conservation of Migratory Species, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (1975), the International Treaty on Plant Genetic Resources for Food and Agriculture (2004), the Ramsar Convention on Wetlands (1971), the World Heritage Convention (1972) and the International Plant Protection Convention (1952).

Each of the biodiversity-related conventions works to implement actions at the national, regional and international level in order to reach shared goals of conservation and sustainable use. In meeting their objectives, the conventions have developed a number of complementary approaches (site, species, genetic resources and/or ecosystem-based) and operational tools (e.g., programmes of work, trade permits and certificates, multilateral system for access and benefit-sharing, regional agreements, site listings, funds).

The seven biodiversity-related conventions

CBD

Convention on Biological Diversity

The objectives of the CBD are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from commercial and other utilization of genetic resources. The agreement covers all ecosystems, species, and genetic resources.

CITES

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Through its three appendices, the Convention accords varying degrees of protection to more than 30,000 plant and animal species.

Please note that the International University of Andalusia offers a Master's Degree Course on CITES and CBD Implementation

Convention on the Conservation of Migratory Species of Wild Animals
The CMS, or the Bonn Convention aims to conserve terrestrial, marine and avian migratory species throughout their range. Parties to the CMS work together to conserve migratory species and their habitats by providing strict protection for the most endangered migratory species, by concluding regional multilateral agreements for the conservation and management of specific species or categories of species, and by undertaking co-operative research and conservation activities.

The International Treaty on Plant Genetic Resources for Food and Agriculture
The objectives of the Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The Treaty covers all plant genetic resources for food and agriculture, while its Multilateral System of Access and Benefit-sharing covers a specific list of 64 crops and forages. The Treaty also includes provisions on Farmers' Rights.

Convention on Wetlands (popularly known as the Ramsar Convention)
The Ramsar Convention provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The convention covers all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation in general and for the well-being of human communities.

World Heritage Convention (WHC)
The primary mission of the WHC is to identify and conserve the world's cultural and natural heritage, by drawing up a list of sites whose outstanding values should be preserved for all humanity and to ensure their protection through a closer co-operation among nations.

Towards Sustainable Development Goals

'The future we want' outcome document of the UN conference in Rio de Janeiro, Brazil, in 2012 reconfirms global commitment to "*sustainable development and to ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations*". World political leaders "*…recognize that many people, especially the poor,*

depend directly on ecosystems for their livelihoods, their economic, social and physical well-being, and their cultural heritage. For this reason, it is essential to generate decent jobs and incomes that decrease disparities in standards of living to better meet people's needs and promote sustainable livelihoods and practices and the sustainable use of natural resources and ecosystems."

UNDP launched an unprecedented global conversation through which people can help shape the future development agenda that will build on the Millennium Development Goals (MDGs) after 2015. Three out of the eight millennium development targets – on poverty, slums and water – have been met ahead of the 2015 deadline, but much remains to be done. The future development framework – the Post-2015 agenda – should build on the lessons learned from working toward achieving the MDGs, which have been providing the structure for the UN's development activities since the Millennium Summit in 2000.

Assessment landscape – selected major integrated assessments by the EEA and partners

Integrated assessments at the EEA

SOER - state of the environment and outlook reporting

The European Environment Agency (EEA) is mandated to publish a State and Outlook of the Environment Report (SOER) every five years, to evaluate the European environment's state, trends and prospects.

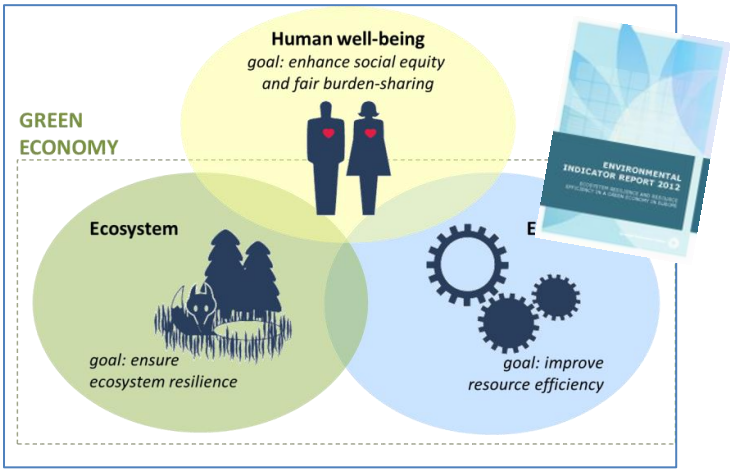
To date, the EEA has produced four SOER reports — in 1995, 1999, 2005 and 2010. They have been consistent in providing a comprehensive environmental assessment, aggregating environmental information in an accessible manner. During this period, however, both our understanding of environmental challenges in Europe and the environmental policy context in the EU have evolved.

The next SOER report is planned for publication during the first quarter of 2015, with the overarching goal of providing policymaking agents and the public with an assessment based on objective, reliable and comparable environmental information. Separate parts of SOER 2015 will address environmental challenges at contrasting scales: global, European and national; a SOER 2015 Synthesis will provide a strategic integrated perspective.

SOER process covers assessments of relevant megatrends connected to the 'global world' and Europe's interactions therein; one addresses the topic of ecosystems (released in December 2013):

Global megatrend update: 8 Growing demands on ecosystems : driven by global population growth and associated demands for food and energy, as well as evolving consumption patterns, the pressure on the Earth's ecosystems is continuously increasing. Continuing depletion of natural capital globally would not only increase pressure on European ecosystems but also produce significant indirect effects, such as environment-induced migration.

Environmental Indicator Report 2012 - summary



The need for a transformation to a green economy has emerged as a key environmental priority both at the European and the global level, given the unprecedented rates of change, interconnected and systemic risks, and increased vulnerabilities of environmental challenges.

The ***green economy*** is one in which environmental, economic and social policies and innovations enable society to use resources efficiently, thereby enhancing human well-being in an inclusive manner, while maintaining the natural systems that sustain us. At its core is the twin challenge of improving resource efficiency whilst ensuring a resilient structure and functioning of ecosystems that can deliver the many ecosystem services we rely on. The report offers an indicator-based assessment that focuses on measuring progress towards meeting this twin challenge.

Part 1 introduces in some detail key concepts used in the report, i.e. ecosystem resilience, resource efficiency and green economy.

Part 2 presents six thematic assessments building on a selection of the EEA environmental indicators. Two types of environmental indicators are highlighted in a green economy context. First, indicators that describe the state of, or impacts on, the environment, and thus help illustrate threats to ecosystem resilience. Second, indicators that depict environmental pressures and indicate progress in improving resource efficiency. In addition, developments in key associated economic sectors are exemplified. […]

Part 3 concludes by reflecting that, by and large, European environmental policies appear to have had a clearer impact on improving resource efficiency than on maintaining ecosystem resilience. This underlines that while improving resource efficiency remains necessary, it may not be sufficient to ensure a sustainable natural environment.

The report argues that in striving towards a green economy there would be value in considering objectives and targets that explicitly recognise the relationships between resource efficiency, ecosystem resilience and human well-being as well as the different time lags for green economy policy actions to succeed. The report also offers some reflections on indicators to support measuring progress towards such objectives and targets.

The full report is available at
www.eea.europa.eu/publications/environmental-indicator-report-2012

Environmental Indicator Report 2013 - summary

SOER 2010 Synthesis emphasised the increasingly systemic nature of environmental challenges and highlighted the need for greening the economy. It argued that further resource efficiency gains have to be realised to ensure resilient ecosystems that can deliver the natural resources and ecosystem services that we depend on.

The ***Environmental indicator report 2013*** measured progress towards the green economy, focusing on two key aspects of the transition: resource efficiency and ecosystem resilience.

Part 1 describes the policy background, the analytical approach and the indicators used. Acknowledging limitations of economic indicators, such as gross domestic product (GDP), as a well-being measure, the report reflects upon several concepts of human well-being, in the ecosystem perspective. It also looks into analytical frameworks for environmental and environment and health assessments, acknowledging their limitations in addressing the complex nature of interactions between humans and the environment, large and partly irreducible uncertainties, knowledge gaps and imperfect understanding. […]

Part 2 consists of four thematic assessments, focusing on food, water, energy and housing. It analyses the trends in demand and the corresponding supply mechanisms using, for example, consumption and production data and trade statistics. The environmental pressures arising from these resource use patterns are then described and interpreted in terms of human exposure and selected health and well‑being impacts. […]

Part 3 provides an integrated reflection on the interlinkages between environmental problems and (policy) challenges in addressing these problems. It commences with an overview of the trends across the resource categories and then reviews the opportunities for responding to these interdependent challenges.

The emerging overall picture is characterised by resource efficiency gains in some areas and generally reducing environmental pressures. But considerable health and well-being challenges exist. European consumption remains very resource-intensive, particularly when seen in a global perspective.

Viewed separately, each of the 'resource use systems' is subject to very different governance mechanisms, and hence different intervention options apply. Water provisioning is subject to market forces in a limited way, with the EU Water Framework Directive providing a comprehensive legislative framework at European level to ensure water security in terms of quantity and quality. In contrast, Europe's systems for producing and consuming energy have been largely shaped by market forces. Indeed, the security of fuel supplies depends to a high degree on the functioning of world markets. However, recognising the widespread environmental and human harm that the global energy system today causes, governments increasingly intervene to correct market incentives via taxation, emissions trading and incentives for renewable energy.

Food provisioning and resource use for housing take intermediate positions on the spectrum of government involvement. In the case of food provision, agricultural production and market mechanisms are strongly affected by policy interventions in the EU such as the Common Agricultural Policy. Negotiations in the World Trade Organization tend towards liberalisation, however, breaking down trade barriers and reducing protectionism. As for housing, access to construction materials and energy carriers is largely subject to free market forces, whereas urban development and construction itself are usually heavily regulated.

The interdependence of the resource-use systems highlighted in the report introduces numerous trade-offs and co-benefits into governance options, necessitating an integrated response. Spatial planning and land management emerge as key approaches for framing governance strategies capable of increasing resource efficiency, maintaining environmental resilience and maximising human well-being.

The full report is available at
www.eea.europa.eu/publications/environmental-indicator-report-2013

Ecosystems related assessments products

Biodiversity Baseline: where do we stand?

From the depths of oceans to the highest summits, from icy waters to baking deserts, life flourishes in every corner of our planet. We are currently witnessing a steady loss of biodiversity, with profound consequences for the natural world and for human well-being. The main causes of this loss are changes in natural habitats. But what exactly has changed, by how much and why? The EU 2010 Biodiversity Baseline –under updating- provides facts and figures on the state and trends of the different biodiversity and ecosystem components. It thereby supports the EU in providing factual data for measuring and monitoring progress in the EU from 2011 to 2020.

Overview: where does Europe stand in 2010 with biodiversity?


Ecosystems


Threats


Ecosystem services in the EU

The 'Our Natural Europe' or 'ONE' stories are being developed by the EEA and its Eionet partners to illustrate in everyday language what biodiversity and ecosystems are is and how we're connected to it. They complement more technical EEA work on biodiversity, strengthening public understanding and engagement with efforts to maintain and enhance biodiversity and ecosytems life-sustaining services.

The ONE stories centre on Eionet experts or the people they serve, presenting a diversity of connections:

- between local and global activities;
- between Eionet experts, the work they do and the people they serve;
- between different aspects of genetic, species and ecosystem diversity;
- between the characters, biodiversity and the wider world through cultural or social activities, arts and literature.

They highlight the varied ecosystems and biodiversity of Europe and the threats and pressures they face, including habitat fragmentation and destruction, invasive alien species, pollution, over-harvesting and climate change.

The ONE series commences with stories from Finland and Switzerland – on selected forest and agricultural ecosystems respectively. Additional stories from France, for instance, cover grasslands in mountain areas.

Examples of reports recently released

Developing a forest naturalness indicator for Europe

Concept and methodology for a high nature value (HNV) forest indicator: European forests are a complex mosaic of conditions, constantly influenced by internal dynamics and external pressures determined by natural and anthropogenic factors. This report documents the first steps for the development of a forest naturalness indicator for Europe. An enhanced European HNV forest indicator and its corresponding map will enable us to gain better insight into the current status and extent of forest naturalness, and will allow for further analyses on spatial and time trends.

Effects of air pollution on European ecosystems

Past and future exposure of European freshwater and terrestrial habitats to acidifying and eutrophying air pollutants.

Terrestrial habitat mapping in Europe: an overview

This is a joint MNHN-EEA report. Identification, description, classification and mapping of natural and semi-natural habitats are gaining recognition in the sphere of environmental policy implementation. Although plant science remains at the core of the approach, habitat mapping increasingly finds applications in land planning and management and is often a necessary step in preparing nature and biodiversity conservation plans.

Balancing the future of Europe's coasts — knowledge base for integrated management

The objective of this report is to frame an analytical approach for coastal areas and ecosystems in Europe, and to place this in the context of the new socio-economic drivers of sustainable growth, and the formation of a new integrated policy framework. This framework builds on an ecosystem-based management approach and integrated spatial planning and management. The report presents some key sustainability challenges for European coastal areas and waters, and highlights the need for a consolidated knowledge base and widespread information-sharing to support informed policy development and management actions.

The European Grassland Butterfly Indicator: 1990…-2011

This report presents the European Grassland Butterfly Indicator, based on national Butterfly Monitoring Schemes (BMS) in 19 countries across Europe, most of them in the European Union.

The impacts of invasive alien species in Europe

Biological invasions are one of the main drivers of biodiversity loss. Invasive alien species (IAS) may have far-reaching and harmful effects on the environment and natural resources for generations. The purpose of this report is to raise awareness among key stakeholders, decision-makers, policymakers and the general public about the environmental and socioeconomic impacts of IAS. Twenty-eight dedicated species accounts are provided to highlight the various types of impacts.

These species accounts are based on thorough, up-to-date scientific information from recent research and studies, and highlight the multifaceted impacts of IAS at both the global and regional levels.

Protected areas have increased to cover one fifth of Europe's land

More than 21 % of the land has some kind of protected status in the 39 countries which work with the European Environment Agency (EEA). However, only 4 % of the sea controlled by countries of the European Union is included within the Natura 2000 network of protected areas.

Water management in Europe faces rising challenges as ecosystems weaken

Water pollution and excessive water use are still harming ecosystems, which are indispensable to Europe's food, energy, and water supplies. To maintain water ecosystems, farming, planning, energy and transport sectors need to actively engage in managing water within sustainable limits.

Europe's seas: A valuable asset that must be used sustainably

Many of Europe's marine species, habitats and ecosystems have been threatened for decades. As maritime economic activities are predicted to increase in coming years, a new briefing from the European Environment Agency (EEA) argues that the cumulative impact of human activity should be better managed to avoid irreversible damage to ecosystems.

Late lessons from early warnings: science, precaution and innovation – selected key messages

'Late lessons from early warnings; science, precaution and innovation' 2013 makes a strong argument for precautionary science in political decision-making, allowing us to strike a better balance between using economic opportunities and avoiding disproportionate risks to the environment and human health and well-being. The 2013 report, alongside its 2001 predecessor addresses 34 cases of chemical and technological innovations and whether harm could have been avoided if early warnings from science had been heeded. The reports offer many insights but there are several more systemic conclusions relevant to the focus of the seminar. For example:

- Most cases studies illustrate that if the precautionary principle had been applied on the basis of early warnings from science of risks/harm, many lives would have been saved, damage to ecosystems avoided, costs of inaction to society substantially lowered and businesses steered towards less harmful innovations.
- The nature and extent of harm expands over time for humans and ecosystems e.g. asbestos: 1929 asbestosis; 1954 lung cancer; 1959 mesothelioma; 2012 throat & other cancers; PCBs: 1960s bird reproduction; 2000s neurological harm in children, soil contamination.
- There is a need for more cross-disciplinary systemic approaches that balance precision and relevance, embrace multi-causality, longer timescales and multiple end points.
- Risk assessments should also be transformed to make them broader-based, more inclusive, transparent and accountable. Embrace diverse scientific views especially on emerging issues where uncertainties and ignorance are high and genuine differences are likely, desirable and defensible.
- A better balance could be struck between research investments in new technologies and those made in environment and health science. In the period 1994-2013 EU public research invested 94 billion euros in technological innovations compared with 625 million euros in science.
- Internalising externalities can support reducing risks and harm to people and ecosystems' health and well-being. The external costs of harm are often paid by taxpayers not the source of harm and the markets for safer innovations/substitutes often hindered by cheapness of harmful agents.
- These effects can be internalised via taxes and permits on harmful agents introduced at the outset of probable harm and that rise in line with expanding knowledge of harm, with the revenues used to fund innovations in better alternatives. Up front liability bonds taken out by large scale technology producers could also offset future taxpayer liabilities.

The 2013 report concludes overall that unprecedented global changes bring many benefits as well as exposure to more shocks and surprises. Technological innovations proceed apace often on trajectories that exacerbate risks and threats. Governance systems need to adapt in recognition of the value conflicts underpinning many environmental challenges and risks, and create institutional space for governments, citizens and businesses to have more systematic and non-judgmental analysis of such conflicts and their resolution.

Looking forward, the report also identifies three overall opportunities with regard to the knowledge base:

- To correct prioritisation of economic and financial capital over social, human and natural capitals through broader application of policy principles of precaution, prevention and polluter-pays, and improved accounting systems across government and business;
- To broaden the nature of evidence and public engagement in choices about crucial innovation pathways by balancing scientific efforts more towards dealing with complex, systemic challenges and unknowns and complementing this knowledge with lay, local and traditional knowledge;
- To build greater adaptability and resilience in governance systems to deal with multiple systemic threats and surprises, through strengthening institutional structures and deploying information technologies in support of the concept of responsible information and dialogues.

Summary of Chapter 17 of the report *Ecosystems and managing the dynamics of change* (by J. McGlade and S. van den Hove)

A decade after Rachel Carson's Silent Spring was published, describing the toxic legacy of the twentieth century, Annie Dillard in her Pulitzer prize winning book Pilgrim at Tinker Creek, opened up a different way of looking at the world. It presaged a twenty first century in which the global economy would be based on a more thorough understanding of nature, its functioning and material wealth. Wholly descriptive, yet increasingly relevant, her book captured the very essence of what this chapter is about: that amongst the observations which routinely help to predict the evolution of the natural world are the seeds of surprise — surprise of the unusual and surprise as a portent of future change. Our systemic failure to anticipate such surprises forms the core of this chapter. A series of case studies from fisheries, forests, savannah and aquatic systems are used to underline how early warnings about changes in these natural systems emerged but were not used.

The chapter highlights how the division of knowledge into political, disciplinary and geographic silos has led to the 'recurring nightmares' of short-term interests outcompeting long-term vision; situations where competition replaces co-operation; fragmentation of values and interest; fragmentation of authority and responsibility; and fragmentation of information and knowledge leading to inadequate solutions or even additional problems. In addition, the lack of institutional fit has often confounded the effectiveness of the stewardship of ecosystem services, and led to unexpected surprises, excessive rent seeking and high transaction costs.

Using counterfactual thinking (i.e. the dependence of whether, when and how one event occurs on whether, when and how another event occurs and the possible alteration of events), built around the four interconnected concepts of planetary boundaries, tipping points, panarchy and resilience, the chapter provides an analytical lens through which to explore why many of the warning signals were not seen. The chapter concludes by suggesting why ecosystems are likely to be even more at risk in the future and why we will need to observe and interpret the dynamics of both nature and institutions ever more closely if we are to avoid sudden irreversible ecological changes.

The full report is available at
http://www.eea.europa.eu/publications/late-lessons-2

Science and technical landscape - selected activites in the ecosytems and their services area

Action 5 of the EU Biodiversity Strategy to 2020 calls Member States to map and assess the state of ecosystems and their services in their national territory with the assistance of the European Commission. The results of this mapping and assessment should support the maintenance and restoration of ecosystems and their services. A Working Group on Mapping and Assessment on Ecosystems and their Services (MAES) was set up under the Common Implementation Framework (CIF), the governance structure to underpin the effective delivery of the EU Biodiversity Strategy to 2020.

In line with the Millennium Ecosystem assessment, the objective of the EU assessment is to provide a critical evaluation of the best available information for guiding decisions on complex public issues. It is therefore framed by a broad set of key policy questions. It is structured around a conceptual framework that links human societies and their well-being with the environment, together with a typology of ecosystems to be assessed and mapped and the use of the Common International Classification of Ecosystem Services (CICES) developed for environmental accounting purposes.

The envisaged technical tasks to be completed and potential sources of information, methods and tools to be used are:

I. Biophysical baseline mapping and assessment of the status of major ecosystems;
II. Biophysical baseline mapping and assessment of defined ecosystem services;
III. Alignment of ecosystem service assessments with scenarios of future changes (future outlooks), developed together with policy makers and stakeholders to ensure their salience and legitimacy and consequently the use of the results in decision making;
IV. Valuation of ecosystem services for baseline and contrasting scenarios and integration into environmental and economic accounting.

Ultimately, the assessment of ecosystems and their services in Europe needs to address a broad range of policy questions. In addition, Member States and sectorial policies will have much more specific questions as well. This list of questions will therefore be revisited and evolve over time and priorities may shift also depending on the approaches chosen and the questions prioritized by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

Broad policy questions to be addressed

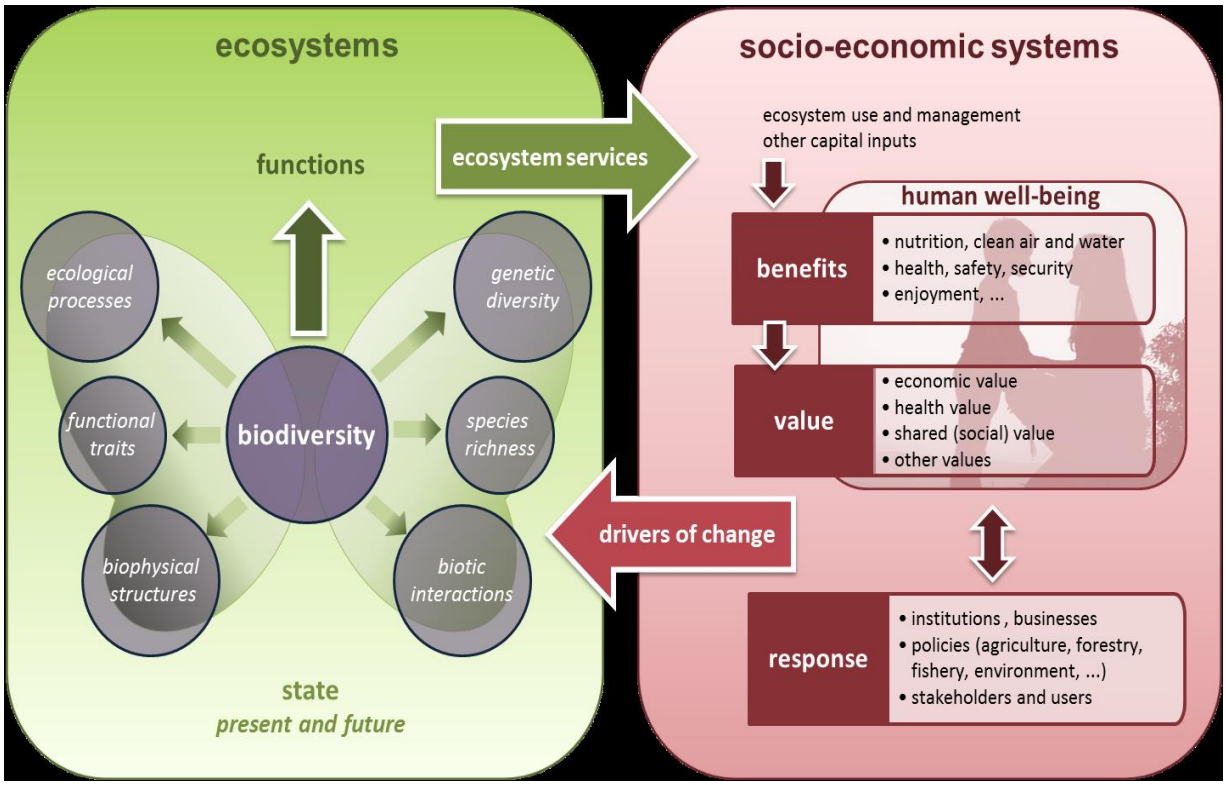
Q1	What are the current state and trends of the EU's ecosystems and the services they provide to society? What are emerging trends and projected future state of the EU's ecosystems and the services they provide to society? How is this currently affecting human well-being and what are the projected, future effects to society?
Q2	What are the key drivers causing changes in the EU's ecosystems and their services?
Q3	How does the EU depend on ecosystem services that are provided outside the EU?
Q4	How can we secure and improve the continued and sustainable delivery of ecosystem services?
Q5	How do ecosystem services affect human well-being, who and where are the beneficiaries, and how does this affect how they are valued and managed?
Q6	What is the current public understanding of ecosystem services and the benefits they provide (some key questions could usefully be included in the 2013 Eurobarometer on Biodiversity)?

Q7	How should we incorporate the economic and non-economic values of ecosystem services into decision making and what are the benefits of doing so (question to be addressed 2020)? And what kind of information (e.g. what kind of values) is relevant to influence decision-making?
Q8	How might ecosystems and their services change in the EU under plausible future scenarios - What would be needed in terms of review/revision of financing instruments?
Q9	What are the economic, social (e.g. employment) and environmental implications of different plausible futures? What policies are needed to achieve desirable future states?
Q10	How have we advanced our understanding of the links between ecosystems, ecosystem functions and ecosystem services? More broadly, what is the influence of ecosystem services on long-term human well-being and what are the knowledge constraints on more informed decision making?

Analytical framework for ecosystems assessments

In 2013 the European Commission published, in a joint effort with EEA, a discussion paper called 'Analytical framework for ecosystem assessments under Action 5 of the EU Biodiversity strategy to 2020' and in 2014 a second report that summarised the six pilots designed for enabling cooperation with the countries, and taking stock of 2013 developments.

Conceptual framework for EU wide ecosystems assessments



The approach established through these reports and a number of MAES working group meetings with Members states was confirmed at a high level conference on MAES (22 May 2014).

Three international classification systems are available to classify ecosystem services: MA, TEEB and CICES. In essence, they relate to a large extent to each other; all three include provisioning,

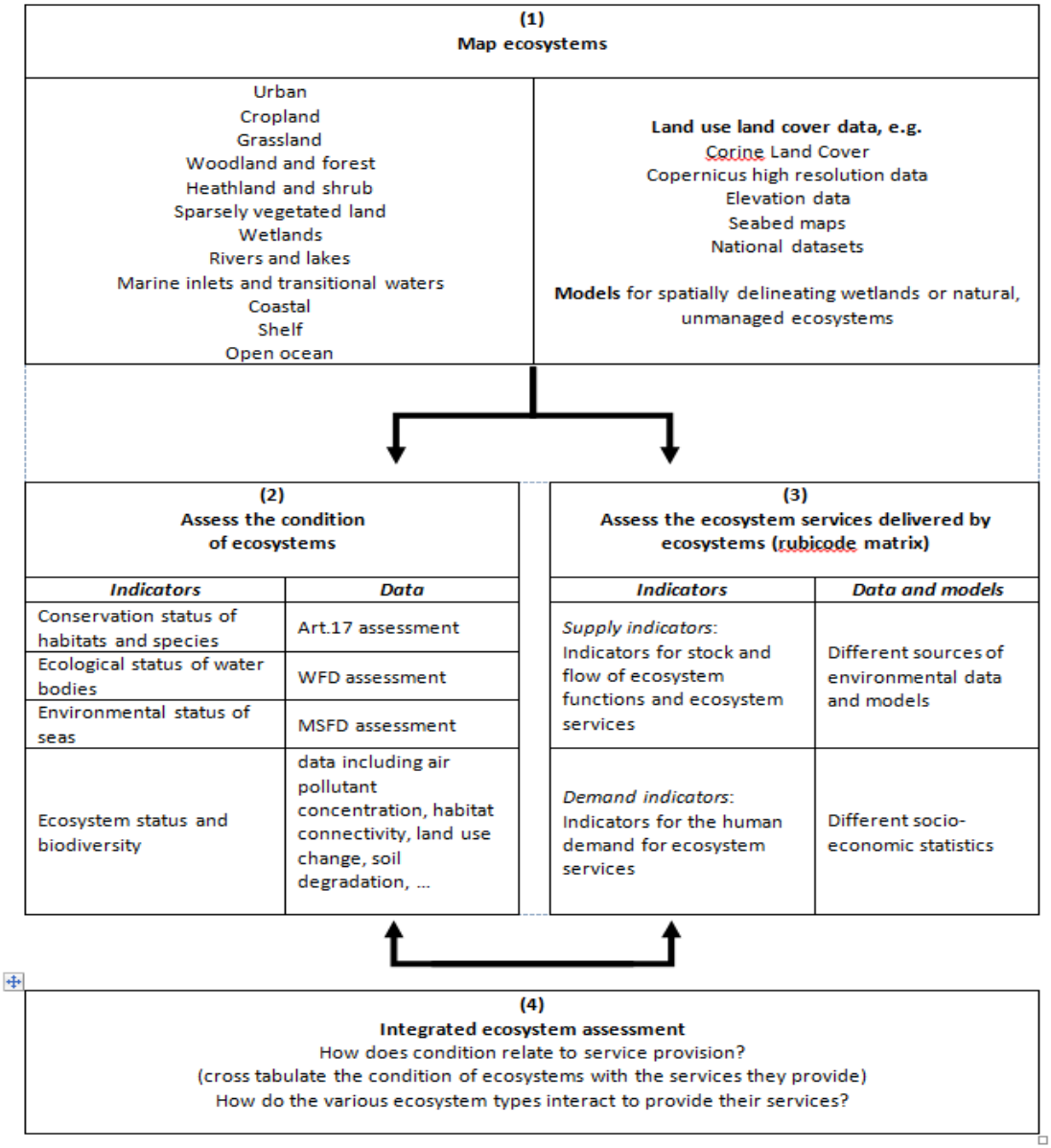
regulating and cultural services. The correspondence between these classifications is illustrated in the table below. Each classification has its own advantages and disadvantages due to the specific context within which they were developed.

MA categories	TEEB categories		CICES v4.3 group[†]
Food (fodder)	Food	**Provisioning services**	Biomass [Nutrition]
			Biomass (Materials from plants, algae and animals for agricultural use)
Fresh water	Water		Water (for drinking purposes) [Nutrition]
			Water (for non-drinking purposes) [Materials]
Fibre, timber	Raw Materials		Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
Genetic resources	Genetic resources		Biomass (genetic materials from all biota)
Biochemicals	Medicinal resources		Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
Ornamental resources	Ornamental resources		Biomass (fibres and other materials from plants, algae and animals for direct use and processing)
			Biomass based energy sources
			Mechanical energy (animal based)
Air quality regulation	Air quality regulation	**Regulating services (TEEB)** **Regulating and supporting services (MA)** **Regulating and maintenance services (CICES)**	[Mediation of] gaseous/air flows
Water purification and water treatment	Waste treatment (water purification)		Mediation [of waste, toxics and other nuisances] by biota
			Mediation [of waste, toxics and other nuisances] by ecosystems
Water regulation	Regulation of water flows		[Mediation of] liquid flows
	Moderation of extreme events		
Erosion regulation	Erosion prevention		[Mediation of] mass flows
Climate regulation	Climate regulation		Atmospheric composition and climate regulation
Soil formation (supporting service)	Maintenance of soil fertility		Soil formation and composition
Pollination	Pollination		Lifecycle maintenance, habitat and gene pool protection
Pest regulation	Biological control		Pest and disease control
Disease regulation			
Primary production Nutrient cycling (supporting services)	Maintenance of life cycles of migratory species (incl. nursery service)		Lifecycle maintenance, habitat and gene pool protection
			Soil formation and composition
			[Maintenance of] water conditions
	Maintenance of genetic diversity (especially in gene pool protection)		Lifecycle maintenance, habitat and gene pool protection
Spiritual and religious values	Spiritual experience	**Cultural services**	Spiritual and/or emblematic
Aesthetic values	Aesthetic information		Intellectual and representational interactions
Cultural diversity	Inspiration for culture, art and design		Intellectual and representational interactions
			Spiritual and/or emblematic
Recreation and ecotourism	Recreation and tourism		Physical and experiential interactions
Knowledge systems and educational values	Information for cognitive development		Intellectual and representational interactions
			Other cultural outputs (existence, bequest)
MA provides a classification that is globally recognised and used in sub global assessments.	*TEEB provides an updated classification, based on the MA, which is used in on-going national TEEB studies across Europe.*		*CICES provides a hierarchical system, building on the MA and TEEB classifications but tailored to accounting.*

[†] Explanatory information from CICES division level [between squared brackets] and from CICES class level (between parentheses).

An ecosystem assessment as required for the implementation of the Biodiversity Strategy to 2020 needs to provide both an analysis of the natural environment by looking at the state of biodiversity

and ecosystems (ecosystem assessment in sensu stricto) and by evaluating the level of ecosystem services provided to people (ecosystem service assessment). It needs to consider both the ecosystems from which the services are derived and also the people who depend on and are affected by changes in the supply of services, thereby connecting environmental and development sectors. Ecosystem assessments, such as the MA and several sub-global assessments that followed the MA, are carried out at multiple temporal, spatial and policy scales.



In the short-term, the essential challenge of Action 5 is to make the best use of and to collate the current information and scientific knowledge available on ecosystems and their services in Europe. Importantly, the knowledge base must be accessible to Member States for mapping and assessment in their territory. The work to be undertaken under Action 5 will strongly build on the outcomes of the MA and TEEB studies. It will also capitalise on the experience and newly developed knowledge from on-going assessments. We mention as examples the recently finished national ecosystem assessments of the UK, Portugal and Spain. At EU level, a European ecosystem assessment will

benefit from the integrated outcomes of the reporting obligations of the Member States under EU environmental legislation such as Habitats and Bird Directive, Water Framework Directive, Marine Strategy Framework Directive, Air Quality Directive, etc. on the status of biotic components of ecosystems (i.e. ecological status of water bodies, conservation status of protected species and habitat types and environmental status of the marine environment) and abiotic environmental conditions such as air quality including greenhouse gas emissions, surface water, groundwater and marine water quantity and physicochemical quality.

	Terrestrial (e.g. agro-ecosystems, forests, semi-natural lands)	Freshwater (aquatic ecosystems e.g. rivers and lakes)	Marine ecosystems (transitional, coastal and EEZs waters)	Atmosphere
Ecosystem mapping (spatial modelling)				
Land cover as base layer				
EUNIS nomeclature				
Enhancements (data)				
Ecosystem condition (assessment)				
Reporting data: status & state				
Linking to CICES				
Linking habitats & species to ecosystems				
Impacts: gains/losses of ecosystem functions				
Pressures on ecosystems (proxy for degradation)				
Pollution				
(Over)harvesting				
Disturbing / structural				

The MAES conceptual model builds on the premise that the delivery of certain ecosystem services upon which we rely for our socio-economic development and long-term human well-being is strongly dependent on both the spatial accessibility of ecosystems as well as on ecosystem condition. This working hypothesis has been translated into a working structure that has been adopted to guide the work of the ecosystem pilot cases (see below). In order to provide operational recommendations to both EU and its Member States, the proposed work structure for the 4 ecosystem pilots is based on a 4 step approach: (i) Mapping of the concerned ecosystem; (ii) Assessment of the condition of the ecosystem; (iii) Quantification of the services provided by the ecosystem; and (iv) Compilation of these into an integrated ecosystem assessment.

Pilot on habitat and species conservation status data for ecosystem assessment. How can reported assessments on conservation status (under Habitats Directive) be used effectively to assess the state of ecosystems and services.

Ecosystem pilots

Agro-ecosystems	Forests	Freshwater ecosystems	Marine ecosystems

What indicators and data are available to map ecosystems and assess their biodiversity, condition and their services?

Agricultural land covers almost half of the EU territory. Besides providing food, agro-ecosystems deliver biotic materials for industrial processes and as a source for energy and provide important regulating and maintenance services such as pollination and pest control. Furthermore some agricultural landscapes are a valuable source of cultural ecosystem services

European forest ecosystems face multiple threats. Currently competing socio-economic demands for forest services can result in multiple drivers of forest change, and may lead to degradation of the forest ecosystem. Yet forests are key providers of almost all ecosystem services provided that they are managed in a sustainable way.

Lakes, rivers, wetlands and groundwater deliver clean water for multiple purposes and are thus vital to human well-being. Lakes are primary locations for summer recreation. Wetlands are crucial in maintaining habitats for many species while regulating water flows and filtering water. An essential question is understanding how achieving good ecological status result in the supply of multiple services.

Oceans, seas and especially coastal zones are estimated to contribute more than 60% of the total economic value of the biosphere. Yet, our knowledge of marine ecosystems and the services they provide is not at the same level as their terrestrial counterparts. In particular, the mapping is lagging behind. Hence, this pilot is among the first to address indicators to map and assess marine ecosystem services

The **pilot on natural capital accounting** aims at exploring the potential for valuation and natural capital accounting at EU and national level. This builds on the biophysical mapping and assessment of the state of ecosystems and of their services in the context of the EU 2020 Biodiversity Strategy using latest developments on ecosystem accounts at global and EU level and concrete examples in Member States.

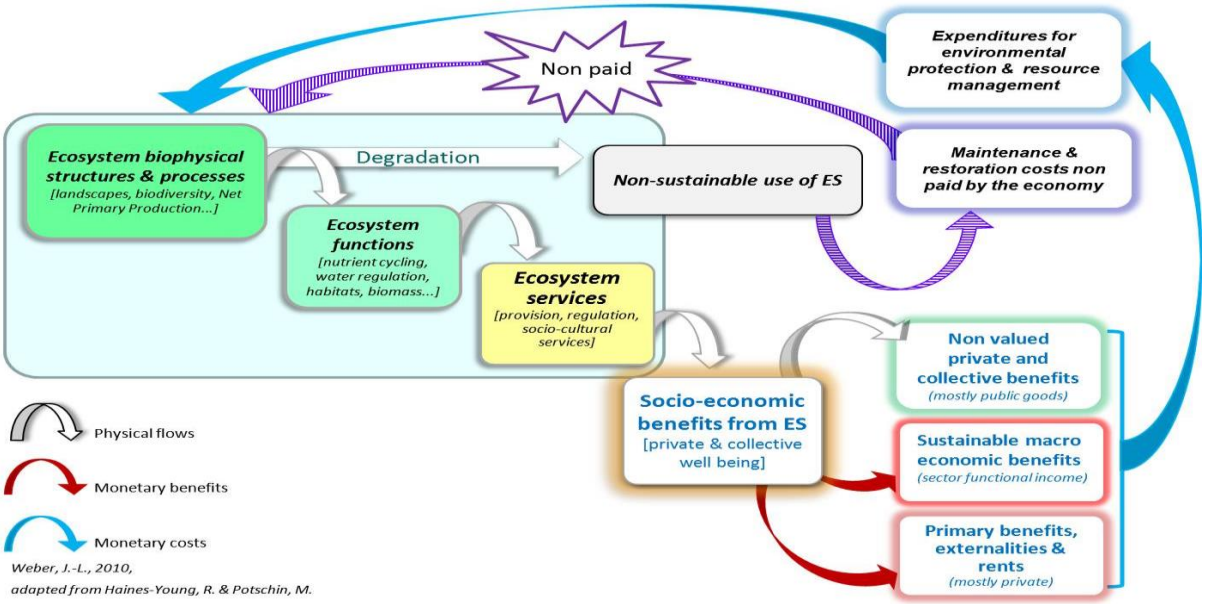
A glimpse at Ecosystems Natural Capital Accounting

In the context of the EU 2020 Biodiversity Strategy the pilot study on Natural Capital Accounting focuses on the ecosystem component of natural capital rather than on geo-physical assets. This provides a direct link to the mapping and assessment of the state of ecosystems and their services. Data compiled under this process will be an important input to the further development of ecosystem (capital) accounts; on the other hand accounting approaches can provide a very useful framework for structuring ecosystem-related data and integrated analysis. Accounting systems only function if they build on clearly categorised, well-structured and comprehensive input data sets. The interest in ecosystem accounting has therefore driven the development of CICES, the 'Common International Classification of Ecosystem Services' (see www.cices.eu), which is the approach recommended under MAES for classifying ecosystem services. Other aspects of data that are important for their analytical value are sufficiently detailed spatial referencing and comparability across space and time. Ensuring these two dimensions is a challenging task for ecosystem-related data sets. The reference document on natural capital accounting (currently under consultation) provides information on key methodological considerations in this regard, building *inter alia* on experience in developing simplified ecosystem capital accounts at EEA.

If set up correctly, ecosystem capital accounting also provides a useful unifying frame for tackling integrated analytical questions. For example, water accounts, carbon accounts and land accounts, and the underlying data, provide relevant information for key pressures on ecosystems and biodiversity, such as fragmentation and degradation. Similarly, the interface between water and land accounts, as well as the use of indicators on accessible water, can help identify areas or ecosystems at risk of water stress. Linked with other accounts or data sets such a system can help to analyse which are the most important pressures (linked to sectoral drivers) that influence state and trends in ecosystem condition.

The United Nations Statistical Commission (UNSC) endorsed the System of Environmental-Economic Accounting – Central Framework (SEEA-CF) and the System of Environmental-Economic Accounting - Experimental Ecosystem Accounts (SEEA-EEA) in February 2013. Although insufficient experience exists to date in the field of ecosystem accounting to adopt international statistical standards at the level of the System of National Accounts 2008 (2008 SNA) or the SEEA Central Framework (SEEA CF2012), the SEEA-EEA presents a conceptual framework that can guide countries with a desire to progress in this domain.

Ecosystem accounting experiments are currently being undertaken in Europe (projects carried out by the European Environment Agency and the Joint Research Centre of the European Commission in 28 countries), Australia, and Canada, and are being tested in various projects in several other places.



Related concepts

Ecological perspective on public health

As argued convincingly in the Millennium Ecosystem Assessment, human health and well-being ultimately depend on well-functioning ecosystems and the way we use natural resources. The ecosystem perspective on human health has further been advanced in the concept of Ecological Public Health (EHP). The core notion of the EHP is that public health thinking needs modernisation around ecological principles, recognising that human (social) ecology is inextricably linked to natural ecology and in direct dynamic interaction with it. The EHP perspective integrates four dimensions of human existence, namely: material, biological, social, and cultural aspects of life.

Population health and wellbeing are based on shifting foundations created by transitions at a societal level. These transitions do not only exert influence independently but continually interact. A critical contemporary transition is an ecological transition, meaning that state of the environment and how it will change in the future is directly connected to our health and wellbeing and we cannot deliver health and wellbeing in the future without close attention to the environment. Transitions shape both health effects and the possibilities of public health interventions. In addition to well recognised transitions in public health, that is demographic and epidemiological, several others are proposed in the concept of ecological public health, namely: urban, energy, economic, nutrition, biological, cultural, and democracy. Recognition of those large scale transitions refocuses public health actions onto the conditions on which human and eco-systems health interact.

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Ecological limits and safe operating space[9]

Globally, pressures on natural resources, ecosystems and the total environment are increasing rapidly (also so-called the "great acceleration"), and there are indications that critical boundaries of resource use, emissions and loads of pollutants as well as environmental degradation are approached or even transgressed at various scales. These boundaries are difficult to define precisely, and the consequences of leaving the 'safe operating space' are largely unknown.

Nevertheless, it has been argued that enough is known by now about the Earth system functioning and the bio-physical processes which determine its self-regulating capacity to justify the delineation of a 'safe operating space' and associated bio-physical boundaries at planetary scale. Such bio-physical boundaries are mostly expressed as acceptable deviations from the natural state.

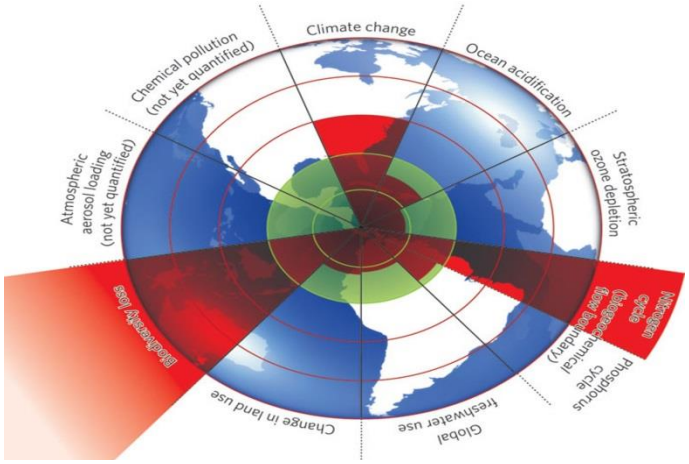

Figure – Illustration of global performance against nine planetary boundaries with the "safe operating space" in green

Research on ***planetary boundaries*** by Rockström et al. (2009) identified nine challenges, seven of which were quantified with respective control variables (e.g., atmospheric CO2 concentration for climate change) and specific boundary values (e.g., 350 ppm CO2). Boundaries were determined at what was considered to be a "safe distance" from the estimated thresholds or dangerous levels, using the best available science and precautionary principles.

Similar and related concepts

- *Carrying Capacity* refers to resource limitations to population growth, and suggests maximum sustainable population levels under given resource limitations (e.g. Daily and Ehrlich, 1992).
- *Limits to Growth* also refer to resource limitations, but go further by recognizing systemic links and dynamics (e.g. Meadows et al. 1972).
- *Critical Loads* are quantitative estimates of an exposure level to one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur (e.g. used by UNECE).
- *Safe Minimum Standards* specify a level below which a specified ecosystem service should not fall, in order to minimize possible social losses connected with irreversibilities (e.g. Ciriacy-Wantrup 1952).
- *Syndromes* are functional patterns of human-nature interaction which describe critical dynamics within the Earth system not specifying boundaries or a desirable state of the Earth system (e.g. used by WBGU).

[9] Based on a draft background paper prepared by Stockholm Environment Institute on "Environmental tipping points, planetary boundaries, and a safe operating space" (by Holger Hoff and Björn Nykvist).

An understanding of ecological limits, such as the planetary boundaries and related concepts can provide a meaningful starting point for discussing ecological limits also at smaller than global scale.

However, when discussing how such ecological limits can be reflected in European or national environmental objectives and targets, it is important to consider also the respective geographical and temporal scales and context at which related dynamics unfold.

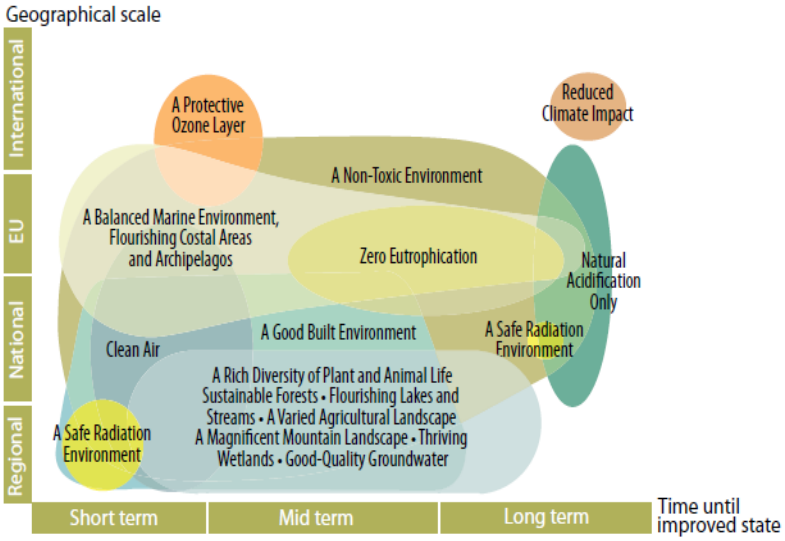

Figure - Relevant geographical and temporal scales for achieving selected environmental objectives (Nykvist et al., 2013)

Furthermore, reflecting on ecological limits at a European scale and their potential role to guide policy target setting at EU or national level, one might distinguish two main dimensions:

- Europe's ***direct*** or ***'territorial'*** pressures on ecological limits - i.e. pressures exerted on ecosystems within the European territory through internal resource use, emissions and environmental degradation within Europe;
- Europe's ***indirect*** or ***'consumptive'*** pressures on ecological limits - i.e. contributions to pressures exerted on ecosystems in other parts of the world through trade or foreign direct investment, and the resulting external resource use, emissions and environmental degradation.

This distinction is particularly relevant where European or national per-capita environmental footprints are significantly larger than global averages and the resulting consumptive pressures are much larger than its territorial pressures alone.

In addition, it is worth noting that there are also feedbacks from approaching or transgressing ecological limits globally on Europe's territorial ecological limits.

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Societal transitions (towards sustainability)[10]

Science has developed a reasonably good understanding of the nature of the environmental challenges societies face across the globe – and of the human actions that cause or greatly contribute to these problems. Yet, in spite of better knowledge – and in some instances, in spite of significant policy efforts – the transition toward more sustainable practices has been far slower than the accumulating evidence indicates is required to avert severe trouble. While many of the environmental problems identified in the 1970s (such as point source pollution of air and water) have been addressed with good results, global challenges with more diffuse causes such as climate change, depletion of fish stocks, biodiversity loss, or overuse of land area have continued to worsen, even if more slowly in some instances.

This is in some ways unsurprising, as effectively addressing these challenges will require quite massive societal changes. We know that absent severe crisis, transformational changes typically develop over time scales measured in decades or longer. Moreover, comparatively few fundamental societal changes have been explicitly guided by collective, socially deliberated, long-term goals like sustainability. Many factors may reinforce long-term patterns of path dependency. While developing consensus on broad problem definitions and goals for their remedy is often possible, the actual implementation of remedies needed to achieve those goals often causes disturbances, disrupting relationships, running at odds with accepted ideas of how things work, and threatening to shuffle the list of economic winners and losers.

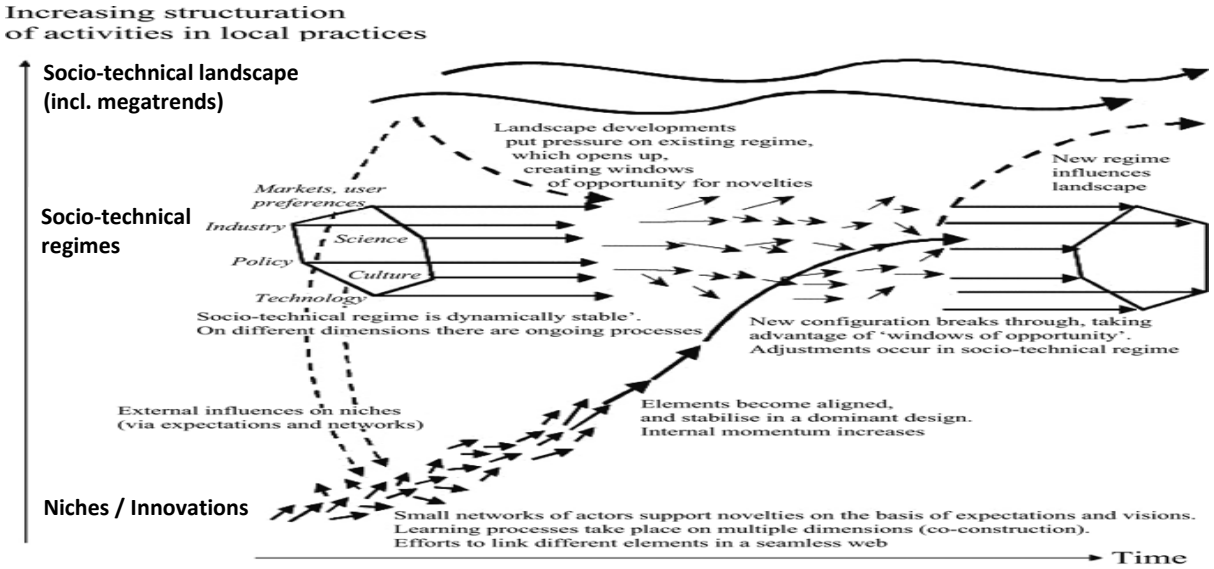

Figure – Multi-level perspective on transitions (adapted from Geels, 2002 and Geels and Schot, 2007)

In addition, an established order, or regime, is also effectively reproduced by millions of small, routine decisions taken by end users, often invisibly. Creativity and innovation are needed to overcome such challenges – in both technical and social spheres – and those innovations must then be converted into new practices. An important reflection in the context of socio-technical transitions

[10] Based on a draft background paper prepared by Stockholm Environment Institute on "Societal transitions" (by Marcus Carson and Tom Burns).

is thus that fundamental systems changes involve not only new technologies, but also changes in markets, social or user practices, culturally embedded discourses, regulatory and policy frameworks, and even governing institutions.

Neo-institutional approaches to fundamental societal change combine multiple theories in their modelling and analysing of societal innovation, adaptation, transitions, and transformation. These approaches seek to specify and analyse agents (both individuals and groups), interaction processes among agents, and the social structures that influence actions. These social structures include institutions and culturally-embedded values and beliefs, and networks of social relationships. Social agents and their interactions are embedded not only in this social structure, but also in a spatial and material context in which their actions are played out.

Transformational change is often catalysed and led by new knowledge that helps redefine the nature of problems societies face, while also suggesting innovative approaches for addressing those problems. Implementation of new strategies takes place within a social structural context in which there is often resistance, and where key elements play a central role in both path dependencies and transformational change in a multi-level perspective. These include:

- the spatial and material ***contexts*** in and across which transformational change processes are played out, including the context of reception, acceptance or support of creative efforts;
- social structure or ***factors***, including culture (beliefs, norms, cognitive models of cause and effect), established institutional arrangements (laws and other kinds of rules) and social relationships (individual and collective membership in networks, organizations, etc.);
- entrepreneurial or obstructive social agents or ***actors***, and their actions and interactions involving creativity or production of new elements or transformation;
- change ***processes*** extending over time, including processes that sustain the status quo (retention processes) and those that help institutionalize new modes, and which define and accept a creation or innovation as useful – at least in the near term.

Societal transitions: from efficiency gains towards system change

Sustainability transitions are long-term, multi-dimensional, and fundamental processes of change in socio-technical systems towards essentially sustainable modes of production and consumption. The transition paradigm mentions the necessity to work with:

- long-term policy frameworks, e.g. the EU's 2050 agenda on energy and climate, biodiversity, resource efficiency and green economy;
- high level government support, e.g. the support by EU member states, EU institutions across different policy areas, and international organizations;
- long-term technology programs with a variety of participants, e.g. public funding and private sector engagement as embedded in the 2020 budget and Horizon 2020, and at level of the member states;
- strong support of public opinion, as changes in socio-technical systems have fundamental impacts on citizens.

Source: Excerpt from The EEA's Multi-Annual Work Programme 2014-2018

Notes

Glossary of terms

Assessment: The analysis and review of information derived from research for the purpose of helping someone in a position of responsibility to evaluate possible actions or think about a problem. Assessment means assembling, summarising, organising, interpreting, and possibly reconciling pieces of existing knowledge and communicating them so that they are relevant and helpful to an intelligent but inexpert decision-maker (Parson, 1995).

Assets: Economic resources (TEEB, 2010).

Benefits: Positive change in wellbeing from the fulfilment of needs and wants (TEEB, 2010).

Biodiversity: 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 (cf. Article 2 of the Convention on Biological Diversity, 1992).

Biophysical structure: The architecture of an ecosystem as a result of the interaction between the abiotic, physical environment and the biotic communities, in particular vegetation.

Biophysical valuation: A method that derives values from measurements of the physical costs (e.g., surface requirements, labour, biophysical processes, material inputs).

Conservation status (of a natural habitat): The sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species (EEC, 1992).

Conservation status (of a species): The sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations (EEC, 1992).

Drivers of change: Any natural or human-induced factor that directly or indirectly causes a change in an ecosystem. A direct driver of change unequivocally influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy; an indirect driver of change operates by altering the level or rate of change of one or more direct drivers (MA, 2005).

Ecological value: Non-monetary assessment of ecosystem integrity, health, or resilience, all of which are important indicators to determine critical thresholds and minimum requirements for ecosystem service provision (TEEB, 2010).

Economic valuation: The process of expressing a value for a particular good or service in a certain context (e.g., of decision-making) in monetary terms (TEEB, 2010).

Ecosystem: A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit (MA, 2005). For practical purposes it is important to define the spatial dimensions of concern.
Ecosystem assessment: A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the
needs of decision-makers (UK NEA, 2011).

Ecosystem condition: The capacity of an ecosystem to yield services, relative to its potential capacity (MA, 2005). For the purpose of MAES, ecosystem condition is, however, usually used as a synonym for 'ecosystem status'.

Ecosystem degradation: A persistent reduction in the capacity to provide ecosystem services (MA, 2005).

Ecosystem function: Subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services (TEEB, 2010).

Ecosystem process: Any change or reaction, which occurs within ecosystems, physical, chemical or biological. Ecosystem processes include decomposition, production, nutrient cycling, and fluxes of nutrients and energy (MA, 2005).

Ecosystem service: The benefits that people obtain from ecosystems (MA, 2005). The direct and indirect contributions of ecosystems to human well-being (TEEB, 2010). The concept 'ecosystem goods and services' is synonymous with ecosystem services. The service flow in our conceptual framework refers to the actually used service.

Ecosystem state: The physical, chemical and biological condition of an ecosystem at a particular point in time.

Ecosystem status: A classification of ecosystem state among several well-defined categories. It is usually measured against time and compared to an agreed target in EU environmental directives (e.g. HD, WFD, MSFD), e.g. “conservation status”.

Energy inputs: Subsidies added to ecosystems such as fertilizers, fossil fuel, or labour that are required to turn ecosystem functions into ecosystem services and benefits.

Functional traits: A feature of an organism that has demonstrable links to the organism’s function.

Habitat: The physical location or type of environment in which an organism of biological population lives or occurs. Terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural.

Human well-being: A context- and situation dependent state, comprising basic material for a good life, freedom and choice, health and bodily well-being, good social relations, security, peace of mind, and spiritual experience (MA, 2005).

Indicator: Observed value representative of a phenomenon to study. In general, indicators quantify information by aggregating different and multiple data. The resulting information is therefore synthesised.

Socio-economic system: Our society (which includes institutions that manage ecosystems, users that use their services and stakeholders that influence ecosystems)

Value: The contribution of an action or object to user-specified goals, objectives, or conditions (MA, 2005).

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