Enriching the European Shared Socio-Economic Pathways with Considerations of Biodiversity and Nature Using a Nexus Approach

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Abstract

The global scientific community is taking steps toward a nexus approach to address interlinkages across biodiversity and climate systems, yet synergistic research and policymaking remains limited. This gap is manifest in the Shared Socio-economic Pathways (SSP) framework, which is applied in various sectors to make sense of future complexity but excludes consideration of biodiversity and nature. As a result, the SSP narratives disregard feedbacks between socio-economic and environmental systems, potentially limiting options to address both the biodiversity and climate crises simultaneously and masking the need to build resilience to concurrent and cascading risks. In this paper, we explore this gap through a co-creation process at the European scale by enriching the original European-SSPs with considerations of biodiversity and nature using a nexus approach (i.e., interactions across biodiversity, energy, food, health, water, and transport). We investigate the implications through a systems analysis of the original and enriched European-SSP narratives. Our findings show that introducing consideration of biodiversity altered the system dynamics within the European-SSP narratives considerably, with outcomes for biodiversity ranging widely within and across scenarios. Further, the relative significance of indirect drivers changed across SSPs due to novel feedbacks with biodiversity and other sectors. Our findings have important implications for biodiversity governance, highlighting the need for adaptive approaches that respond to emergent socio-economic conditions and systemic policymaking that situates technical interventions within enabling governance contexts. The resulting narratives offer more 'biodiversity-centric' scenarios to the climate research community, demonstrating how scenario frameworks can be enriched to facilitate synergistic research and policymaking.

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Key Points:

- The Shared Socio-Economic Pathways do not include two-way interactions between biodiversity and climate
- Considering biodiversity enriched system interactions and altered socio-economic drivers in the European Shared Socio-Economic Pathways
- A nexus approach can enrich scenario frameworks with a systems perspective

Abstract

The global scientific community is taking steps toward a nexus approach to address interlinkages across biodiversity and climate systems, yet synergistic research and policymaking remains limited. This gap is manifest in the Shared Socio-economic Pathways (SSP) framework, which is applied in various sectors to make sense of future complexity but excludes consideration of biodiversity and nature. As a result, the SSP narratives disregard feedbacks between socio-economic and environmental systems, potentially limiting options to address both the biodiversity and climate crises simultaneously and masking the need to build resilience to concurrent and cascading risks. In this paper, we explore this gap through a co-creation process at the European scale by enriching the original European-SSPs with considerations of biodiversity and nature using a nexus approach (i.e., interactions across biodiversity, energy, food, health, water, and transport). We investigate the implications through a systems analysis of the original and enriched European-SSP narratives. Our findings show that introducing consideration of biodiversity altered the system dynamics within the European-SSP narratives considerably, with outcomes for biodiversity ranging widely within and across scenarios. Further, the relative significance of indirect drivers changed across SSPs due to novel feedbacks with biodiversity and other sectors. Our findings have important implications for biodiversity governance, highlighting the need for adaptive approaches that respond to emergent socio-economic conditions and systemic policymaking that situates technical interventions within enabling governance contexts. The resulting narratives offer more 'biodiversity-centric' scenarios to the climate research community, demonstrating how scenario frameworks can be enriched to facilitate synergistic research and policymaking.

Plain Language Summary

Biodiversity and climate systems are interconnected, but research and policy making that addresses these connections remains limited. This gap is manifest in the Shared Socio-economic Pathways (SSPs), which are used as useful narratives of the future in various sectors but exclude consideration of biodiversity and nature. This gap limits options to find solutions that address both the biodiversity and climate crises simultaneously and masks complex forms of interacting risk. In this paper, we enrich the original European-SSPs with considerations of biodiversity and nature using a systems approach, considering interactions

across biodiversity, energy, food, health, water, and transport. We also investigate the implications of doing so through a systems analysis. We found that introducing biodiversity altered the system dynamics within the European-SSP narratives considerably, with widely varying outcomes for biodiversity. Further, the relative significance of indirect drivers changed across the scenarios due to novel interactions with biodiversity and other sectors. Our findings highlight the need for adaptive biodiversity governance approaches that respond to emerging socio-economic conditions and systemic policymaking that situates technical interventions within enabling governance contexts.

1 Introduction

Climate change and biodiversity loss are deeply entangled crises (Pörtner et al., 2021; IPBES, 2024). Human activities such as land use change, overexploitation of natural resources, and pollution are driving the degradation, fragmentation, and loss of habitats, which is accelerating species extinction (Jaureguiberry et al., 2023; McCallum, 2015; Turvey and Crees, 2019). Climate change is mainly caused by greenhouse gas emissions, which are driven by similar direct and indirect drivers to those driving biodiversity loss (e.g., land use and pollution, in addition to social preferences, technological change, economic growth). The impacts of climate change, such as sea level rise, frequency and severity of extreme weather events, and shifts to the overall climatic regime (IPCC, 2021), further disrupt ecosystem structures and processes, thereby disrupting carbon sequestration further and perpetuating biodiversity loss (Carey, 2009; IPCC, 2022; Lawrence and Soame, 2004).

These dual crises have significant impacts on people. The loss of biodiversity and nature's contributions to people threatens many aspects of human wellbeing (Díaz et al., 2006), such as a greater risk of infectious pathogen emergence (Schmeller et al., 2020) and threats to food security and nutritional diversity (Sunderland, 2011; Wahlqvist and Specht, 1998). Climate change amplifies these impacts and introduces new threats, such as direct risks to human life and infrastructure during extreme weather events (IPCC, 2022) and forced migrations as sea level rise renders coastal areas uninhabitable (Lincke and Hinkel, 2021; Storlazzi et al., 2023). Further, the potential crossing of biodiversity and climatic tipping points increases the possibility for nonlinear impacts and cascading risks, with uncertain yet potentially severe consequences for both nature and people (Lenton et al., 2023). These impacts are not felt equally, with the most vulnerable populations most significantly affected (Chaplin-Kramer et al., 2023; IPCC, 2022). Further, solutions for halting and reversing biodiversity loss and climate change influence one another in complex ways. For example, monoculture afforestation or bioenergy supply helps mitigate climate change through carbon sequestration while potentially reducing biodiversity (Calvin et al., 2021; Stephens and Wagner, 2007), yet maintaining or improving the biodiversity of these ecosystems can improve their resilience to many disturbances including climate change (Seddon et al., 2020; Thompson, 2009).

The intertwined nature of these crises highlights the importance of a nexus approach to science and policy (IPBES, 2024). In a nexus approach, interlinkages between biodiversity and climate, in addition to a range of other sectors such as energy, food, health, water, and transport, can be addressed in a systemic and integrated way (Müller et al., 2015; Pascual et al., 2022). The aim of such approaches is to understand and mitigate trade-offs while identifying opportunities for synergistic action. The Intergovernmental Panel on Climate Change (IPCC) and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) play an important role in synthesizing evidence on their respective issues and have recently taken steps toward a nexus approach. For example, the IPBES Nexus Assessment, which went to plenary in December 2024, considers interlinkages between biodiversity and the climate system, in addition to a range of other sectors and systems (IPBES, 2024, 2019). The IPCC Working Group II (Impacts, Adaptation, and Vulnerability) characterized the impact of climate change on ecosystems and their services in the Sixth Assessment Report (IPCC, 2023a, 2023b). Most notably, the IPCC and IPBES hosted a joint workshop in December of 2020, which resulted in a co-sponsored workshop report on biodiversity and climate change (Pörtner et al., 2021). Yet, synergistic action remains limited, and the failure to address both climate change and biodiversity loss can be at least partially attributed to challenges dealing with the systemic nature of these crises, which requires mainstreaming solutions across socio-economic drivers and sectors that may be resistant to change (IPBES, 2018; Rounsevell et al., 2020).

Scenarios are increasingly popular tools for exploring complex futures (Börjeson et al., 2006; Oteros-Rozas et al., 2015; Pereira et al., 2021). Both the IPCC and IPBES have adopted scenario frameworks that explore futures deemed relevant to their flagship issues. The IPCC community scenario framework includes Shared Socioeconomic Pathways (SSPs) that describe five possible global socio-economic trajectories, which are combined with Representative Concentration Pathways (RCPs) and Shared Policy Assumptions (SPAs) to explore complex futures under climate change and climate policy (van Vuuren et al. 2011; Kriegler et al. 2014; O'Neill et al. 2014; Riahi et al. 2017). The SSPs have been taken up as useful narratives of a global future for many different applications across sectors and scales (O'Neill et al., 2020), including to underpin recent global biodiversity projections (Pereira et al., 2024).

These existing scenario frameworks offer useful contributions to understanding the future of both climate change and biodiversity loss. However, every scenario framework can only offer a limited view of the diverse domains, scales, or perspectives implicated in the future of these challenges (Lazurko et al., 2023; Swart et al., 2004; Verburg et al., 2016). For example, Kok et al., (2019) state the need for "further extension" of the downscaled European SSPs (Eur-SSPs) to address the necessary scope of drivers, factors, sectors and actors that may be relevant for different applications of the SSPs. An important identified gap in the SSPs is the lack of explicit consideration of environmental change, including biodiversity and nature, as intertwined with socio-economic futures driving climate change (O'Neill et al., 2020; Pereira et al., 2021). Yet, a nexus approach requires efforts to consider interactions between indirect drivers underpinning these dual crises and their implications and feedbacks, including across sectors. This gap points to the potential for limits to the plausibility and comprehensiveness of the SSP narratives, particularly when applied at sub-global scales and for a wide range of topics beyond climate change (O'Neill et al., 2020). As a result, the scenarios may fail to serve their desired outcomes, such as to motivate transformative actions to reverse climate change and biodiversity loss simultaneously or to build resilience to multiple interconnected risks.

In this paper, we aim to enrich the SSPs with considerations of biodiversity and nature using a nexus approach. We use the term 'biodiversity nexus' to refer to a nexus approach that considers interlinkages and feedbacks between biodiversity, energy, food, health, water, and transport. We focus on the European SSPs (Eur-SSPs) as a demonstrative case, which were downscaled and extended from the global SSPs (Kok et al. 2019). Our objectives were to 1) enrich the original Eur-SSPs narratives by detailing them with interlinkages and feedbacks between biodiversity and nature and the other elements of the biodiversity nexus using a participatory, systems approach and 2) compare the dominant interactions and biodiversity implications across the scenarios and in relation to the original Eur-SSPs through a systems analysis. These insights inform reflections on future scenario work for the IPCC and IPBES.

2 Materials and Methods

2.1 The IPCC scenario framework

The SSPs are a key part of the scenario framework used by the IPCC community. The SSPs describe five possible global socio-economic future trajectories located on two axes: socio-economic challenges for adaptation and socio-economic challenges for mitigation (O'Neill et al., 2017). The SSPs have been taken up as useful narratives of a global future for diverse applications across scales and sectors (O'Neill et al., 2020). The global SSPs have been extended to produce European SSPs (Eur-SSPs), resulting in four distinct scenarios that mirror the global SSPs, excluding SSP2 which is often considered a more business-as-usual trajectory (Kok et al., 2019). These narratives are located on two axes: inequality (low to high) and carbon intensity per GDP (low to high). The narratives include a sustainable future with global cooperation and less intensive lifestyles (We are the World; Eur-SSP1); a future in which countries struggle to maintain living standards in a high-carbon intensive Europe (Icarus; Eur-SSP3); a future in which power becomes concentrated in a small elite and Europe becomes an important player (Riders on the Storm; Eur-SSP4); and a future in which a lack of environmental concern leads to the over-exploitation of fossil fuel resources addressed by technological solutions (Fossil-fuelled Development; Eur-SSP5).

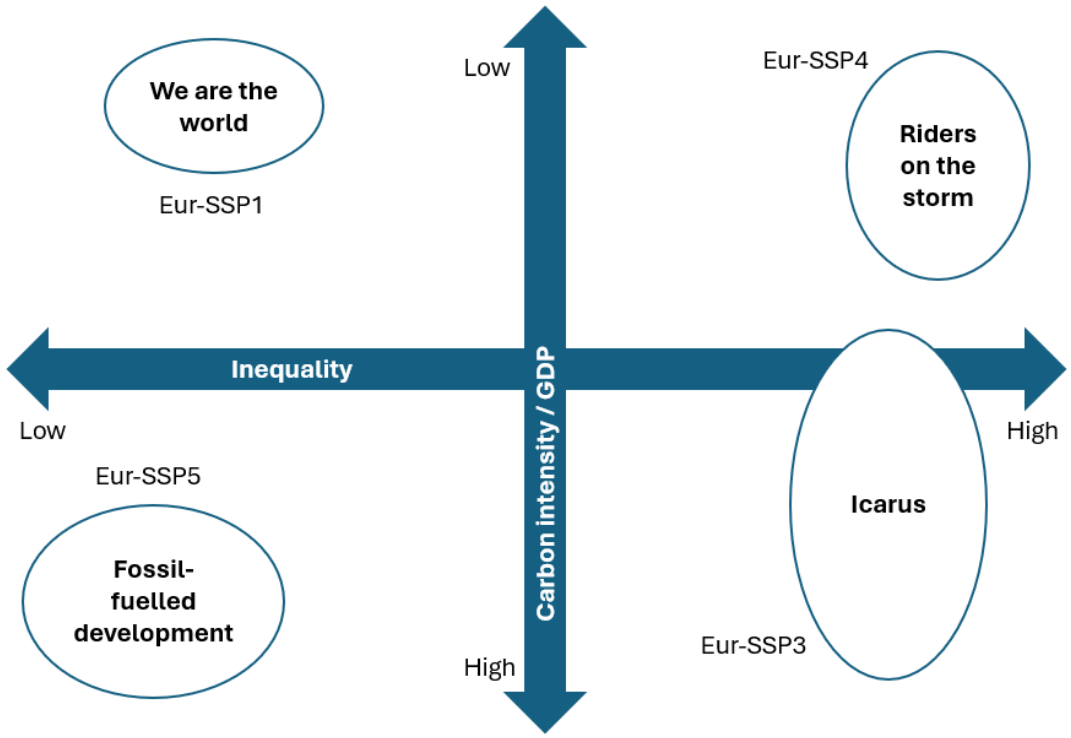


Figure 1: European SSPs for climate change research, used as a starting point for enriching with biodiversity and nature using a nexus approach (adapted from Kok et al. 2019)

2.2 Enriching the Eur-SSPs with considerations of biodiversity and nature

The initial data for enriching the Eur-SSPs were collected during the first stakeholder co-creation workshop of the BIONEXT project (bionext-project.eu) held on 4-5 May 2023 in Santorini, Greece. The workshop was attended by 26 participants, who were selected to ensure diverse representation of regions of Europe (northern, central and eastern, western, and southern Europe), organisational types (government, business, civil society or non-governmental organisation, and advocacy for minority groups), and expertise related to seven nexus elements (biodiversity, water, food, health, energy, transport and climate change). During the workshop, BIONEXT researchers served as facilitators and notetakers to capture the data emerging from verbal discussion and visual materials (e.g., in notetaker templates, audio recordings and photos of visual materials).

During the SSP exercise of the workshop, workshop participants were familiarized with the four Eur-SSP scenario narratives (Eur-SSPs 1, 3, 4 and 5) through a presentation. Participants were then randomly assigned into four groups where a facilitator for each Eur-SSP asked them to add additional events or impacts that may occur within the Eur-SSP narratives at different time points to the year 2100 related to the elements of the biodiversity nexus (by putting stickers on posters, e.g., Figure 2). These ‘events’ or ‘impacts’ were meant to be additional drivers or implications of existing events in the narratives to ensure they enriched the narrative yet were still coherent with the existing Eur-SSP. If not already explicit in the ‘event’ or ‘impact’, participants were then asked to indicate whether the events had positive or negative implications for biodiversity and nature. Participants repeated this exercise across the four Eur-SSPs until the posters were filled with additional events and implications for biodiversity and nature. The raw data produced during the workshop was transcribed and anonymized for further analysis (Table S2).

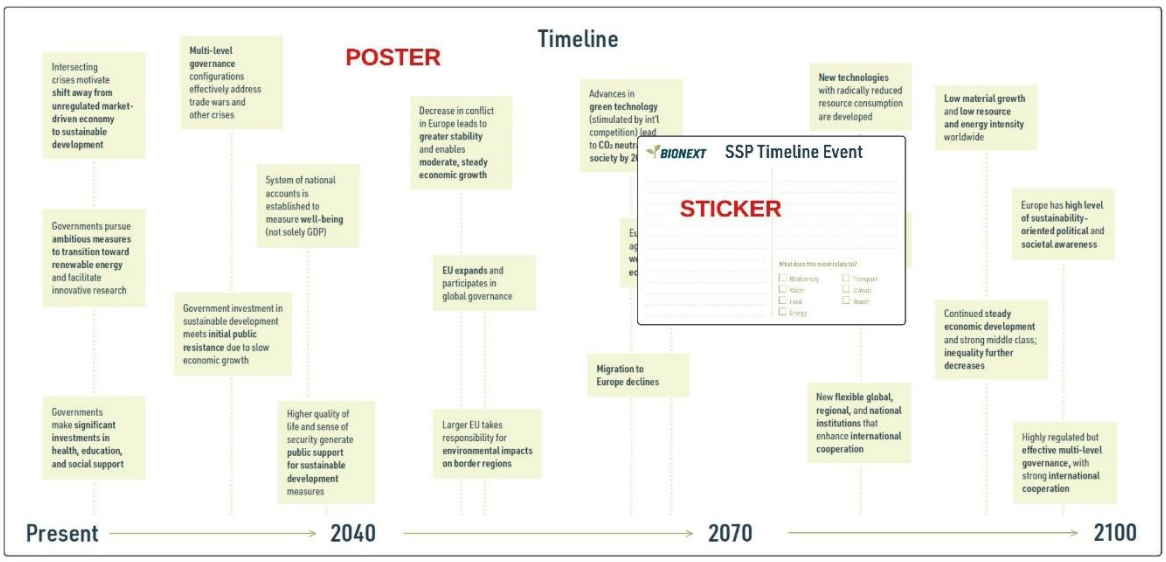


Figure 2: Example of poster and stickers used to enrich the original European SSPs with considerations of biodiversity and nature, using SSP4 as an example

The data collected during the workshop exercise were synthesised and analysed to enrich the original Eur-SSP narratives by integrating the events/impacts and implications for biodiversity at appropriate sections of the SSP narratives across different time scales. The detailed procedure for doing so, including a quality assurance procedure, can be found in Text S1.

2.3 Validating the enriched Eur-SSPs using a nexus approach

The draft enriched Eur-SSPs were then further elaborated with a subgroup of stakeholders during an online webinar on 21 November 2023, which aimed to validate the enriched Eur-SSP narratives from the workshop and to further enrich them with more explicit consideration of the elements of the biodiversity nexus (i.e., biodiversity, energy, food, health, water, and transport). Climate change was excluded as a nexus element in this exercise, since the intention was to enrich the socio-economic drivers of the SSPs, which would then be paired with RCPs to consider climate change impacts. The 26 participants from the workshop were invited and 10 attended. A detailed procedure for the webinar and how the draft enriched Eur-SSP narratives were adapted to create final enriched Eur-SSP narratives as a result can be found in Text S1.

2.4 Systems analysis of the enriched Eur-SSPs

A systems analysis was conducted to further describe and evaluate the implications of enriching the original Eur-SSPs with considerations of biodiversity and nature. To do so, the full enriched Eur-SSP narratives were analysed to find interlinkages between a standardized set of nodes. These nodes were a) elements of the biodiversity nexus (Kim et al., 2024) and b) indirect drivers of change used to describe the original Eur-SSPs (Kok et al., 2019) as defined in Table 1. Broad definitions allowed the systems analysis to capture a comprehensive picture of the narratives.

Table 1: Scenario nodes and definitions used in the systems analysis

Category	Nodes	Description
Elements of the biodiversity nexus	Biodiversity	Directly related to the state of terrestrial, inland water, and marine biodiversity and nature broadly defined, including the state of ecosystems, the land area of nature, outcomes for individual species, etc.
	Water	Directly related to the state of water resources, including infrastructure development for water supply and water/wastewater treatment, in addition to the state of freshwater and marine resources.
	Food	Directly related to the state of food systems across supply chains, including agricultural inputs and agricultural systems, fisheries, food culture, diets, etc.
	Health	Directly related to the state of human health, including both the state of the health sector and connections between human health and nature.
	Energy	Directly related to the state of energy systems, including energy supply and demand, energy mixes (including renewables), and infrastructure/technology development.
	Transport	Directly related to the state of transport systems, including active transport (walking, cycling) and public and private modes.
Indirect drivers of change	Geopolitical stability	Degree of geopolitical stability or lack of conflict, i.e., high/low.
	International cooperation	Degree of international cooperation, e.g., strong EU, weak/strong trade.
	Globalisation	Pace of businesses/policies/etc gaining international influence and/or coordination.
	Net migration	Balance of immigration and emigration, with a focus on demographic change as influenced from outside of Europe.
	Mobility across borders	Degree of openness for mobility across borders, with a focus on border control and economic opportunity primarily within Europe.
	Economic development	Pace of economic growth, i.e., high/low, gradual, and/or type of economic development taking place.
	Technology development	Pace, reach and nature of technology development.
	Decision-making level	Dominant level of decision-making, i.e., international, EU, national, local, fragmented, with a focus on who has power.
	Quality of governance	Quality of structures and processes related to governance, including relative priority on environment vs economy or short-term vs long-term orientation.
	Choice	Degree/freedom of choice related to land and resource use, usually related to policies.

	Social cohesion	Extent of connectedness among groups in society, with a focus on public attitudes, perception and culture.
	Social respect	Degree of respect between countries or between societies, with a focus on respect and explicit participation across groups in society.
	Environmental respect	Degree and distribution of appreciation for the environment in the population.
	Education investments	Relative quantity and distribution of investment in education, i.e., high/low and equitable or elites, in addition to other aspects such as the type or quality of education.

Four researchers qualitatively coded the enriched Eur-SSP narratives for statements that implicitly or explicitly state a relationship or interlinkage between two nodes in Table 1. These were entered into a database, which characterised each interlinkage in a standardized format (i.e., 'from' and 'to' nodes, text summary of the nature of the interlinkage, original or enriched Eur-SSP, implicit vs explicit interlinkage, direct or indirect interlinkage, corresponding time slice, descriptive positive or negative direction, and implications for biodiversity if relevant). A detailed procedure for how the database was created including quality assurance procedures can be found in Text S1.

The first analysis of the database assessed changes to the relative importance of different nexus elements or indirect drivers in the enriched versus original Eur-SSPs. This was done by producing a summary table detailing a count of the interlinkages from and to all nexus elements and indirect drivers across the original versus enriched Eur-SSPs, in addition to two systems maps for each Eur-SSP, one representing interlinkages in the original narrative from Kok et al. (2019) and the other representing interlinkages in the enriched narratives. These system maps were produced to show the nodes (Table 1) and the edges as interlinkages between these nodes. The diagrams allow for interpretation of the relative prevalence of interlinkages in the scenario narrative, as inferred by the number of database entries for that interlinkage (i.e., thickness of the arrows), the relative importance of that node in the scenario narrative, as inferred by the number of database entries implicating that node (i.e., the size of the nodes), and the positive, negative or neutral/mixed direction of the interlinkage (i.e., the colour of the edges).

The second analysis assessed the role of biodiversity and the biodiversity nexus in each enriched Eur-SSP. A synthesized version of the database was created that summarised the multiple database entries relevant for each interlinkage. This database was used to create two sets of sub-system maps that detail 1) the impact of the biodiversity nexus on indirect drivers and 2) the impact of indirect drivers on the biodiversity nexus. An

interpretation of the relative prevalence of interlinkages in the scenario narrative, relative importance of nodes, and positive, negative or mixed directions were made possible using the same procedures as for the first analysis.

3 Results

3.1 Description of enriched Eur-SSP narratives

This section summarises the enriched Eur-SSP narratives, focusing on the state of the biodiversity nexus as extended from the original Eur-SSPs (Kok et al., 2019). The full enriched Eur-SSP narratives are included in Text S1, which can be compared to the original narratives in the SM of Kok et al. (2019).

Enriched Eur-SSP1

The world shifts away from a market-driven economy towards moderate but steady economic growth for sustainable development. There is overall higher political stability and lower inequality with strongly regulated multi-level governance. The European Union (EU) is expanding with strong international cooperation towards renewables and green technology and reduced consumption. From the present to 2040, the governments pursue ambitious measures for the energy transition and social support with an emphasis on plural knowledge and cultural and biological diversity. There are initial trade-offs between renewable energy and pressures on land and biodiversity with public resistance to spending due to slow economic growth. Protected areas are expanded with more green space and green infrastructure. From 2040 to 2070, the European political agenda focuses on well-being over economic growth as the EU expands and participates in global governance, empowering local authorities and communities to implement solutions with co-benefits for climate, biodiversity and wellbeing. Agricultural reform leads to more positive impacts on biodiversity and AI-assisted policy planning mainstreams biodiversity policy across sectors. People lead more sustainable lives in smaller rural towns. From 2070 to 2100, Europe has a high level of sustainability-oriented awareness with continuing economic development, decreasing inequality and improving health. The state of biodiversity is among the core societal indicators.

Enriched Eur-SSP3

Economic woes in major economies and regional conflict fragments the EU, leading to high inequality within and between countries. Increasing border controls and barriers to trade result in rising energy and food prices and increasing demand for natural resources, causing severe ecosystem failures. From the present to 2040, populist movements fuel rising international tension and persistent conflicts, resulting in the reprioritization of environmental policies in favour of defence. Rising food insecurity and poorer environmental quality impact human health. Travel is reduced between countries due to border controls, reducing pressure on nature but lower environmental protection allows for continued use of pesticides, herbicides and antibiotics. The economy in Europe stagnates and the EU breaks apart. From 2040 to 2070, the gap between poorer and richer countries in the EU widens. Legislation for protected areas is abandoned and water wars arise with the collapse of some fisheries. The social fabric disintegrates and increases migration away from poor countries in Europe. From 2070 to 2100, the EU loses its leading position and deindustrialises. Criminal organizations and corruption take hold, and well-educated people migrate outside of Europe. These factors eventually reduce demand for energy and materials, alleviating environmental pressure and allowing rewilding in certain areas. Food production becomes extensive, with many people leading a subsistence lifestyle. The majority accepts political instability and social injustice and learns to live with less.

Enriched Eur-SSP4

The world shifts strongly towards innovation leading to a high-tech green Europe with strong partnerships between business and European governments. Power is concentrated in a small political and economic elite with growing inequality within and between the European countries. From the present to 2040, new innovations improve biodiversity in economically important ecosystems. Business and political elites gain control over land, which in some cases benefits ecosystems and biodiversity at the expense of a large population. As public trust grows, industrial greenwashing expands, and businesses exploit nature for profit. Tipping points are crossed affecting countries outside of Europe initially, as green innovation enables adaptation within Europe. From 2040 to 2070, technological development becomes the backbone of the economically strong EU but increases demands for resources outside of Europe, exploiting ecosystems on a global scale. Inequalities rise due to skill-based technological development, unequal education and

political power. Access to quality resources (e.g., food, healthcare, water) is unequal. Sub-cultures and counter-movements begin to move to rural areas to adopt land-based sustainable practices, while slums in cities put pressure on nature. Overseas territories begin to adopt localized policies for biodiversity protection. From 2070 to 2100, the EU has become a market leader in green technologies, but the need for strategic autonomy and international pressure leads the EU to endogenize mining and production, reducing pressure on ecosystems abroad but degrading local ecosystems. The small, connected elite benefits and becomes increasingly disconnected from other classes. Social cohesion is low and stratified, so people begin to turn back to the land to adopt sustainable lifestyles.

Enriched Eur-SSP5

The push for economic, technological and social development is coupled with the exploitation of cheap and readily available fossil fuel resources. Significant investments are made in health, education and social support with people embracing high consumption lifestyles. From the present to 2040, market deregulation leads to a strong labour market and prosperity-driven technology development. Technological and scientific innovation enables the creation of new food systems, and higher purchasing power reduces meat consumption. However, increased imports and fossil-fuel-based transport systems impact biodiversity and deep-sea fossil fuel extraction is allowed in Marine Protected Areas. The resulting ecological degradation motivates governments to close or limit access to valuable ecosystems. From 2040 to 2070, public trust in political decision-making increases. There is a strong faith in technological solutions to environmental problems, including geo-engineering, but the environment continues to degrade as people remain unaware. Despite the lower meat consumption, overconsumption and agricultural efficiency reduce dietary diversity and everyone adopts a very energy-intensive lifestyle. People in cities become used to living in an artificial and 'closed' society divorced from nature. Near 2070, biodiversity tipping points are reached, ecosystems collapse and food insecurity grows. From 2070 to 2100, the EU continues its focus on technological solutions fuelled by the exploitation of fossil fuels. New carbon markets and available investments in biodiversity protection are accompanied by a growing risk of corruption. The environment degrades seriously, and human innovation cannot keep pace in masking its impact. Human health suffers with

343 increasing diseases and the health system breaks down. There is a slow re-emergence of
344 renewables as fossil fuel prices rise.

345 3.2 State of the biodiversity nexus in enriched Eur-SSP narratives

346 Table 2 describes the state of biodiversity and the other elements of the biodiversity
347 nexus in the four enriched Eur-SSPs, which are the key additions to the original Eur-SSP
348 narratives. The findings highlight how the state of biodiversity varies across Eur-SSPs, with
349 enriched Eur-SSP1 having the most positive and Eur-SSP5 having the most negative impacts.
350 How these impacts change over time are included in a more comprehensive table in Table
351 S1.

352 **Table 2:** Description of the state of the elements of the biodiversity nexus in each of four enriched Eur-SSPs

Element	SSP1	SSP3	SSP4	SSP5
Biodiversity	+ Biodiversity improves due to nature restoration, mainstreaming into policy, and enhancing human-nature relations	+ / - Biodiversity has mixed impacts from geopolitical fragmentation, initially increasing natural resource use but later reducing pressure in late century due to governance failure	+ / - Biodiversity has mixed impacts from technology development, until inequality worsens biodiversity and counter movements return to nature	- Biodiversity declines and collapses due to uncontrolled economic development and resource extraction and use
Water	Water resources in good condition due to more sustainable practices	Water resources degraded and a source of conflict, with unequal access	Water resources improve from technology, but inequality puts pressure on infrastructure and availability of resources	Water resources improve from technology, but uncontrolled development eventually degrades water resources
Food	More sustainable and integrative food production	Food insecurity from governance fragmentation, leading to intensification and eventually more extensive land use from deindustrialisation	High-tech food system caters to economic and political elite, resulting in food crisis for poorer majority	High-tech food system eventually degrades the environment, ultimately causing Europe to rely on food imports
Health	Healthcare and wellbeing improve due to government investment and more sustainable ways of living	Healthcare and wellbeing declining and unequal, with healthcare only for richer countries and regions	Healthcare privatised and technology driven, with wellbeing declining and healthcare only for societal elite	Healthcare and wellbeing decline as focus on economic development and treatment rather than prevention neglects other aspects of wellbeing
Energy	Sustainable, renewable and cooperative energy systems across Europe	Governance fragmentation and economic development affect energy demand and access and perpetuates reliance on fossil fuels	Technology innovation, renewable transition, and elite control of energy supply	Continued fossil fuel exploitation eventually resulting in peak fossil fuel and beginnings of switch to renewables at the end of the century
Transport	Transition toward sustainable transport systems across Europe	Decreased innovation and priority in transport sector due to fragmentation and militarisation	High-tech clean and active transport systems implemented in Europe	Increased demand for fossil-fuelled transport to enable economic growth

353

3.3 Comparing the significance of indirect drivers between original and enriched Eur-SSPs

This section compares the original and enriched Eur-SSP narratives by comparing changes to the relative significance of indirect drivers and their relationship to the elements of the biodiversity nexus. Table 3 presents a high-level summary of the relative prevalence of nexus elements and indirect drivers in the original and enriched Eur-SSP narratives. Overall, the comparison between the original and enriched Eur-SSPs reveals how consideration of implications for biodiversity and nature, and subsequently of the biodiversity nexus, enriched the complexity of interlinkages within the narratives significantly. Biodiversity changed in its prevalence in the narratives most significantly across the enriched Eur-SSPs, compared to the original narrative. SSP3 changed the least (14 new interlinkages), while all other SSPs have a similarly significant increase in count of interlinkages (24 to 27). Thus, the enriched narratives of all SSPs highlight the importance of biodiversity in underpinning other nexus elements and being affected by indirect drivers. However, the relative importance of these relationships differ across the SSPs. In Eur-SSPs 3, 4 and 5, the food nexus element was the next most significant after biodiversity, whereas in SSP1, health was the next most significant. Food is shown as particularly important in Eur-SSPs 3, 4 and 5 as concerns related to food supply and the intensive use of agricultural land is central to these scenarios. In Eur-SSP3 the population need food to survive, whereas in Eur-SSP 4 and 5 technological and economic development have strong influences on agriculture and its role in the nexus, with inequality also playing a significant role in SSP4 as the poorer masses experience food crises and return to the countryside to grow their own food. Health is shown to be particularly important in Eur-SSP1 due to the move to a well-being economy where quality of life and connections to nature are central.

Table 3. Summary of the count of the number of statements describing interlinkages from (Fr) or to (To) the node (nexus element or indirect driver) in each row for the original versus enriched Eur-SSPs. The sum (+) is the total count of from and to for that original or enriched Eur-SSP. The change (Δ) is the sum (+) of the enriched minus the sum (+) of the original, to show how the relative importance of that node increased when the Eur-SSPs were enriched with considerations of the biodiversity nexus. The cell colours show a linear gradient from least significant (i.e., lowest count) in the narrative (red) to most significant (i.e., highest count) in the narrative (green).

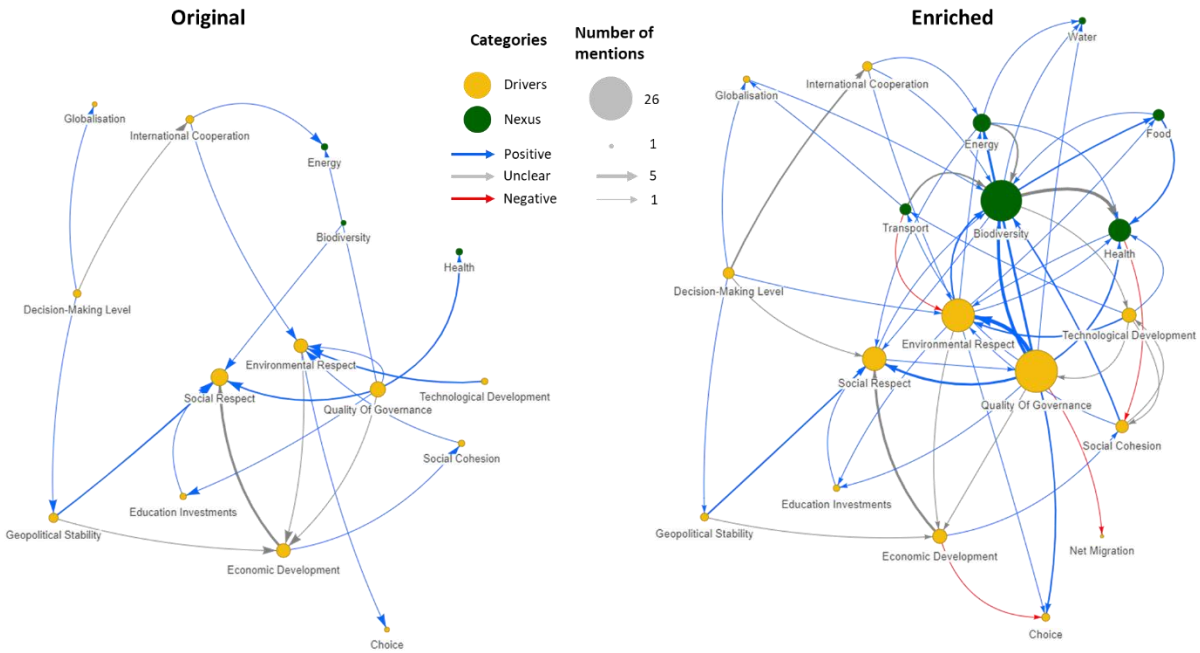
	Eur-SSP1							**Eur-SSP3**							**Eur-SSP4**							**Eur-SSP5**						
	Original			Enriched				Original			Enriched				Original			Enriched				Original			Enriched			
	Fr	To	+	Fr	To	+	Δ	Fr	To	+	Fr	To	+	Δ	Fr	To	+	Fr	To	+	Δ	Fr	To	+	Fr	To	+	Δ
Biodiversity	1	0	1	9	16	25	24	0	2	2	3	13	16	14	0	2	2	5	24	29	27	0	6	6	8	23	31	25
Health	0	2	2	2	11	13	11	1	5	6	1	9	10	4	0	1	1	2	7	9	8	2	1	3	3	8	11	8
Water	0	0	0	0	3	3	3	0	1	1	3	3	6	5	0	0	0	2	3	5	5	0	0	0	2	1	3	3
Food	0	0	0	3	3	6	6	1	0	1	7	10	17	16	0	0	0	8	5	13	13	0	0	0	6	10	16	16
Energy	0	2	2	5	5	10	8	0	8	8	5	11	16	8	2	1	3	6	2	8	5	3	6	9	6	10	16	7
Transport	0	0	0	4	2	6	6	5	1	6	5	2	7	1	0	0	0	1	3	4	4	0	2	2	4	4	8	6
Geopolitical stability	3	1	4	3	1	4	0	2	0	2	6	2	8	6	1	1	2	1	3	4	2	0	1	1	0	2	2	1
International cooperation	2	1	3	3	2	5	2	2	0	2	3	0	3	1	0	0	0	0	0	0	0	1	1	2	1	2	3	1
Globalisation	0	1	1	1	2	3	2	1	0	1	2	1	3	2	1	0	1	1	0	1	0	4	0	4	4	0	4	0
Net migration	0	0	0	0	1	1	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
Mobility	0	0	0	0	0	0	0	0	1	1	2	3	5	4	0	1	1	2	2	4	3	0	1	1	2	1	3	2
Economic development	4	3	7	5	3	8	1	7	0	7	12	3	15	8	1	3	4	6	4	10	6	14	5	19	23	9	32	13
Technology development	2	0	2	6	2	8	6	0	2	2	1	2	3	1	5	4	9	20	6	26	17	3	0	3	12	3	15	12
Decision-making level	3	0	3	6	0	6	3	0	0	0	3	0	3	3	8	1	9	10	1	11	2	2	0	2	2	0	2	0
Quality of governance	8	0	8	24	2	26	18	5	2	7	8	3	11	4	3	0	3	3	0	3	0	3	3	6	10	3	13	7
Choice	0	1	1	0	4	4	3	1	1	2	4	1	5	3	1	3	4	5	4	9	5	1	0	1	4	2	6	5
Social cohesion	1	1	2	4	3	7	5	2	1	3	3	2	5	2	2	1	3	9	6	15	12	0	2	2	0	4	4	2
Social respect	0	9	9	2	12	14	5	3	4	7	3	6	9	2	1	6	7	4	11	15	8	1	5	6	2	5	7	1

Environmental respect	2	5	7	8	12	20	13	0	0	0	4	3	7	7	0	0	0	2	6	8	8	0	1	1	1	4	5	4
Education investments	1	1	2	1	2	3	1	0	1	1	0	1	1	0	0	0	0	0	0	0	0	2	1	3	4	1	5	2

383

Table 3 also highlights how including the biodiversity nexus in the narratives had indirect effects, which appear as marked increases in the significance of different indirect drivers in the original narratives. A comparison between the original and enriched Eur-SSPs details the complex interactions behind these higher-level findings, particularly focusing on interactions between indirect drivers and nexus elements. Eur-SSP1 and SSP4 are visualised in Figure 3 and Figure 4 as examples, and Eur-SSP3 and 5 can be found in Figure S1 and S2.

A comparison of the size of the nodes in enriched versus original Eur-SSP1 (Figure 3) shows that environmental respect and quality of governance increased in importance significantly. This change was due to the important role of environmentally friendly lifestyles and strong governance in enabling and reinforcing positive outcomes across the biodiversity nexus, both directly and indirectly through their influence on economic development and education. In contrast, a comparison of the size of the nodes in enriched versus original Eur-SSP4 (Figure 4) shows that technological development gained influence due to mixed interactions with the biodiversity nexus, as innovation leads to intensive extraction of natural resources that have negative impacts on biodiversity, while green technological developments in food production ease some pressure on land and ecosystems. Environmental respect also gained importance in both SSPs, as improved ecosystems allow people to enjoy nature for recreation in Europe while high-tech solutions in some sectors (e.g., food) disconnect people from nature and perpetuate biodiversity loss. In the enriched Eur-SSP3 (Figure S1), economic development becomes more influential through its role in increasing demand for natural resources within the biodiversity nexus, eventually leading to economic crisis that creates stress within various aspects of the system. Geopolitical stability also gains influence as escalating regional rivalry causes wealthy countries within Europe to reduce their living standards and invest in the military, limiting Europe's overseas environmental footprint and reducing mobility between countries. In enriched Eur-SSP5 (Figure S2), economic development increases in significance, as fossil-fuelled development is enabled by technological enhancements that increase the efficiency and pace of natural resource extraction.



411
412 * 'Number of mentions' refers to the number of times the node of edge was mentioned in the
413 scenario narrative (Text S2).

414 **Figure 3:** Original (left) versus enriched (right) system map of the narratives for Eur-SSP1. The
415 nodes include the biodiversity nexus elements in green and indirect drivers in yellow. The size
416 of the nodes corresponds to the number of times the element is mentioned in the interlinkages
417 to and from that node. The thickness of the edge corresponds to the number of mentions
418 underlying that interlinkage. The colour of the edge corresponds to the positive (blue), negative
419 (red), or mixed/neutral (grey) direction of the node-to-node relationship.

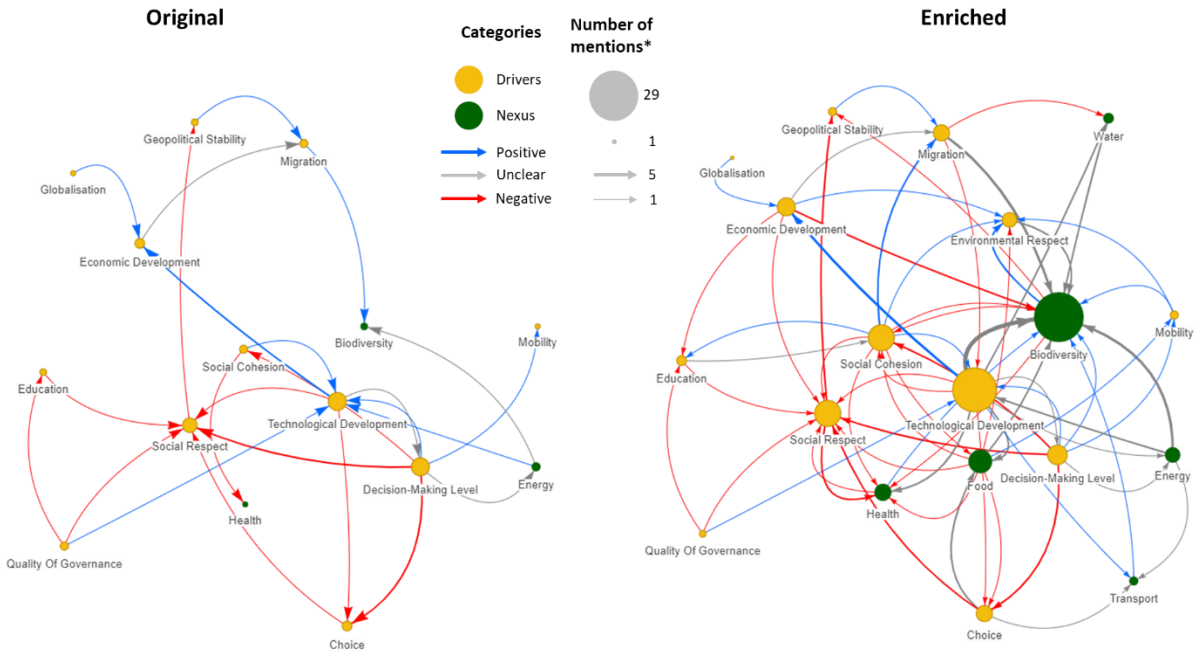


Figure 4: Original (left) versus enriched (right) narratives for Eur-SSP4. See Figure 3 caption for a detailed explanation of the figure.

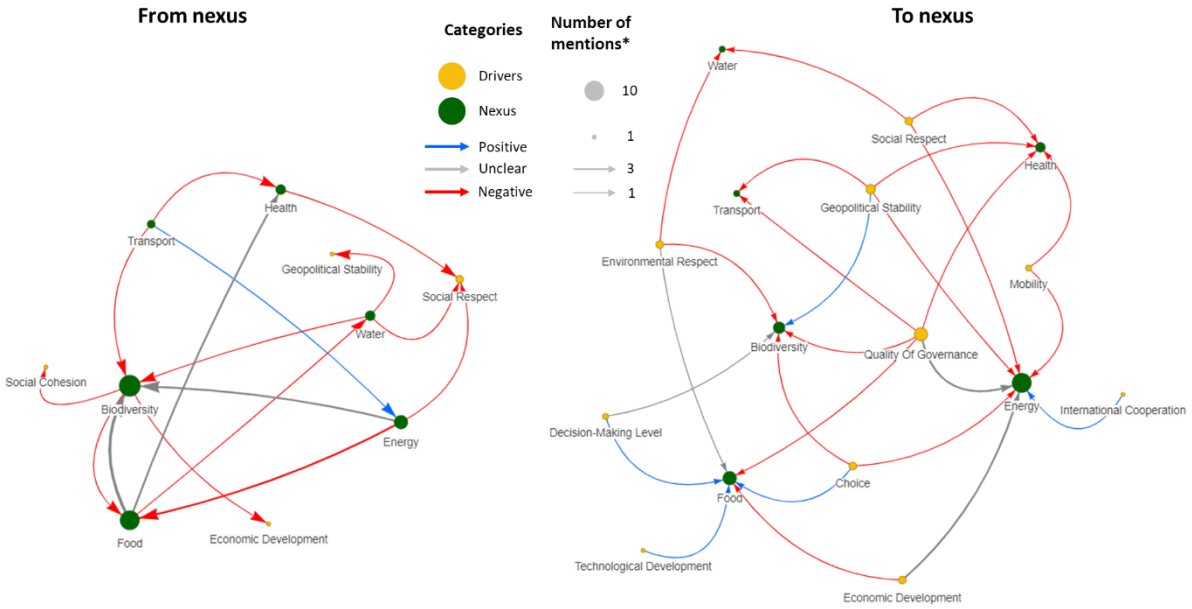
3.4 Describing interlinkages between the biodiversity nexus and indirect drivers in the enriched Eur-SSPs

The process of enriching the Eur-SSPs with considerations of biodiversity and the biodiversity nexus increased the relative significance of indirect drivers in the narratives (Section 3.2). These changes were explored in more detail by looking at how the interlinkages within the biodiversity nexus and directly from biodiversity nexus elements to indirect drivers (i.e., positive or negative), in addition to feedbacks between the biodiversity nexus and the wider socio-economic system, manifest within the different scenarios. The analysis is visualised and discussed for enriched Eur-SSP3 and 5 as examples, which can be explored further in annotated figures for all Eur-SSPs (i.e., with labels showing a description of interlinkage) in Figures S3 to S6.

The sub-system maps for enriched Eur-SSP3 in Figure 5**Figure *5*** show how nexus elements influence one another and indirect drivers directly. Regarding interlinkages between nexus elements, biodiversity, food and energy are most strongly interconnected. A decline in pollinators reduces food production while increasing energy prices affect food prices.

Agricultural expansion leads to biodiversity loss and increased demand for energy leads to environmental degradation, both of which motivate a turn later in the scenario toward localized food production and in turn reduce energy demand in ways that positively impact biodiversity. Direct influences of the biodiversity nexus on indirect drivers are numerous and diverse. For example, depleted biodiversity causes societal and economic shocks while unequal distribution of energy resources motivates international cooperation to diversify energy sources across countries. Privatization of healthcare and water scarcity lead to unequal access to these services and frequent large-scale desertification drives water wars.

The feedbacks from indirect drivers back toward the biodiversity nexus (right, **Figure 5**Figure 5) show how quality of governance has the most negative influence on the biodiversity nexus, as the deterioration of governance systems across regions and scales gradually makes it impossible to coordinate the maintenance of transport and healthcare infrastructures and ensure food security. Importantly, the quality of governance contributes to ceasing regulations related to biodiversity and the environment. However, food security is still enabled by other drivers, such as technological development. Geopolitical instability also has detrimental impacts on multiple aspects of the biodiversity nexus. The increasing incidence of political and social conflicts requires resources to be shifted from investments in energy, transport and health to military spending. In addition, the collapse of value chains forces societies across Europe to use less clean energy and cope with worsening healthcare. At the same time, Europe's instability decreases its involvement in global value chains and thus decreases its pressure on ecosystem outside Europe. Energy is negatively influenced by multiple indirect drivers, which explains a rather surprising positive influence of international cooperation – in an attempt to mitigate the lack of energy resources, remaining governance structures try to establish alliances with other countries to help secure energy supply.



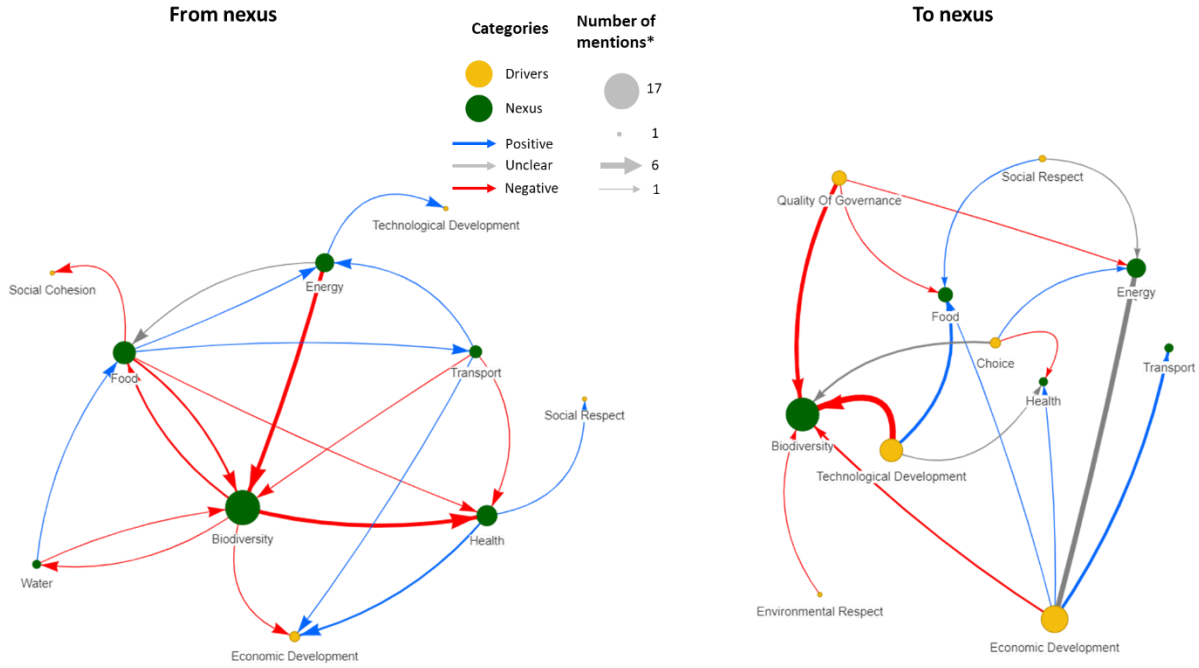
* 'Number of mentions' refers to the number of times the node of edge was mentioned in the scenario narrative (Text S2). The position of the nodes was selected for clarity and ease of comprehension.

Figure 5: Sub-system maps of enriched Eur-SSP3 highlighting interlinkages within the biodiversity nexus and first-degree interlinkages from the biodiversity nexus to one another and to indirect drivers (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). The nodes include the biodiversity nexus elements in green and indirect drivers in yellow. The size of the nodes corresponds to the number of times the element is mentioned in the interlinkages to and from that node. The thickness of the edge corresponds to the number of mentions underlying that interlinkage. The colour of the edges corresponds to the positive (blue), negative (red), or mixed/neutral (grey) direction of the interlinkage.

The sub-system maps for enriched Eur-SSP5 in Figure 6**Figure *6*** show how biodiversity nexus elements influence one another and indirect drivers directly. As with Eur-SSP3, biodiversity is strongly connected with health, energy and food within the nexus. This is due to the role of environmental degradation, biodiversity loss, and limited access to nature negatively affecting wellbeing and public health, and the role of fossil fuel exploitation, which is exacerbated by energy policy and strategies, in damaging natural resources and marine biodiversity. Environmental degradation also has negative impacts on food production to the point of causing food insecurity. Health has a positive influence on indirect drivers, as the rebound from the economic and health crises in Europe allows long-term investments in health that lead to economic and social sustainability. Economic development is most strongly

484 influenced by the nexus elements. For example, increased demand for transport and
485 investments in health boost economic development, but people relying on the fish sector
486 transition to other livelihoods due to the negative consequences on marine biodiversity caused
487 by fossil fuel extraction.

488 The indirect drivers also feedback on the biodiversity nexus (right, Figure 6**Figure 6**).
489 Economic development based on fossil fuel exploitation and natural resource use negatively
490 impacts biodiversity but has a range of mixed outcomes for other sectors. For example, near-
491 term economic prosperity allows for increases to health investments, accompanied by a rise in
492 transportation demand. Technological development also has a negative impact on biodiversity
493 as technology development motivates increasing resource use. Quality of government also
494 feeds back onto biodiversity and the nexus including energy and food, as governments limit
495 environmental protection to prioritise economic interests, contributing to a reliance on energy
496 and food imports.



497
498 **Figure 6:** Sub-system maps of enriched Eur-SSP5 highlighting interlinkages within the
499 biodiversity nexus and first-degree interlinkages from the biodiversity nexus to indirect drivers
500 (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). See
501 Figure 5 caption for a detailed explanation of the figure.

4 Discussion

These findings suggest important implications for biodiversity governance and scenario development in the IPCC and IPBES research communities.

4.1 Implications for biodiversity governance

Enriching the Eur-SSPs with considerations of biodiversity and nature offers important insight into the underlying socio-economic dynamics that drive changes to the state of biodiversity. The analysis of the enriched Eur-SSPs shows that all indirect drivers interact with biodiversity directly or indirectly through other elements of the biodiversity nexus, with widely varying outcomes for the state of biodiversity and other nexus elements (Table 2). Which indirect drivers are most important for the overall system dynamics depends on the scenario context (Table 3). For example, quality of governance is a highly influential driver in Eur-SSP1 as society transitions toward sustainability, whereas geopolitical stability is highly influential in Eur-SSP3 which is characterised by fragmented governance and conflict. Together, these findings suggest that the state of biodiversity (i.e., positive, neutral, or negative over time) across Eur-SSPs is highly influenced by the evolution of deeply uncertain indirect drivers (Pereira et al., 2024) whose relative priority will change depending on the future trajectory in different regions across Europe (IPBES, 2024).

The findings suggest possible interactions between indirect drivers that may hold more leverage for halting and reversing biodiversity loss. For example, under multiple Eur-SSPs, interactions between economic development and technological development perpetuate unsustainable extraction or use of natural resources, even when oriented toward sustainability (e.g., green business and its externalities outside of Europe in Eur-SSP4). A similar finding occurred when downscaling the global SSPs to the United Kingdom (Harmáčková et al., 2022). This finding reinforces the importance of policy interventions that break the feedback loop between natural resource use and development: for example, by accounting for social needs and environmental limits and externalities within and beyond Europe (Chava, 2014; Raworth, 2017; Sala et al., 2020). In contrast, quality of governance and to a lesser extent environmental respect and social cohesion play a cornerstone role in the transition toward more nature-positive and sustainable futures in enriched Eur-SSP1. However, if these governance and

societal drivers orient away from biodiversity, as they do in other scenarios, these drivers also play a significant role in perpetuating biodiversity loss (e.g., fragmented governance deprioritising environmental policies in Eur-SSP3). This finding reinforces the importance of a systemic policy approach that situates interventions to support biodiversity within an enabling and even transformative governance context (Huang et al., 2018; Smith et al., 2003; Visseren-Hamakers et al., 2021). Further, it aligns with recent findings in IPBES (2024), which highlights how future scenarios with positive outcomes for biodiversity and other sectors are characterized by sustainable lifestyles, more equitable distribution of benefits, and pro-sustainability policies and regulations, in addition to shifts to a range of indirect drivers related to governance and power relations. Importantly, our findings also highlight how each Eur-SSP is not wholly 'good' or 'bad' for biodiversity: even the scenarios that result in negative biodiversity outcomes overall include the crossing of ecological tipping points later in the century, after which society recognises and begins orienting toward sustainability (see also Harmáčková et al., 2022). Such findings reveal the importance of embedding nature-positive actions across policy portfolios in anticipation of these windows of opportunity, even amid more challenging socio-economic conditions (Bennett et al., 2016; Westley et al., 2011).

The findings also reinforce the need for a nexus approach in biodiversity governance, which embeds biodiversity objectives and goals across sectors and nexus elements (IPBES, 2024) . Across the enriched Eur-SSPs, positive or negative outcomes for biodiversity are not always felt directly from indirect drivers themselves (e.g., quality of governance or economic development), but rather through their influence on other nexus elements (e.g., food, energy, health, water, transport) and their interactions with biodiversity (IPBES, 2024; Kim et al., 2024). For example, in Eur-SSP1, improved governance and environmental respect enable mainstreaming of agroecological practices that can benefit biodiversity (e.g., Chappell and LaValle, 2011). In turn, biodiversity impacts health through access to green space and indirectly through its contribution to organic and nutritious food (e.g., Crinnion, 2010). In contrast, in Eur-SSP3, a decrease in environmental respect and related increased use of pesticides in high-yield unsustainable agricultural intensification leads to biodiversity loss in land and water systems, negatively impacting human health. Similarly, in Eur-SSP5, fossil fuel-based energy and

transport sectors cause cascading effects in various sectors including health and food, which have both direct and indirect impacts on biodiversity. In such cases, biodiversity 'bites back', for example through its influence on food prices or food quality, or as ecological tipping points are crossed that affect human health directly (e.g., Hough, 2014). Perhaps most importantly, the implications of unsustainable practices and overconsumption of resources across sectors, and the resulting state of biodiversity, is intimately tied to societal outcomes, as under multiple scenarios a lack of access to resources is tied to deep and widening inequalities and conflict (Carmignani, 2013; Mildner et al., 2011). Thus, a nexus approach that considers these cross-sectoral interactions and feedbacks is needed if governance is to address the risks of social injustice accompanied by environmental collapse (IPBES, 2024), as overlooking them may underestimate the scope and scale of plausible socio-economic and environmental change.

4.2 Implications for scenario frameworks for IPBES and the IPCC

The findings have important implications for the biodiversity and climate change research communities developing and applying the scenario frameworks, including IPBES and the IPCC. The SSPs were originally developed as exploratory socio-economic scenarios for climate change research and have now been downscaled to regional and local contexts and operationalised for scenario analyses in sectors beyond climate change. These processes include quantitative, data-driven approaches drawing from databases and literature (Absar and Preston, 2015; Rohat et al., 2018) and co-creation processes drawing from stakeholder knowledge (Chen et al., 2020; Frame et al., 2018; Harmáčková et al., 2022; Zandersen et al., 2019). This uptake and extension of the SSPs is a testament to the appetite for scenario frameworks that address socio-economic uncertainty. Yet, the original SSPs were not necessarily designed with all of these applications in mind, affirming the need to be transparent about their strengths and limitations for applications in different sectors and scales (O'Neill et al., 2020).

This paper speaks directly to the discussion on gaps and future applications of the original Eur-SSPs. Kok et al., (2019) state the need for "further extension" of the enriched Eur-SSPs to address a wider set of drivers, factors, sectors and actors, highlighting that the SSPs have been developed for different purposes than they may be applied and thus may result in

589 mismatching drivers, sectors, and content. We affirm that these challenges exist and offer a
590 methodology for enriching existing narratives in ways that begin to address these gaps for
591 applications of the Eur-SSPs in biodiversity and climate research. For example, we have shown
592 that introducing consideration of biodiversity and nature to the original Eur-SSPs had significant
593 implications on the overall system dynamics. This manifested differently across each of the Eur-
594 SSPs, including by magnifying the importance of particular indirect drivers and introducing
595 feedbacks from biodiversity back onto direct and indirect drivers of biodiversity loss.
596 Additionally, we have shown that considering nexus interactions in scenario development (i.e.,
597 across biodiversity, food, energy, transport, water and health) reveals a much richer picture of
598 the cause-and-effect mechanisms within the scenario and the relative importance of certain
599 indirect drivers and nexus elements within the interactions that lead to or mitigate
600 environmental challenges. Kok et al., (2019) also point to methodological choices that simplified
601 the original Eur-SSP narratives (i.e., to develop 'equivalent scenarios' that directly translate
602 outcomes from global to European scale), and thus resulted in narratives that may have
603 excluded European-specific uncertainties. We affirmed that this challenge exists, as the
604 incorporation of biodiversity and the biodiversity nexus introduced European-specific
605 considerations that were masked in the original scenarios (e.g., green, technology-led
606 development in Eur-SSP4 creating environmental externalities in other countries).

607 We have also gone beyond the gaps stated by Kok et al., (2019) to show that the original
608 Eur-SSPs may underestimate the complexity and scale of change that may only be revealed
609 when biodiversity is introduced as intertwined with socio-economic futures. For example, the
610 crossing of biodiversity tipping points has significant socio-economic consequences in the latter
611 part of the century in Eur-SSPs 4 and 5. Additionally, we reflect how the SSPs can help explore a
612 wide range of outcomes for biodiversity, though few are truly nature positive, which affirms the
613 finding of Alexander et al., (2023). More specifically, we show that the original Eur-SSPs can
614 benefit from being enriched by details that could help mediate the relationships between
615 climate- and biodiversity-related interventions. For example, renewable energy initiatives have
616 mixed impacts on biodiversity in multiple Eur-SSPs, drawing attention to the need for
617 mechanisms for decarbonisation (e.g. hydro, solar, wind powered energy, decarbonised

transportation) to be carefully weighed against broader consequences such as resource exploitation, metal waste generation and species habitat losses and collision (e.g., Gasparatos et al., 2017; Santangeli et al., 2016). A nexus perspective highlights the need for evidence on response options with multiple benefits across sectors including and beyond biodiversity and climate (IPBES, 2024).

4.3 Methodological considerations

This study offers numerous methodological reflections. We aimed to demonstrate an iterative, participatory, and complexity-oriented process for enriching the Eur-SSPs with considerations of biodiversity and nature using a nexus approach. This process prioritised co-creation, wherein the researchers structured an accessible process that relied heavily on a carefully selected set of stakeholders and experts to identify key interactions and drivers that addressed the range of sectors in the biodiversity nexus. We embarked on one iteration to fill gaps (i.e., the webinar), which offered the level of detail and rigour required to meet the aims of this study. However, more iterations in the participatory process may have enabled more interactions to be identified and added, which may have allowed for bolder conclusions about exactly which indirect drivers, nexus elements and interactions are most critical for the future. Further, stakeholders' ability to enrich the Eur-SSPs depended on existing knowledge about these nexus interactions, many of which are still uncertain or under researched (Kim et al., 2024; IPBES, 2024). This gap points to open questions about our findings, such as whether the indirect drivers with few interlinkages can be assumed as less important or perhaps represent gaps in knowledge. Further, rigorous evidence is required to better quantify the impacts across interlinkages in the systems analysis.

5 Conclusion

In this paper, we showed how considering interlinkages and feedbacks between indirect drivers and the biodiversity nexus in the Eur-SSPs enriched the complexity of narratives, highlighting the importance of biodiversity in underpinning other nexus elements and in reciprocal relationship with indirect drivers. By looking at sub-system maps of the influences from – and to – the biodiversity nexus, we were able to paint a clearer picture of the feedbacks

between the biodiversity nexus and the wider system of indirect drivers. These findings have various implications for biodiversity governance. For example, our findings show the diverse outcomes for biodiversity across socio-economic futures, highlighting the need for an adaptive and context-relevant policy approach that can respond to emerging socio-economic trajectories of change. We also reveal interactions between indirect drivers that may hold more leverage for halting and reversing biodiversity loss amid diverse other priorities (including climate change), reinforcing the need for a systemic policy approach that situates technological interventions to support biodiversity within an enabling societal and governance context and a wider economic system.

For the scenario communities, we reinforce previous calls for extension of the Eur-SSPs to address a wider set of drivers, factors, sectors and actors. We demonstrate a methodology for doing so in ways that explore the nature of the entangled biodiversity and climate crises, thereby offering more 'biodiversity-centric' scenarios to the climate research community – and in turn, climate-relevant scenarios to the biodiversity community. However, this is only a first step. A deeper analysis of the entangled biodiversity-climate crisis may also introduce the implications of various RCPs to detail how climate change impacts on biodiversity interact with these already-complex interactions between biodiversity and socio-economic change. Further, climate projections themselves do not sufficiently account for feedbacks between climate and biodiversity nor interactions between interventions (climate mitigation and adaptation, biodiversity conservation, habitat restoration, and nature-based solutions), highlighting an opportunity for deeper integration between these two domains. Further, a nexus perspective highlights the need for further evidence regarding and implementation of policy implementation scenarios and models in understanding how multiple associated sustainability targets across temporal and spatial scales could be achieved (IPBES, 2024). Beyond these areas, interactions and feedbacks between the indirect drivers themselves and their effects on the nexus elements is reflected to some extent in the narratives, but requires further exploration. Finally, our analysis focused on the scenario narratives as a whole and further iterations would detail how the systemic interactions evolve over time. We hope this contribution demonstrates

and inspires more intentional application of scenario frameworks that reflect the complexity of interacting environmental challenges.

Acknowledgments

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Open Research

No additional data beyond the workshop data (Table S2) and final enriched European SSPs (Table S1) were produced during this study. All data used for this paper has been anonymized and published in accordance with the research ethics protocols for confidentiality and informed participant consent.

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Earth's Future

Supporting Information for

Enriching the European shared socio-economic pathways with considerations of biodiversity and nature using a nexus approach

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Contents of this file

Introduction

The Supplementary Information contains the following, which support the main content of the journal paper:

- Text S1 includes methodological details that clarify how the European Shared Socio-Economic Pathways (SSPs) were enriched and analysed using a nexus approach.
- Text S2 includes the full enriched European-SSP narratives produced through the study, which support the analysis in the main text.
- Figures S1 to S6 support Figure 3 to 6 in the main text as additional visualisations for the scenarios that are discussed but not fully visualized in the main text.
- Table S1 supports Table 2 in the main text by providing the temporal change of the state of each of the nexus elements in each scenario.
- Table S2 includes the anonymise data collected from the workshop, before any further analysis or synthesis into the narratives. Please note that some of the data was not included in the final enriched European SSPs in Text S2 due to considerations made later in the analysis, such as internal consistency and overall coherence of the narrative.

Text S1.

Detailed methodology for enriching Eur-SSPs using workshop outputs: The stickers were clustered according to time span (i.e., present to 2040, 2040 to 2070, or 2070 to 2100) and then according to common themes. A summary statement was written to summarise common themes. These summary statements were then integrated into the original Eur-SSP narratives in ways that maintained internal consistency and plausibility within the original Eur-SSPs and maintained the narrative flow. These revisions were verified and calibrated by a quality assurance review against the raw notes from the workshop by a reviewer. During this process, internal consistency was again checked in each Eur-SSP for further adjustments, and some modifications were made to bring coherence to the events and implications across time scales. An additional quality assurance review was conducted on the draft enriched Eur-SSP narratives by a researcher independent of the original analysis.

Detailed webinar methodology: After a welcome and introductions, facilitators presented each of the enriched Eur-SSPs followed by an opportunity for participants to ask questions and give feedback. After this, participants were split into breakout groups, each dedicated to one of the four enriched Eur-SSPs, to draw a collaborative system diagram that allowed them to map out elements of, and interlinkages within, the biodiversity nexus in the narrative supported by an online Miro board and a facilitator. The process attempted to cover the whole Eur-SSP narrative by mapping out existing elements and interlinkages from the draft narrative on a standardized map of the nexus, and then further enriching the diagram. Groups that had extra time discussed the indirect drivers (e.g., social, technological, economic, etc.) that were driving the trade-offs and synergies within the biodiversity nexus in that Eur-SSP. The discussion was captured via the Miro board and a dedicated notetaker for each group.

Detailed methodology for adapting enriched Eur-SSPs using webinar outputs: The captured data were synthesized and incorporated into the draft enriched Eur-SSP narratives to produce a final version. To do so, the discussion points for each SSP were collated and comments were made on the draft enriched Eur-SSP narratives, highlighting potential changes to be made based on feedback after the presentation of the narratives and additions/enrichments of narratives during the collaborative systems mapping exercise. In-text edits were then made on the draft narratives with changes tracked, and notes were made regarding which webinar inputs were moved to different time periods in the narrative or rejected because of internal inconsistency. The new narratives were then subject to a second quality assurance review following the same procedure as the draft narratives after the workshop. The final narratives were then sent to stakeholders for final validation.

Detailed methodology for generate a systems analysis of enriched Eur-SSPs: Each interlinkage was labelled according to the following criteria: (i) from (originating element); (ii) to (receiving element); (iii) statement from the narrative informing the interlinkage; (iv) textual summary of the interlinkage; (v) whether the statement was from the original versus enriched narrative; (vi) whether the interlinkage was directly stated (i.e., explicit) or inferred from the narrative (i.e., implicit); (vii) whether the interlinkage implies a direct or indirect link between elements; (viii) corresponding time period in the narrative (i.e., present to 2040, 2040 to 2070, 2070 to 2100); and (ix) positive or negative interlinkage (i.e., increasing or decreasing the 'to' variable, except for biodiversity, which was positive or negative impacts on biodiversity). After initial coding of the database, each of the four coding researchers

reviewed the database for one other Eur-SSP and commented on the comprehensiveness and consistency of the database to inform a revision. Finally, a researcher who was not involved in the original coding reviewed the whole database for comprehensiveness and consistency across all four Eur-SSPs, which informed a final revision of the database.

Text S2.

BIONEXT Enriched European SSP1 scenario

From Present to 2040: The interplay of financial, environmental and economic crises has strong repercussions for European citizens affecting jobs and standards of living. This fuels the feeling that societal behaviour needs to change away from an unregulated market-driven economy to a sustainable development path, and European leaders are compelled towards further integration of financial, fiscal and environmental policies. Eventually, a system of national accounts is put in place that adopts a basket of wellbeing-based performance measures instead of GDP. These are supported by scientific evidence linking human wellbeing to nature and biodiversity. Science-policy dialogues open up to plural knowledge systems and worldviews around biodiversity. Indigenous and traditional knowledge becomes embedded in curricula, laws and policies. As a result, cultural and biological diversity becomes part of everyday life.

Governments are under increasing pressure to take ambitious measures to move Europe to a more just and sustainable future. This includes tackling climate change and biodiversity loss, whilst also investing in health, education, and social support. Protected areas are expanded for nature restoration, and policy incentives are used to promote the provision of ecosystem services and sustainable practices on private agricultural and forestry land. This leads to gradual improvements in soil health and forest resilience, but it is recognised that more still needs to be done to tackle problems such as pollution and to offset indirect impacts of protected areas (e.g., displacement effects). Investments are also made to increase green space and green infrastructure in urban areas, supported by initiatives from government, communities and industry. These investments promote cycling and walking as alternative sustainable modes of transport for short distances, whilst the railway network is expanded for longer distance travel by gradually repurposing roads and integrating high-speed rail lines with nature corridors. These sustainability investments come at the expense of somewhat slower economic growth, constraining resource availability and livelihoods. As such, the green transition is initially met with some resistance. However, the resulting higher quality of life and a growing feeling of security and safety are eventually embraced. People are generally healthier, consuming more nutritious and diverse foods, and feeling more connected to their local environment.

In Europe and worldwide, trade wars and other economic crises are addressed by multi-level governance configurations with increasing effectiveness. This includes collaborative governance of marine protected areas, which are managed taking account of local context and local knowledge to improve the health of marine ecosystems, whilst supporting small-scale fisheries and fishers. The agricultural sector reforms to become more regenerative, respecting biodiversity and the ecosystem services upon which it relies (e.g. pollination). Investment in green technologies and geo-engineering increases

rapidly, facilitating an energy transition towards renewables and energy efficiency. The increased use of renewable energy, which includes bioenergy, initially increases pressure on land and results in negative impacts on biodiversity. However, over time the risks of these sustainable energy sources are addressed so they have net positive impacts on air and water quality and quantity, which improve biodiversity and human health. The social benefits of energy cooperatives are also widely recognized, and significant support is allocated to them. By 2040, efforts to transform Europe to a sustainable society are starting to pay dividends. This is reinforced by gradually changing lifestyles as humans increasingly recognize themselves as part of nature. Despite this progress, innovative solutions are still needed to address trade-offs, particularly in areas with high population density.

From 2040 to 2070: A decrease in conflicts in Europe's southern and eastern border regions leads to higher political stability and moderate but steady economic growth in an increasingly equitable Europe, which allows the middle class to grow stronger. European countries also recognise the essential role of local leaders and authorities, giving more power to local communities who design integrated solutions for lowering greenhouse gas emissions that bring co-benefits for biodiversity conservation and human wellbeing. The local communities collaborate to protect local biodiversity and put pressure on governments and the European Union to support conservation of ecosystems across regions. At the EU level new regulations are brought into law to limit thoughtless and wasteful consumption by introducing resource-caps per capita on material footprints, including water, energy and carbon. People lead more sustainable lives in compact cities or in smaller towns that are self-sufficient in the production and consumption of renewable energy and healthy food.

The European Union expands further and participates in new global governance initiatives. The larger EU takes responsibility for addressing its environmental impacts in the border regions and leads investments that help the pursuit of sustainable development goals globally. This contributes to widespread ecosystem restoration beyond Europe with the greening of arid areas, and cities joining forces to ban wildlife trade around the globe. This financing of sustainable growth outside of the EU reverses increasing trends in migration to Europe and, for the first time this century, migration towards Europe starts to decline.

There is a substantial shift in the European political agenda with a greater focus on wellbeing than economic growth, driven by human losses associated with climate change combined with positive improvements in accessible education and lifestyle. Some governments in Europe adopt a degrowth economic model. Biodiversity is consistently mainstreamed with AI-assisted policy planning and implementation that ensures policy coherence across sectors. By the 2050s, sustainability policies have matured with stricter enforcement of environmental protection. Sectors have transformed to address the underlying causes of biodiversity loss and now allocate more budget to biodiversity conservation and restoration. Advances in green technologies are

further stimulated by international competition leading to a CO_2 neutral society by 2050. The positive impact of the sustainable transition becomes increasingly visible, gaining more support from the public and the governments.

From 2070 to 2100: Worldwide, consumption is now oriented toward low material growth and low resource and energy intensity. This results from the development of new technologies that enable radically reduced resource consumption through increased resource efficiency and a strong increase in the use of renewable energy sources, facilitated by new flexible global, regional, and national institutions that enhance international cooperation. People limit air travel and spend more time in nature within their own country. Nevertheless, innovation in the aviation industry allows zero emissions travel enabling people to occasionally experience biodiversity hotspots worldwide, though in some cases this has rebound effects as some people travel more. New technologies are inspired by nature, traditional knowledge and transdisciplinary practice, with balanced participation of women, which stimulates more integrative biodiversity conservation. This leads to co-benefits for regulating the climate, retaining water and underpinning sustainable and diverse food production systems. This ensures that all European citizens have access to healthy and nutritious diets.

Economic development is no longer based on growth and biodiversity has become a core indicator of the health and wellbeing of society. Europe's landscape is more diverse with well-designed land use in rural areas integrating across the agricultural, forestry, water resource and energy sectors. As a result, people's mental health is enhanced through their increased connection with nature. This leads to improved physical health as individuals engage in less stressful activities, resulting in longer and healthier lives. The ageing population increasingly values biodiversity and high quality green space for recreation and relaxation but also puts pressure on social services in some cases. Technological advancements further support this positive trend. Continued steady economic development and the strong middle class enable economic and social inequality to further decrease. By 2100, Europe is characterised by a high level of sustainability oriented political and societal awareness which is reflected in the education system, focusing on renewable energy and low material growth, in a strongly regulated but effective multi-level governance structure with strong international cooperation.

BIONEXT Enriched European SSP3 scenario

From Present to 2040: With the economy gradually picking up, the demand for resources increases, which turns out to be a tipping point for the state of the environment. In particular, increasing resource demand contributes to worsening the biodiversity and climate change crises resulting in severe ecosystem failures which lead to cascading and compounding shocks in society and the economy. Consequently, the world economy does not perform as expected, triggering economic crises across the

European Union that stress the structural differences across and within Member States. Populist movements become increasingly mainstream and are further fuelled by increasing riots in multicultural neighbourhoods.

Actions to address the severely degraded environmental state are developed, but without any cooperation at the EU level they are not prioritised. Gradually, government and public support for environmental policies declines as policies to revive the economy are considered more important. The focus on economic development increases demand for energy, resulting in further environmental degradation, rising inflation, biodiversity loss and ecosystem damage. The rise in populism results in increasing border controls and barriers to trade, which in addition to inflation substantially increases energy prices which in turn increase food prices (e.g., due to fertiliser prices). Growing international tensions and persistent conflicts initiate a massive build-up of the defence sector, which is resource hungry but not resource efficient. Mobility between EU countries declines and innovation in the public and private transport sector diminishes due to the increased focus on the military. Escalating regional rivalry significantly reduces the overseas environmental footprint of European countries, allowing some local recovery of ecosystems outside Europe.

Extreme weather events become more frequent and further increase the costs of resources, damage control and defensive measures; this causes the economy in Europe to start to stagnate. This, in turn, increases unemployment rates and leads to the phasing out of the social security system. Agricultural areas expand and intensify as growing food becomes a key priority, yet farmers are under pressure due to rising energy costs. Less environmental protection influences food quality as the use of pesticides, herbicides and antibiotics (in livestock production) is less strictly regulated. Weakened regulations on nutrient management and water use result in significant impacts from diffuse pollution, agricultural irrigation and soil degradation. Water scarcity increases across Europe due to the impacts of climate change, but to a much greater extent in some regions, resulting in unequal access to water. Pressure on natural resources for consumer goods (e.g. wood) leads to growing competition among corporates and pushes governments to harvest unsustainably. This, together with agricultural expansion, leads to large losses in natural areas and species. Energy resources are unevenly distributed with some regions relying on existing fossil fuels, such as coal, whilst others move to local bioenergy production.

The majority of people live in large urban centres with increasing food insecurity and declining living standards, impacting health. Lack of planning regulations in cities leads to urban sprawl and significant build-up of traffic within large urban conurbations. This increases energy demand and air pollution affecting human and ecosystem health. Overall sickness increases, with the privatisation of healthcare making treatments accessible for only the richest and no public health facilities for the remaining population. In light of increasingly scarce public resources, long-term policy planning

becomes rare with hardly any money for education, research or innovation. Eventually the EU breaks down.

From 2040 to 2070: Continuing negative social, environmental and economic developments widen the gap between the poorer countries and regions particularly in the periphery of Europe and the richer, larger countries that maintain a decent level of social, economic and political stability. Policymaking is focused on immediate crisis prevention and is short sighted and egoistic. Environmental crises, such as climate change and biodiversity loss, remain a low political priority. A fragmented Europe struggles to care for its natural capital and resources as countries cannot effectively externalise the damage. Protected area legislation is abandoned to ease the ongoing conversion of natural habitat to agricultural land to help achieve food security, negatively impacting biodiversity. Illegal, unreported and unregulated fishing increases to cope with rising food prices, resulting in the collapse of some fisheries. Agricultural intensification decreases water quality with nutrient outflows from production impacting lakes, estuaries and oceans, and causing harmful algal blooms and dead zones. A severe decline in pollinators also negatively impacts food production. However, in some local communities, lack of access to artificial fertilizers and pesticides and a move to local food production and consumption has some positive effects on human health, biodiversity and greenhouse gas emissions, with some implications on agricultural expansion that in turn negatively impacts biodiversity (e.g., deforestation).

With the disintegration of social fabric, Europeans in the poorer regions increasingly migrate in search of jobs, and are employed in countries that are somewhat better off, for relatively low wages. Most migration is within Europe. Eventually, new regional blocs are formed in the north and in the south of Europe, while new alliances with other countries are forged to ensure sufficient energy supply. By 2070, social counter-movements appear with some signs of a slight economic recovery and increased social cohesion. Yet, these signs are temporary and do not take root in a fragmented and divided Europe with strong regional rivalry and conflict. Water wars become increasingly frequent in southern and eastern Europe due to large-scale desertification. Environmental flows are not maintained in rivers leading to huge losses in aquatic biodiversity in these regions. The general lack of economic resources and means to afford new technologies, coupled with weak institutions and governance structure, leads to an increasing resource intensity and fossil fuel use. Health systems fail as there is no cross-border cooperation in times of emergency, leading to increased health inequalities including limited access to facilities and availability of medication, and lower life expectancy.

From 2070 to 2100: In the absence of strong (inter)national institutions, criminal organizations and corruption take hold, in the aftermath of failed counter movements. Europe has lost its leading position, reinforced by difficulties to re-establish effective collaborations. Economic growth significantly reduces as the fragmented European regions deindustrialize and focus on maintaining basic human needs, such as food

security. This reduces demand for energy and materials, alleviating environmental damage and allowing incremental rewilding of certain areas. In the majority of Europe, food production becomes highly extensive as technological means of increasing yields are no longer available. Many people return to a subsistence lifestyle on the land working with nature to produce food locally.

The far-reaching fragmentation and cultural diversity have triggered a brain drain with the well-educated migrating to regions outside Europe that offer better opportunities. Eventually, Europe is not worse off than the rest of the world but struggles to avoid becoming the world's backwater as new clean technologies are increasingly developed elsewhere and affordable only for the richer European countries. Governance becomes increasingly community-based as co-ops establish and try to support each other in informal economies. However, clean water, clean energy and healthcare is only ensured for richer countries and regions, whilst the majority accept political instability and social injustice and learn to live with less.

BIONEXT Enriched European SSP4 scenario

From Present to 2040: Sparked by economic crises and extreme weather events, the EU increases commitment to find innovative solutions to the depletion of natural resources and climate change. In combination with current relatively high levels of social cohesion, energy efficiency and environmental policy-making this initiates a shift towards a high-tech green Europe. This transformation is strongly supported by large businesses that successfully seek collaboration with the increasingly powerful European government. High tech green jobs are available to highly skilled young workers and there is increasing public support for environmental policies and practices. New innovations improve biodiversity in economically important ecosystems, such as through sustainable and high-tech agriculture and food production (e.g., lab-based), improved water management systems, and the mainstreaming of biodiversity within the pharmaceutical industry. Eventually, average wealth starts to increase as crises are successfully combatted and people enjoy pockets of nature for recreation. At the same time, the centralised public-private partnerships and related policies result in increased social disparities within countries. For example, a high-tech and increasingly privatised health sector leads to new treatments and cures, but little attention is given to prevention of illnesses worsened by rising inequality. Additionally, the business and political elite gains control over land and secure elite access to high-quality foods, which in some cases benefits ecosystems and biodiversity (e.g., as high-tech food production frees up land) at the expense of a large proportion of the population. Meanwhile, energy utilities engage with the energy transition through digitalisation strategies but, as public trust grows, begin to greenwash their activities and exploit nature for profit. The deep seabed is opened for mining to meet rising demand for technology, resulting in a significant loss in marine biodiversity.

Traditional knowledge related to the environment that is not directly economically valuable (e.g., for identifying new medications) is lost. Already-marginalized groups are pushed to vulnerable regions across Europe where they experience more significant impacts of climate change and biodiversity loss. Tipping points are crossed affecting countries outside of Europe initially as green innovation enables adaptation within Europe, such as technological fixes to declining bee populations. In addition, the people and ecosystems of countries outside of Europe are negatively impacted by the extractive industries that support the shift to green technology within Europe. This destabilizes already-fragile economies who move away from trade relationships with the EU.

From 2040 to 2070: Technology development is strong in the high-tech economy and sectors. Energy companies hedge against price fluctuations by diversifying their energy sources, with investments in both carbon-intensive fuels such as coal and unconventional oil, but also low-carbon energy and experimental sources such as tidal power, which have mixed impacts on biodiversity. High-tech transport systems emerge across Europe, fuelled by hydrogen and clean electricity. New high-tech sectors are growing in importance and gradually become the backbone of an economically strong Europe. However, this transition toward a high-tech green Europe continues to increase demand for resources in regions outside of Europe, exploiting ecosystems on a global scale. At the same time, inequalities are rising because of several simultaneously acting factors. These include skill-based technology development, highly unequal investments in education, and less affluent groups having increasingly weak political power and limited access to credit.

Strong technological development in food production leads to intensive production concentrating around cities, resulting in an exodus from rural areas that improves biodiversity in abandoned lands. This land abandonment is accompanied by an increased demand for land for clean energy production (e.g., solar-PV), including to fuel new high-tech transport systems which in turn reduce environmental pressures such as pollution. Techno-innovations also increase water demand, putting pressure on freshwater ecosystems, but new and improved industrial processes allow for better and more efficient water purification and recycling. However, people in cities suffer due to lack of employment, low purchasing power, poor-quality food, and inadequate access to healthcare. Together, these increasing disparities in economic opportunities and political power lead to increasing inequalities and stratification both across and within countries. The traditionally strong middle class decreases in influence but only slightly in numbers and can no longer afford to consume at high levels. Significant inequality and lack of social support provides a weak basis for preserving public goals such as nature protection, so biodiversity declines further. Elite capture of land leads to privatisation of natural resources such as water, creating bottlenecks in supply for the majority of the population. The poorest communities are driven to wildlife consumption through hunting, illegal and unreported fishing, foraging (?) and backyard animal production,

which spreads diseases and leads to biodiversity and wildlife extinction. Inadequate access to formal healthcare leads people to return to nature for natural remedies.

By 2070, there is a large and widening gap between an internationally connected society that is well educated and contributes to knowledge-intensive and capital-intensive sectors of the global economy, and a more fragmented collection of lower income societies that work in a labour intensive, low-tech economy, mostly in the service sector for the benefit of the elite. This leads to social unrest amongst the lower classes and a decline of trust in governments. Unskilled and uneducated people who are dissatisfied with the global elite form sub-cultures and counter-movements. Some of these movements move back to rural areas to adopt land-based sustainable practices on previously abandoned land. This is combined with more active modes of transport such as walking and cycling.

Despite a strong EU, power becomes increasingly concentrated in a relatively small political and business elite, while vulnerable groups have decreasing representation and influence. Among others, this results in increased conflicts in poorer regions of Europe and migration flows to safer areas, which become protected and biodiverse `islands'. These migration flows within the EU shift the geographic distribution of natural resource use, increasing exploitation of some areas while abandoning others to rewild. Slums appear and grow across Europe in areas of high migration pressure, leading to a dramatic loss of habitat and pollution of waterways around cities, thereby reversing the impacts of technological efficiencies in the water sector. Migration flows into Europe are highly controlled by the elite, but Europe increasingly attracts illegal immigrants competing for decreasingly available low-skilled jobs. Overseas territories and former colonies continue to be disproportionately affected by natural resource extraction by European businesses, triggering a move to more localized and tailor-made policies for biodiversity protection in these regions.

From 2070 to 2100: Europe has become a market leader in (green) technologies, because of long-term under-investment in new resources in many other regions of the world related to uncertainty in fossil fuel markets. The need for strategic autonomy leads the EU to shorten value chains and endogenize mining and production activities where possible, reducing pressures on ecosystems outside of Europe but degrading ecosystems within Europe. Protected by a strong elite, the small "connected" upper class benefits, with high-skilled workers moving easily across countries to tap into new business opportunities. The elite becomes increasingly separated from other social classes, including the now quickly dwindling middle class, and through their exclusive access to high-tech, high-quality food and large areas of land and nature. This results in deepening inequalities within and among countries across Europe.
The majority of the population does not benefit from technological breakthroughs and does not profit from alliances between big business and the political elite. For example, agriculture focuses on high-input and GMO production in large-scale industrial farms in association with the high-tech food sector, explicitly excluding small-holder farmers.

This disconnects people from nature and perpetuates biodiversity loss. With decreasing public funding, good education is only accessible to those who can afford it. Technological development has not resulted in reduced energy prices but has instead established an oligarchy of green business developers that control energy supply and reduce resource availability for the majority. The wide gap between rich and poor leads to a worsening food crisis as poor people struggle to access healthy food. Where possible, people return to the countryside on marginal, formerly private lands that are not a priority for big business, where they grow their own food and begin to reconnect with nature. These regional communities in select rural areas continue to adopt sustainable lifestyles, locally lowering climate emissions and improving rural biodiversity, though in some cases their lack of access to technology puts pressure on ecosystems (e.g., use of biofuels). They also support each other through a focus on informal education, peer-to-peer learning and biodiversity value. As a governing body, the European Union is strong with strong ties with the lobbying industry. Social cohesion, however, is now low and stratified, while human health has decreased for most. By 2100, Europe is an important player in a world full of tensions, but with growing inequalities across and within European countries.

BIONEXT Enriched European SSP5 scenario

From Present to 2040: In the rebound from the economic and health crises in Europe, there is a shift towards market deregulation, resulting in a strong labour market and increased purchasing power. Global markets are increasingly integrated, with interventions focused on improving institutional participation of and benefits for disadvantaged population groups. There are also strong investments in health, education, and institutions to enhance human and social capital, since the economy is strong and growing rapidly. This results in a decrease in political unrest. The push for economic and social development is coupled with the exploitation of cheap and readily available fossil fuel resources. Market deregulation leads to an increase in imports and exports of commodities and food, increasing demand for transport and fossil-fuel resources. This is met through the expansion of road, air and shipping transport systems fuelled by the large-scale extraction of shale gas. This further stimulates economic growth but increases pollution, severely impacting biodiversity and human health. Environmental protection is reduced to enable increased access to natural resources. Deep sea fossil fuel extraction is allowed in Marine Protected Areas, resulting in drastic impacts on marine biodiversity and small-scale fishers. Fishers transition to other sectors, leading to a loss of cultural heritage.

Europe regains its leading position in the global economy, which further contributes towards a focus on economic growth and export markets rather than environmental policies. The increased economic wealth stimulates the development of (green) technologies. For example, technological and scientific innovation enable creation of efficient agriculture (e.g., precision farming) and new food systems (e.g., lab grown meat, GMOs, cell-based seafood, vertical farming, and hydroponics), and higher

purchasing power drives consumers toward these products. This reduces pressures on land use, particularly in terms of decreases in livestock and livestock feedstock production. Technological innovation in healthcare focuses on treatment rather than prevention or health promotion. Technology is only able to mask the negative impacts of environmental degradation on human health and wellbeing to some extent, and long-term illnesses increase as fertility rates decline. Governments only act to limit access to valuable ecosystems when their degradation threatens trade and economic growth. Nuclear energy is slowly phased out everywhere in Europe, while investments in biofuels and other renewables are relatively low, in favour of cheaper and more readily available fossil fuels.

From 2040 to 2070: Because of decreased energy price volatility and stabilising economies, public trust in political decision-making increases which facilitates strategies related to further exploitation of natural resources. Attempts to improve energy self-sufficiency within Europe intensify technological development aimed at greater extraction of fossil fuel resources, further driving climate change resulting in ecosystem collapse. Yet, faith remains strong in the ability to effectively manage social and ecological systems, including by geo-engineering and other technology fixes (e.g., carbon capture and storage). High and low skilled immigration and mobility remain high as European economies flourish. Job availability across all market sectors is high and contributes towards a reduction of inequalities and competition. Population across all societal classes, and the strengthening middle class in particular, adopts a very energy intensive lifestyle. Overconsumption and a focus on agricultural efficiency also reduces dietary diversity, leading to poorer health and a loss of cultural diversity.
Education focuses on the importance of innovation in key economic sectors, such as energy, agriculture, and transport, rather than the environment and nature protection, instilling a strong trust in technology. Where environmental problems occur, these are tackled locally and reactively with technological solutions. For example, a rise in the use of desalinated water in southern and southwestern Europe enables increases in intensive food production with some negative impacts on marine biodiversity. As the environment degrades, the majority of the population is unaware because of successful technological innovation, for example in food and water production, vaccination availability, and climate adaptation, which decrease the dependency on ecosystem services. Yet, the effects of degradation are broad, such as increases in microparticle pollutants, declining water quality and poor soil quality, which collectively have a negative impact on biodiversity, food production and public health. Deep sea mining is pursued at massive scales, leading to deep sea ecosystem collapse. Carbon cycles and sequestration are severely impacted. Targets in the Paris Agreement are not met, leading to high levels of climate change and more frequent extreme climate events. Near 2070, biodiversity tipping points are reached, and ecosystems collapse as food insecurity grows. Food prices rise and unemployment worsens in rural areas. As climate impacts manifest, people move to cities and become used to living in artificial and 'closed' societies divorced from nature. The rural minority adopt self-organised, local,

and often manual means for procuring natural resources, increasing the strain on biodiversity.

From 2070 to 2100: In general, Europe continues on its path towards economic and social sustainability through competitive markets; investments in education and health; innovation and a strong focus on technological solutions fuelled by an (over)exploitation of fossil fuel resources, with an ever-stronger pressure on natural resources. Technology is used to mitigate the high levels of climate change with a strong emphasis on extracting CO_2 from the atmosphere through various carbon capture and storage technologies. The continuous high stability of the energy market and economies have changed European policymaking, now predominantly focusing on and investing in policies related to human and social capital (including financial systems and infrastructure), rather than environmental protection. However, new carbon markets begin to emerge as market-based solutions to tackling climate change are sought. Environmental conditions degrade so severely that human innovation for masking the effects cannot keep apace. Biodiversity loss occurs at scale. Human health suffers, with increasing non-communicable diseases straining health systems. Rapid sea-level rise forces a retreat of low-lying communities from the coastline, resulting in millions of properties being abandoned with mixed impacts on the housing markets.

The population continues to grow with many non-coastal European cities having become economic hubs with efficient transportation means, increasing demand for natural resources in and around urban areas. Europe maintains an economic advantage internationally but is blamed for harmful climate and biodiversity impacts and failure to adapt to severe climate change leads to continued reliance on imports including for food and energy security. However, national governments have less political power, which enhances the free circulation of services, goods and people. Moreover, democracies are threatened as the cracks in prosperity begin to show. Youth no longer have access to nature, contributing to declining physical and mental well-being. Towards 2100, the environment is locally seriously degraded as non-renewables are further exploited, which eventually results in a slow re-emergence of investments in renewables, deemed necessary as prices of fossil fuels rise following peak oil. Transport and energy systems begin to accelerate the move away from fossil-fuel dependency where possible. Yet, despite massive spending on technology and adaptation measures, they are still insufficient for halting and reversing the climate and ecological crises.

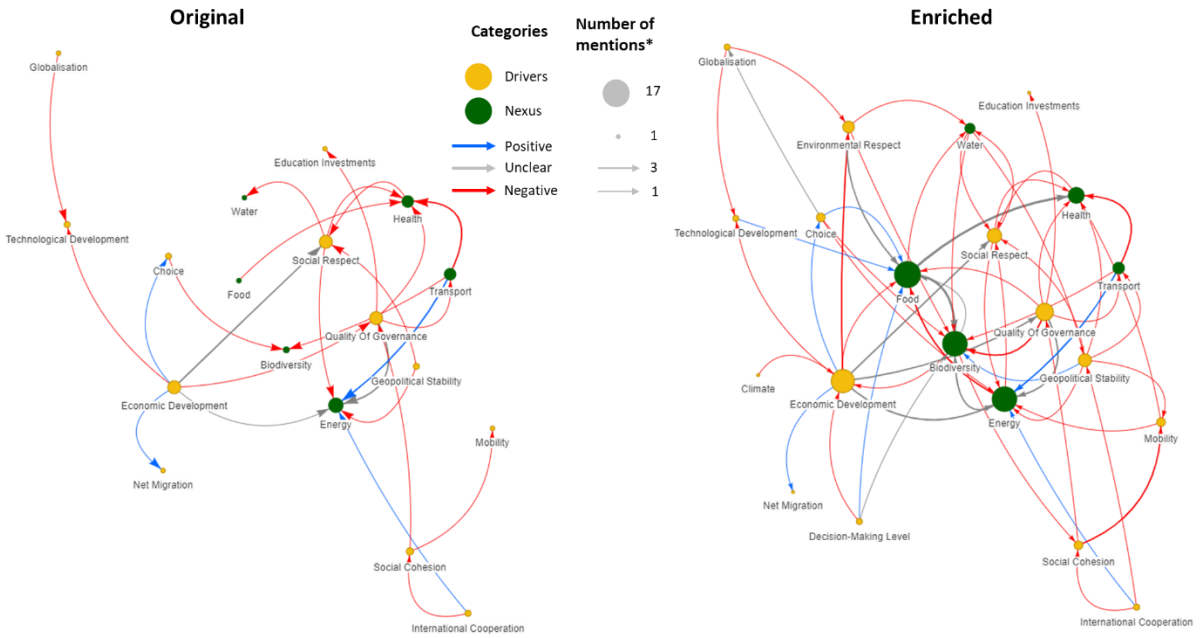


Figure S1. Original (left) versus enriched (right) system map of the narratives for Eur-SSP3. The nodes are scenario elements, with the biodiversity nexus elements in green and indirect drivers in yellow. The size of the nodes corresponds to the number of times the element is mentioned in the interlinkages to and from that node. The edges on the systems maps were produced so there is only one arrow for each node-to-node relationship. The thickness of the edge corresponds to the number of mentions underlying that interlinkage. The colour of the edge corresponds to the positive (blue), negative (red), or mixed/neutral (grey) direction of the node-to-node relationship.

* 'Number of mentions' refers to the number of times the node of edge was mentioned in the scenario narrative (Text S2).

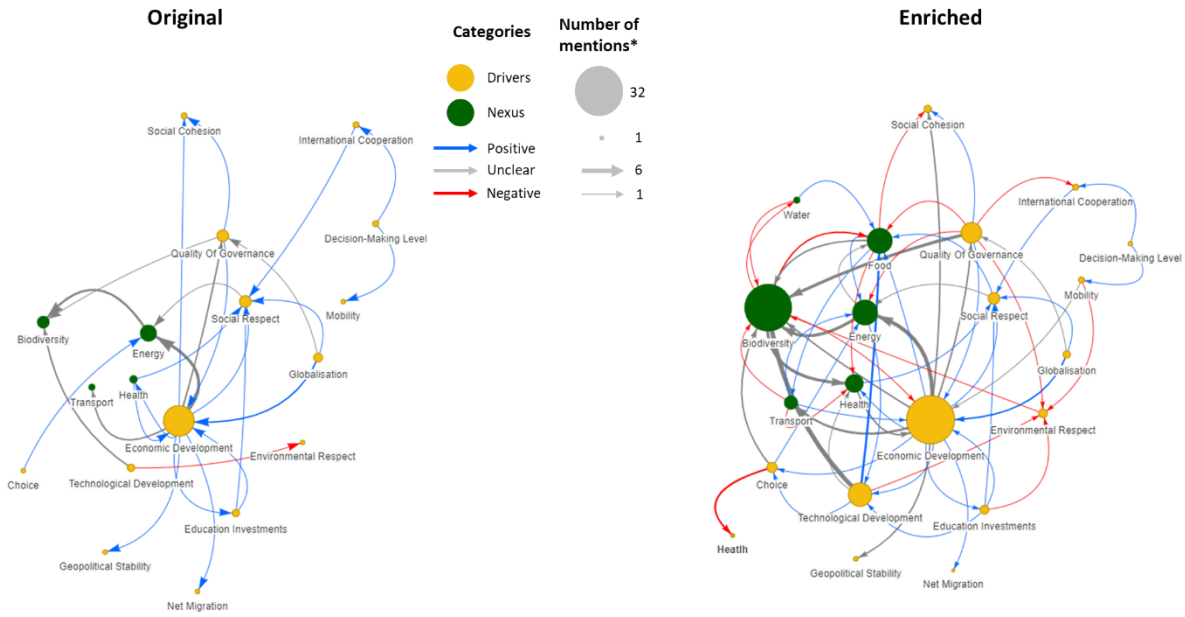
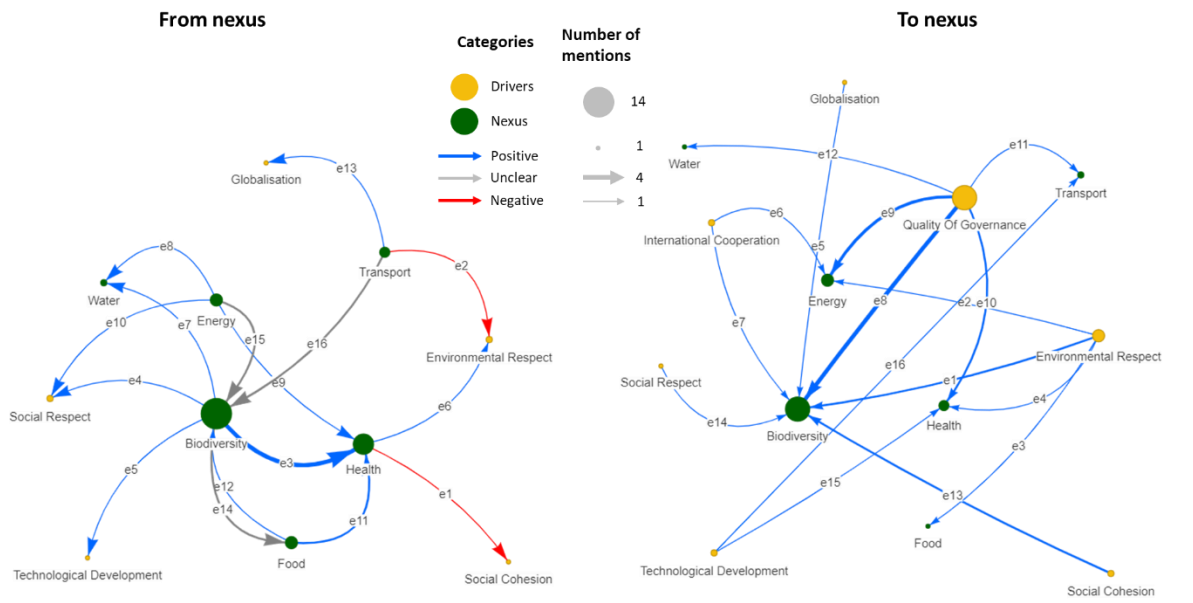


Figure S2: Original (left) versus enriched (right) system map of the narratives for Eur-SSP5. See Figure S1 caption for a detailed explanation of the figure.

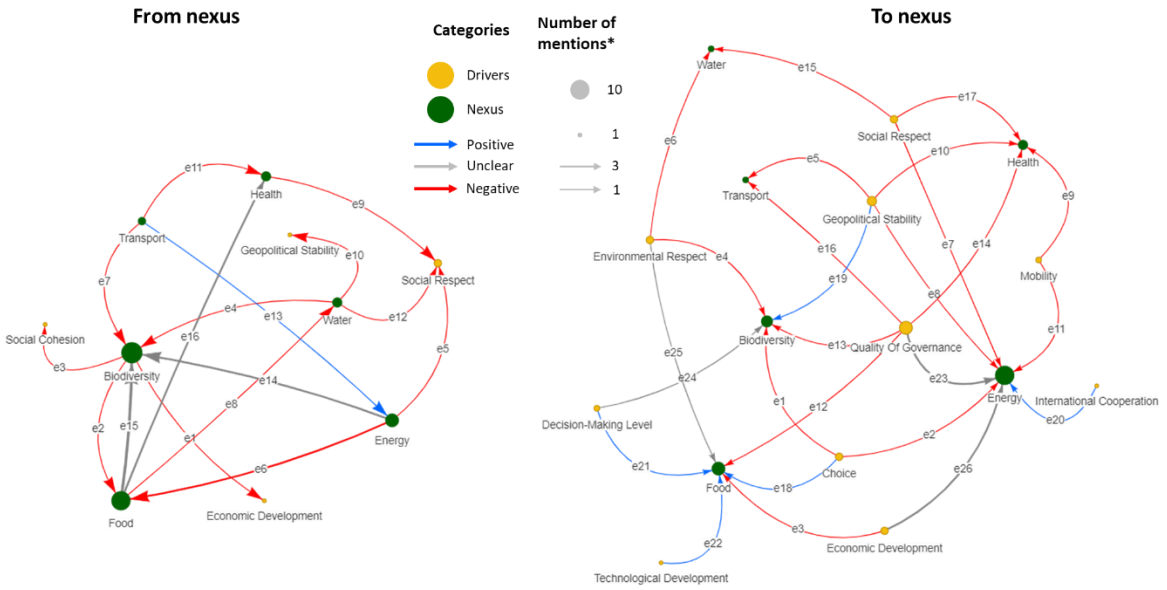


e1	Ageing population put pressure on social services (e.g., healthcare)
e2	Less air travel means that people recreate locally, in nature
e3	Biodiversity supports human health and wellbeing
e4	Standards of living deteriorate due to environmental crises
e5	New technologies are inspired by nature
e6	The ageing population increasingly values biodiversity and green space
e7	Integrative biodiversity conservation affects positively water retention
e8	Sustainable energy affects positively water quantity and quality
e9	Sustainable energy sources improve air and water quality, improving human health
e10	The social benefits of energy cooperatives are widely recognised
e11	Sustainable and diverse food production systems ensures access to healthy and nutritious diets for people
e12	Regenerative agriculture respects biodiversity
e13	Sustainable air travel allows people to experience biodiversity worldwide
e14	Participatory management of Marine PAs affects positively food production systems, but terrestrial PAs reduce soil availability for food (land competition)
e15	Renewable energy (including bioenergy) puts pressure on biodiversity due to land pressure but allows better air and water quality
e16	Transport infrastructure facilitates nature corridors but zero emissions flights increase travels causing negative impacts on environmental health

e1	Sustainable practices on agricultural lands improve soil health and forest resilience while low GHG emissions bring co-benefits for biodiversity
e2	Environmentally friendly lifestyles lead to local production and consumption of renewable energy
e3	Environmentally friendly lifestyles lead to local production and consumption of food
e4	Solutions for lowering GHG emissions bring co-benefits for wellbeing
e5	Investments for global SDGs positively contributes to biodiversity globally
e6	International cooperation facilitate the use of renewable energy sources
e7	Cities collaborate to ban global wildlife trade
e8	Government initiatives (PAs, green space, sectoral integration) allow to protect biodiversity and its services
e9	Regulations and investments in technology facilitates transition towards renewable energy
e10	EU political agenda focused on wellbeing
e11	Government investments promote cycling and walking, and railway network is expanded
e12	EU regulations limit water footprints
e13	Transdisciplinary and integrative practices stimulate biodiversity conservation
e14	Local knowledge in the management of MPAs causes healthy marine biodiversity
e15	Technological advancements help to longer and healthier lives
e16	Innovation in the aviation industry allows zero emissions travel

Figure S3: Sub-system maps of enriched Eur-SSP1 highlighting interlinkages within the biodiversity nexus and first-degree interlinkages from the biodiversity nexus to indirect drivers (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). The nodes are scenario elements, with the biodiversity nexus elements in green and indirect drivers in yellow. The size of the nodes corresponds to the number of times the element is mentioned in the interlinkages to and from that node. The thickness of the edge corresponds to the number of mentions underlying that interlinkage. The colour of the edges corresponds to the positive (blue), negative (red), or mixed/neutral (grey) direction of the interlinkage. The edge labels refer to text describing the interlinkages in the table below the sub-system map.

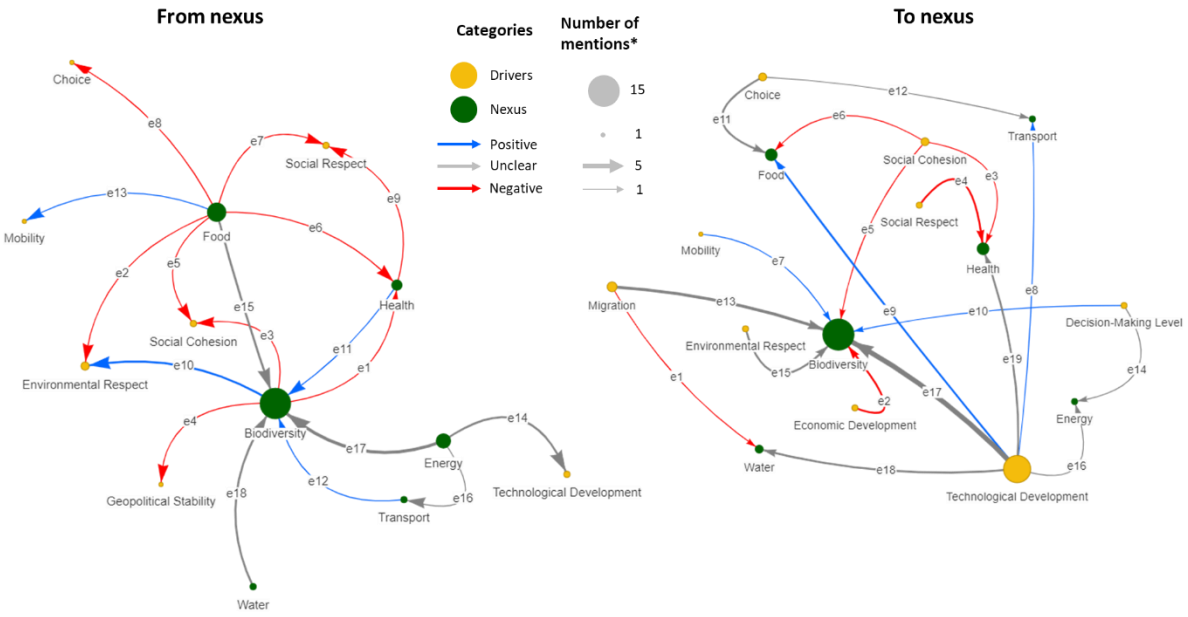
* 'Number of mentions' refers to the number of times the node of edge was mentioned in the scenario narrative (Text S2).



e1	Depleted biodiversity contributes to economic shocks
e2	Decline in pollinators reduced food production
e3	Depleted biodiversity contributes to societal shocks
e4	Environmental flows not maintained in rivers leading to loss of aquatic biodiversity
e5	Unequal distribution of energy resources results in difference in energy type used by different countries
e6	Increasing energy prices increases food prices (e.g., due to impacts on fertilizer prices)
e7	Traffic causes air pollution which affects ecosystem health
e8	Agricultural intensification increases nutrient pollution in water bodies
e9	Privatisation of healthcare makes treatment only accessible for the richest.
e10	Water wars become frequent due to large-scale desertification
e11	Traffic causes air pollution which affects human health
e12	Water scarcity is worse in some regions than others, leading to unequal access
e13	Build-up of traffic increases energy demand.
e14	Increased demand for energy results in further environmental degredation, then later in the century reduced demand for energy results in less environmental degredation
e15	Agricultural expansion and unsustainable harvesting leads to loss in biodiversity, and in mid-century, protected areas can be converted to agricultural land leading to a negative impact on biodiversity. However, a lack of access to artificial agricultural inputs and localised food production has positive impact on biodiversity
e16	Increasing food insecurity negatively impacts health, but in mid-century a shift away from artificial fertilisers and pesticides and local food production has positive impact on health

e1	Demand for resources depletes biodiversity and leads to ecosystem failures
e2	Deindustrialization reduces demand for energy
e3	Growing competition for resources leads to unsustainable harvesting
e4	Weakened regulations result in soil degradation
e5	Increased focus on military reduces innovation in transport
e6	Less environmental protection reduces water quality
e7	Social injustice causes the less wealthy to learn to live with less clean energy
e8	Geopolitical instability causes the less wealthy countries to learn to live with less clean energy
e9	No cross-border co-operation during emergencies leads to increased health inequalities
e10	Geopolitical instability causes the less wealthy countries to learn to live with less healthcare
e11	Increased border controls and barries to trade increase energy prices
e12	Unregulated/illegal fishing results in collapse of fisheries
e13	Decision making focuses on immediate crisis prevention, so biodiversity protection is not prioritised. Protected area legislation allows conversion of agricultural land resulting in biodiversity loss
e14	Privatisation of healthcare makes treatment only accessible for the richest
e15	Social injustice causes the less wealthy to learn to live with less clean water
e16	An insufficient regulation of planning leads to urban sprawl and buildup of traffic
e17	Social injustice causes the less wealthy to learn to live with less healthcare
e18	Growing food becomes a priority, expanding agricultural areas
e19	Escalating regional rivalry reduces Europe's overseas environmental footprint, allowing ecosystems to recover
e20	Alliances with other countries helps secure energy supply.
e21	Deindustrialsation focuses on basic needs including food security
e22	Agricultural production becomes extensive (i.e., taking up large land area) because agrotechnology is not available
e23	Weak governance causes increased fossil fuel use.
e24	Actions to address biodiversity loss developed but not prioritised due to lack of EU-level cooperation
e25	Less environmental protection (e.g. regulation on pesticides) impacts food quality
e26	Focus on economic development increases demand for energy

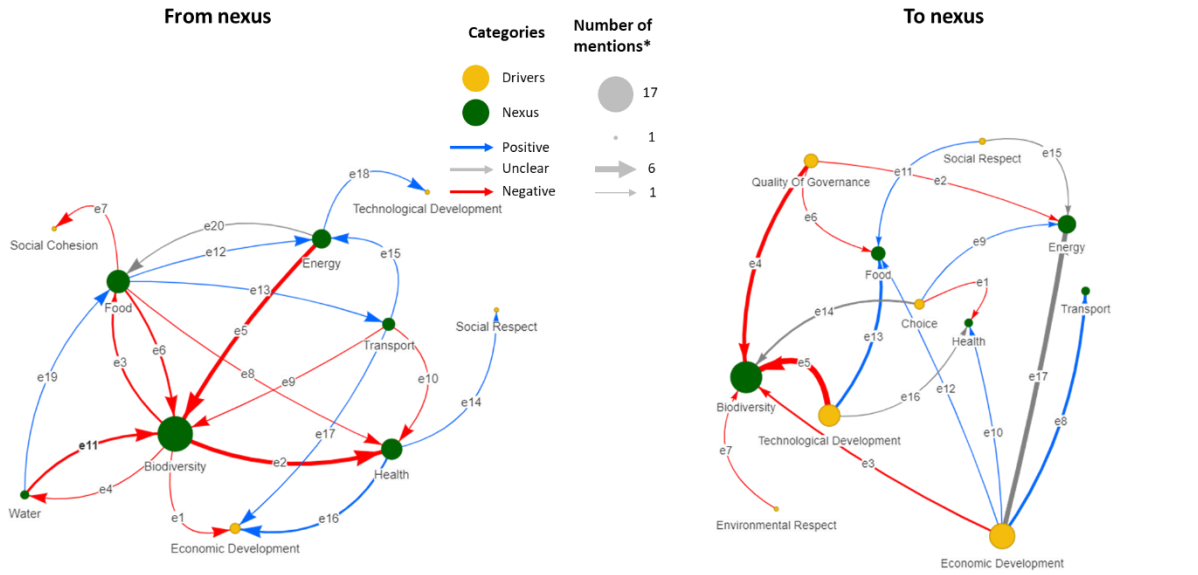
Figure S4. Sub-system maps of enriched Eur-SSP3 highlighting interlinkages within the biodiversity nexus and first-degree interlinkages from the biodiversity nexus to indirect drivers (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). See Figure S3 caption for a detailed explanation of the figure.



e1	People return to nature for natural remedies
e2	High-tech industrial agriculture disconnects people from nature and perpetuates biodiversity loss
e3	Unequal access to land and nature leads to increasing separation of elite
e4	Negative biodiversity impacts on countries outside of Europe destabilise already-fragile economies who move away from trade relationships with the EU.
e5	Access to high-quality food leads to increasing separation of elite
e6	Backyard animal production, hunting, and illegal and unreported fishing spreads diseases
e7	People suffer (lack of social respect) due to poor-quality food
e8	Majority of population does not benefit from high-tech industrial agriculture
e9	People suffer due to inadequate access to healthcare
e10	Improved ecosystems allow people to enjoy nature for recreation in Europe. Negative impacts of biodiversity abroad leads to the development of localised biodiversity protection.
e11	Mainstreaming of biodiversity in pharmaceutical industry improves biodiversity.
e12	High-tech transport system reduces environmental pressures (e.g., pollution)
e13	Technological development in food production leads to exodus from rural areas
e14	Energy efficiency enables shift toward high-tech green Europe, supported by extractive industries.
e15	Sustainable and high-tech agriculture and food production improve biodiversity, but backyard animal production and illegal hunting and unreported fishing by poorer communities' harm biodiversity.
e16	High-tech transport uses hydrogen and clean energy
e17	Energy utilities engage in transition but greenwash nature for profit and experiment with novel sources, with mixed impacts on biodiversity.
e18	Improved water management systems improve biodiversity but increase of water demand in other sectors puts pressure on ecosystems.

e1	Slums appear and grow across Europe, negatively impacting waterways
e2	Technological development negatively impacts ecosystems overseas and within Europe
e3	Social cohesion on average is low, and human health has decreased
e4	Rising inequality worsens health outcomes (e.g., prevention of illnesses and inadequate access to healthcare)
e5	Inequality provides weak basis for biodiversity protection
e6	Wide gap between rich and poor leads to a food crisis
e7	Exodus from rural areas improves biodiversity on abandoned lands
e8	Technological development leads to high-tech transport systems
e9	New innovations support sustainable and high-tech agriculture and food production
e10	Business and political elite gains control over land, which in some cases benefits ecosystems (e.g., as high-tech production frees up land)
e11	Poorest communities pursue wildlife consumption and backyard animal production, and sub-cultures move back to rural areas to adopt sustainable practices
e12	Sub-cultures and counter movements move back to rural areas and adopt active modes of transport.
e13	Migration within Europe shifts geographic distribution of resource use, increasing exploitation of some areas while abandoning others to rewild
e14	The oligarchy of leaders controls energy supply
e15	High-tech industrial agriculture disconnects people from nature and perpetuates biodiversity loss. Regional communities adopt sustainable lifestyles in response.
e16	Energy utilities pursue digitalisation
e17	New innovations have mixed impacts on ecosystems, while extractive industries negatively impact ecosystems abroad.
e18	New innovations support improved water management systems, but also increase water demand for other sectors.
e19	New innovations support mainstreaming of biodiversity in pharmaceutical industry and new treatments and cures, but does not give enough attention to prevention

Figure S5. Sub-system maps of enriched Eur-SSP4 highlighting interlinkages within the biodiversity nexus and first-degree interlinkages from the biodiversity nexus to indirect drivers (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). See Figure S3 caption for a detailed explanation of the figure.



e1	Loss of marine biodiversity leads fishers to transition to other sectors
e2	Environmental degradation and biodiversity loss negatively impact public health. No access to nature further deteriorates health and well-being.
e3	Environmental degradation negatively impacts food systems; Eventually an ecosystem collaps leads to food insecurity
e4	Environmental degradation negatively impacts water quality
e5	Energy demands driven by economic development and policies lead to overexploitation of fossil fuels with significant impacts on biodiversity
e6	Efficient agriculture reduces pressure on land; food production has some negative impacts on marine biodiversity
e7	Focus on agricultural efficiency causes a loss of cultural diversity
e8	Agricultural efficiency reduces dietary diversity, leading to poorer health
e9	Expansion of transport systems leads to increase in pollution (due to fuel demand and extraction) impacting biodiversity
e10	Expansion of transport systems leads to increase in pollution (due to fuel demand and extraction) impacting human health
e11	Poor water quality negatively impacts biodiversity
e12	Increase in imports and exports of food means higher demand for fossil-fuel resources
e13	Increase in food imports and exports leads to higher demand for transport
e14	Investments in health lead Europe to social sustainability
e15	Expansion of transport systems increses demand for fossil-fuels
e16	Investments in health lead Europe to economic sustainability
e17	Transport systems further stimulate economic growth
e18	Demands for energy self-sufficiency intensify technological development
e19	Use of desalinated water increases intensive food production
e20	Deep sea fossil fuels extraction results in drastic impacts on small-scale fishers

e1	Overconsumption reduces dietary diversity which leads to poorer health
e2	Governance inefficiency to tackle environmental issues leads to reliance on energy imports
e3	Economic development based on exploitation of fossil fuels and high demand on natural resources negatively impacts biodiversity
e4	Government limits environmental protection to economic interests; Public trust in decision-making leads to increase in exploitation of resources
e5	Technological innovations increase extraction and processing of natural resources, which negatively impacts biodiversity, while technological solutions increase efficiency in was that reduce dependency on ecosystem services.
e6	Governance inefficiency to tackle environmental issues leads to reliance on food imports
e7	Environmental degradation has negative impacts on biodiversity
e8	Economic development increases demand for transport and transport systems
e9	Population adopts energy intensive lifestyles
e10	Strong and rapidly growing economy causes investments in health
e11	Higher purchasing power drives consumers toward new agricultural products
e12	Market deregulation leads to an increase in impacts and exports of food
e13	Technology drives new food systems and products and more efficient agriculture
e14	Changing demand for food commodities decreases land use pressure; eventually natural resource management in rural areas increases pressure on biodiversity
e15	The push for social development fuels exploitation of fossil fuels
e16	Tech innovation enhancing treatment but not prevention or health promotion
e17	Economic development increases demand for fossil fuels, pushing out renewables; later, energy systems reinvest in renewables to move away from fossil-fuel dependency

Figure S6. Sub-system maps of enriched Eur-SSP5 highlighting interlinkages within the biodiversity nexus and first-degree interlinkages from the biodiversity nexus to indirect drivers (right) and the interlinkages from indirect drivers directly on the biodiversity nexus (left). See Figure S3 caption for a detailed explanation of the figure.

Table S1. Description of the state of the elements of the biodiversity nexus in each of four enriched Eur-SSPs

Element	SSP1	SSP3	SSP4	SSP5
Biodiversity	+ Biodiversity improves due to nature restoration, mainstreaming into policy, and changing human-nature relations • To 2040: biodiversity benefits from nature protection • To 2070: biodiversity benefits from mainstreaming by local communities and global goals • To 2100: biodiversity benefits from changing culture around human-nature relations	+ / - Biodiversity has mixed impacts from mixed response to geopolitical fragmentation and changing resource demand • To 2040: biodiversity suffers from lack of government and public support • To 2070: biodiversity declines due to reducing environmental legislation • To 2100: governance breakdown reduces demand for resources and biodiversity benefits	+ / - Biodiversity has mixed impacts from technology development, until inequality worsens biodiversity and counter movements return to nature • To 2040: biodiversity has mixed impacts from shift to high-tech green Europe • To 2070: biodiversity suffers from technological fixes inside and outside of Europe • To 2100: biodiversity declines as Europe endogenizes mining impacts but begins to bounce back from counter movements	- Biodiversity declines and collapses due to uncontrolled economic development and resource extraction and use • To 2040: biodiversity declines from economic drivers • To 2070: biodiversity declines as ecosystems collapse due to uncontrolled resource extraction and use • To 2100: biodiversity loss at scale as efforts to reverse ecological crisis fail
Water	Water resources in good condition due to more sustainable practices • To 2070: water quantity improves through more sustainable practices (e.g., energy) • To 2100: water resources in good condition from more sustainable landscapes	Water resources degraded and a source of conflict, with unequal access • To 2040: Water scarcity increases and unequal access begins • To 2070: Water wars frequent in southern and eastern Europe • To 2100: Water only available for richer countries	Water resources improve from technology, but inequality puts pressure on infrastructure and resources • To 2040: water resources benefit from improved technology in water management • To 2100: pressure on water resources from slums and elite privatisation	Water resources improve from technology, but uncontrolled development eventually degrades water resources • To 2100: technology initially reduces reliance on water resources but over time degrades water quality
Food	Sustainable and integrative food production	Food insecurity from governance fragmentation, leading to intensification and eventually more	High-tech food system caters to economic and political elite, resulting in food crisis for poorer majority	High-tech food system eventually degrades the environment,

	• To 2070: sustainable food practices adopted that are compatible with biodiversity • To 2100: sustainable and integrative food production systems established across Europe	extensive land use from deindustrialisation • To 2040: food prioritised but insecure due to fragmented decision-making • To 2070: food exploits nature due to agricultural intensification and reduced environmental legislation • To 2100: food system deindustrialises and becomes highly extensive as chemical inputs run out	• To 2040: high-tech and elite-oriented agricultural and food system • To 2070: intensive production around cities with poor quality food for majority • To 2100: food crisis as poorest struggle for access to healthy food	eventually causing Europe to rely on food imports • To 2040: new food systems from technological and scientific innovation • To 2070: agricultural efficiency and intensive production begins to cause environmental degradation, and food insecurity grows • To 2100: Europe depends on food imports
Health	Healthcare and wellbeing improve due to government investment and more sustainable ways of living • To 2040: health improves as government investments in health and sustainability • To 2070: health improves as people lead more sustainable lives • To 2100: health is high as a holistic health system is in place for all	Healthcare and wellbeing declining and unequal, with healthcare only for richer countries and regions • To 2040: health declines as privatisation and unequal access begins • To 2070: health declines further as lack of cross-border cooperation increases health inequality • To 2100: health poor for most and only secured for wealthy regions	Healthcare privatised and technology driven, with wellbeing declining and healthcare only for societal elite • To 2040: health shifts toward innovation and privatisation due to technology • To 2070: health declines due to unequal access and lack of prevention; a return to natural remedies among poor • To 2100: health poor for majority and only secured by elite	Healthcare and wellbeing decline as focus on technology and economic development neglects other aspects of wellbeing • To 2040: health declines as technology innovation focuses on treatment and not prevention • To 2070: health decreases due to declining state of the environment • To 2100: human health poor
Energy	Sustainable, renewable and cooperative energy systems across Europe • To 2040: transition toward renewable energy systems	Governance fragmentation and economic development affect energy demand and access and perpetuates reliance on fossil fuels • To 2040: economic development boosts energy demand and energy prices rise	Technology innovation, renewable transition, and elite control of energy supply • To 2040: energy utilities pursue efficiency and digitalisation • To 2070: diversification of energy mix to hedge against price inflation	Continued fossil fuel exploitation eventually resulting in peak fossil fuel and beginnings of switch to renewables • To 2040: continued commitment to fossil fuel exploitation with low demand for renewables

	• To 2070: self-sufficiency in consumption and production of renewable energy • To 2100: sustainable and renewable energy systems with international cooperation	• To 2070: lack of economic resources and weak governance perpetuates reliance on fossil fuels • To 2100: energy access limited to richer countries; governance breakdown reduces energy demand	and increased demand for renewables • To 2100: elite control of energy supply	• To 2070: energy considered a key sector driving economic development • To 2100: fossil fuel peak reached, resulting in re-emergence of renewables
Transport	Transition toward sustainable transport systems across Europe • To 2070: switch toward short-medium distance transport through active modes and better railway • To 2100: zero emissions air travel but people still limit air travel	Decreased innovation and priority in transport sector due to fragmentation and militarisation • To 2100: increased focus on military and lack of planning diminishes innovation and quality of transport planning	High-tech clean and active transport systems implemented in Europe • To 2100: high-tech transport system fuelled by hydrogen and clean electricity, with more people adopting active modes	Increased demand for fossil-fuelled transport to enable economic growth • To 2070: economic development increases demand for fossil-fuelled transport • To 2100: European cities become economic hubs with efficient transport, eventually moving away from fossil fuels

Table S2. Full dataset from stakeholder workshop used to enrich the European SSPs with considerations of biodiversity and nature

	SSP1				SSP3				SSP4				SSP5			
	Event	Impact on Biodiversity	*Possible summary for SSPs (before checks for internal consistency)*	*Notes*	Event	Impact on Biodiversity	*Contribution summary*	*Notes*	Event	Impact on Biodiversity	*Contribution summary*	*Notes*	Event	Impact on Biodiversity	*Contribution summary*	*Notes*
Present to 2040	EU rules about finance are reset		*EU rules about finance are re-set and system of national account is established to measure natural capita and well-being.*		EU values such as solidarity will disappear. EU policy design will no longer exist. Individualisim will grow No consensus to collaborate. No decision at global level at benefit of all		*EU policy design will no longer exist. EU values such as solidarity will disappear with growing Individualisim and no consensus to collaborate. National policies support only solutions at country level and lack further coordination, resulting in Inefficient public policies.*		EU strong political and economic commitment to force innovation allow for a transfer to sustainable food systems. Food products get strongly regulated in terms of impact on biodiversity, climate, diseases, etc.	Reduction of intensive food systems allows biodiversity to flourish – less diseases, less ecosystem pressure	Strong political and economic commitment to innovation stimulates innovation in sustainable agriculture. Food products are strongly regulated to protect biodiversity.		Due to increase negative impact on natural environment trough massive extensive tourism, government starts to close/limit access to most valuable ecosystems.	less reservats/protected areas are open	Due to the severe negative impact of mass tourism, governments begins to close or limit access to the most valuable ecosystems.	
	System of national accounts is established to measure well-being	This only works if we can establish an enormous shift in human behaviour		*combined with one above*	National policies support only solutions at country level, lack of further coordination, Inefficient public and policies			*combined with above*		less herbicides and pesticides			The pollution will bring forward the overshoot day to an unrealistic early date in the year	Political turmoil will hinder the exploitation of abundand fossil fuel use	Political turmoil hinders the exploitation of abundant fossil fuel use.	
	Faced with the need for coordination action of enhanced global status, EU member states agree on a treaty change, giving EU competencies? In tax, foreign policy, etc. (and perhaps losing some members a long the way).; This paves the way to an European federation, presuming a shared identity among citizens is enhnaced		*Faced with the need for an enhanced status the European federation in the world, EU member states agree on a treaty change, giving EU competencies In tax, foreign policy, etc. EU imports resources from elsewhere in the world, contributing to global degradation of nature.*	*seems to contradict positive impact of EU green deal*	Lack of strong EU means their global impact is decreased, less money in EU is less inversment in mining, food trade etc., Less money, less consumption allows a decreace in Europes global impact and allows local recovery		*Lack of strong EU leads to decreased global impact with less inversment in mining, food trade, etc., allowing local recovery. Smaller scale and regional community governance increases with Individualistic behaviour.*		General awareness to focus on improving the state of the environment and tools available. Improvement.	new tech may improve the protection of ecosystems and biodiversity	Public awareness of environmental issues stimulates new technologies that protect ecosystems and improve biodiversity.		No more MPAs, or if there are meaningless, allow for fossil fuel extractionin MPAs, thus increases …? European seas	signifcant negative impact on marine biodiversity, also negative impact on small scale fishers, who ultimately need to transition to other jobs (later), this is easily possible, but LOSS OF CULTURAL HERITAGE	Fossil fuel extraction is allowed in Marine Protected Areas, severely impacting marine biodiversity and small-scale fishers. Fishers transition to other sectors, resulting in a loss of cultural heritage.	
	EU exports all of its resource consumption elsewhere to the rest of the world, contributing to degradation elsewhere	Global nature degraded by EU consumption		*combined with one above*	Increase of smaller scale and regional community governance, Individualistic behaviour (for the individual or small group that has formed)			*combined with above*	Power and control increase over policy and land. Initially biodiversity benefits as social exclusion increases and natural resources protected. Health of wealthy improves and of poor declines. Wildlife health where protected improves.	Nature [?] benefits from elites but collapses later [precitiously?]	The political and business elite gains significant control over land, which benefits ecosystems and biodiversity at the expense of large proportion of the population.		Despite tech-innovation due economic growth; the health adverse impacts of a failing environment and the dominant lifestyle, leads to impact in: eg. health: cancer, low fertility rates, lung diseases. e.g. rights: rights around reproduction are declining in due attemept to reverse the population decline due to womens's bodies who must return into supporting a labour market with reproductive care. Food: failing crops due to tipping points worlaide being flipped.		Despite technological innovation, the impacts of environmental degradation and unbridled economic growth lead to adverse health impacts, including higher rates of cancer and lung diseas and lower fertility rates. Reproductive rites decline as governments attempt to reverse population decline and stimulate the labour market. Further, many people experience poor mental health, increasing costs of social and physical health care.	
	First results and impact of plans and agreements like EU green deal are surfacing. This motivates further more ambitious plans, positively impacting the climate crisis and its impact on biodiversity. People are eating more diverse and yet are more connected to local ecosystems		*First results of plans and agreements like EU green deal are surfacing. This motivates more ambitious plans, positively impacting the climate and biodiversity crisis. People are eating more diverse and yet are more connected to local ecosystems. EU policy (environmental and agricultural) primarily incentivises the provision of ecosystem services and sustainable practices in private agricultural and forestry sectors. This improves soil health and forests to be more resilient but there is still more to be done at the policy level.*		Regionalisation cultural smaller economic entities with specialisaiton, regionalisation will increase cultural identification and solidarity. This might play out well if regions can level out on regional solidariity		*Regionalisation of smaller economic entities with specialisaiton strengthens cultural identification and solidarity.*		the focus on tech-solutions fails to address the drivers of the biodiversity and climate crisis with catastrophic consequences on tipping points and life on Earth these are mostly affecting landscapes outside of Europe for a couple of years as the green tech extends the adaptation capacity of EU countries	Biodiversity and climate-related tipping points reached	The focus on technological solutions ultimately fails to address the drivers of the global biodiversity and climate crises. Tipping points are crossed affecting countries outside of Europe initially as green technological innovation enables adaptation within Europe.		Consumption driven living standards that are disconnected from the nature have a negative impact on health index and giving level of depression in the society (mental health) Increases costs of social/physical health care.	lack of understanding or need for connection to nature.		*Added above*
	EU policy (environmental and agricultural) primarily incentivises via financial mechanisms the provision of ecosystem services and sustainable practices in private agricultural and forestry sectors	improvement of soil health, more resilient forests		*combined with one above*	China will be in control of most of the harbours in Europe			*Unclear whether this level of specificity is relevant*	Marginalised/most vulnerable groups, are pushed into most vulnerable regions of Europe flood risk, heat, wildfires, SLR.	Technological advancement will help but not remove risks	Already-marginalized groups are pushed into the most vulnerable regions of Europe, where they experience more significant impacts of biodiversity and climate crises.		public spendings on health are high and benefits are shared. -> high value treatments to all. But prevention and health promotion are reduced. -> more illness.	no idea about the link between mand and nature"	Public spending on health care is high with benefits shared across the population. High value treatments are available with little prevention and health promotion, so people experience more long-term illnesses.	
		strong legal actions are urgently required but they must include livelihood security and justice			As EU breaks down countries go individually to secure food. Huge increas of food intensive production at national levels with transformations of landscape. Wrong diets increase, health decreases	Wildlife disapears from most EU due to food intensive systems. Huge biodiversity loss.	*As EU breaks down countries go individually to secure food, resulting in increased yield-intensive food production with transformations of landscape leading to loss of wildlife and biodiversity across countries.*		Health concerns will stimulate different approaches to generate new medication strategies, cleaning water systems		Public health concerns stimulate innovation to generate new medication strategies and better water systems.		Ecological risk on large scale	Increasing awareness	Ecological risk is experienced on a large scale.	
	Governments pursue ambitious measures to transition…	Biodiversity is both shared and spared			Shift in agricultural structure, national subsidies, market protections for food safety. Significant water problems in some countries for agricultural irrigation.	Soil degradation from intensive farming	*There is a shift in agricultural structure, national subsidies, and market protections for food safety with significant water problems for agricultural irrigation and soil degradation from intensive farming.*		energy utilities start getting engaged more in the energy transition based on higher digitalisation solutions. People (consumers) get happier (at start) and more passive as trust to EU utilities grows.	Energy utilities 'use' nature for profit. Green washing 'peaks'	*Energy utilities engage with the energy transition by focusing primarily on digitilisation solutions. Public trust in EU utilities grows, allowing them to 'use' nature for profit and resulting in increasing greenwashing.*		Science and innovation allow creation of new food systems e.g lab meat, GMO products, Ocean food. High purchasing power drives consumers towards these foods. This lead to reduction on consumption of livestock and consumption int This drives to healthier diets in late 2050	less intensive livestock -> less deseases -> healthier animals in wild ecosystems	Technological and scientific innovation enable creation of new food systems (e.g., lab meat, GMO products, ocean food). High purchasing power drives consumers toward these products, leading to a reduction on consumption of livestock. This shift leads to healthier diets and healthier livestock and wild animals (e.g., fewer diseases).	

Government investment in sustainable development meets initial public resistance...	Strong action on considering the human side of change is utmost needed to skip failure		*seems to contradict SSP1 original narrative*	Land fully concentrated in the hands of a small elite who controls the food system fully. The majority of people are concentrated in big urban centers and food insecurity increases living standards decline	Last remaining healthy ecosystems in the EU are transformed into monocultures to meet the demands of the urban centers	*Land is largely managed by a small elite who controls the food system. Last remaining healthy ecosystems in the EU are transformed into monocultures to meet the demands of the urban poluation. The majority of people live in big urban centers with increasing food insecurity and declining living standards, impacting health.*		Deep sea opened up for mining in order to meet rising demand for green technology, especially renewable energy for energy transition.	significant marine biodiversity loss. Deep sea ecosystems fundamentally altered	*The deep sea bed is opened up for mining to meet the rising demand for green technology, resulting in a significant loss of marine biodiversity.*		Resources are running out before 2050 for some highly technical solutions. Including lack of highly sophisticated medication	Technology innovation are nto realising the trap they fall into	Fossil fuels and resources consumed at a higher rate than can be replenished, so economic growth is limited. People turn back to nature and biodiversity to find solutions for long-term sustainability.	
	Risk of requiring more authoritarian rather than democratic actions early in the transition			Populism results in closed borders and highly localized food systems based on the highly intensified status quo. Bioderversity further declines climate resilience as well. We're depending on local corporate knowledge, mainly resulting into production of unhealthy (for planet&human) commodities with higly inaccessible food biodiversity	Land for food production being used for monoculture and biofules	*Populism results in closed borders and highly localized food systems based on the highly intensified status quo. Bioderversity and climate resilience declines with production of unhealthy commodities from monoculture and biofuel driven land use.*		Strong collaboration between industry and government focuses on protecting nature where it provides ecosystem services that are economically relevant.	ecosystems that are not directly economically valuable are losing protection	Strong collaboration between industry and government focuses on protecting economically-relevant ecosystems, while those that are not directly economically valuable are lost.		We consume fossil fuels and resource at ah higher rate than the planet can produce. -> economic and technological growth find end Fossil fuels finish while the wonderful high tech life disappears	Humans cannot survive withous nature and a well preserved environment -> they turn back to biodiversity for find solutions for sustainability. -Biodiversity is threatened by the high-tech development.		*Added above.*
	Big government investments push away citizens (negative for natural world)			Water scarcity is increasing in Europe but its impact is unequal regionally so it does not gain common attention and solution needed to be implemented. It impacts growing inequality in acces of food.	Water scarcity with biodiversity loss	*Water scarcity is increasing in Europe but its impact is unequal across the region, not gaining sufficient attention to find common solutions to improve it, resulting in inequality in access of water.*			Economically relevant ecosystem services protected			The costs of RES technology drops, enabling great development of wind, solar, storage, etc. project. Energy coops are strongly challenged and hardly compete against energy utilities. Bigger projects large-scale are mostly developed.	Complete lack of consideration about nature and biodiversity marjor lossess	The costs of renewable energy systems including wind, solar, and storage. Exploiting this opportunity leads to rapid development without consideratino of nature, leading to major biodiversity losses.	
Other bio-oriented cycles are not considered yet at a policy level. E.g. phosphate cycle				Pressure on resources for consumer goods (like wood) lead to growing competition among corporates and pushes governments to harvest more with no sustainablity criteria	Loss of natural forest due to more plantations, loss of species and natural places	*Pressure on resources for consumer goods (like wood) leads to growing competition among corporates and pushes governments to harvest unsustainably, leading to loss of natural forest and species.*		High tech does not replace and cannot recreate biodiversity so a false sense of security is created, leading to more rapid biodiversity loss, social inequity, and complete loss of traditional knowledge and culture.	green tech cannot replace biodiversity ...something... through traditional knowledge	High-tech green solutions mask the risks asociated with loss of biodiversity, generating a false sense of security that allows for further ecosystem degradation and a complete loss of traditional knowledge and culture related to the environment.					
Protected areas are quickly established as are lands for restoration. Incentives that recognize farmer actions as [?] are put in place securing livelihoods and [?]. Diets transition to healthy and culturally relevant with support to local production.	Space for biodiversity shared with production lands	*Protected areas are established as land for restoration, space for biodiversity shared with production lands. Incentives for farmers are recognizing actions for securing livelihoods and diets shift to healthy and culturally relevant for local production.*		People get more and more organized in energy co-ops but acces to high tech solutions is limited. Low tech diy pvs/wind systems energy but tensions start to .... As prodcution is not enough to cover energy needs		*People get more organized in energy co-ops but with a limited access to high tech solutions, leading to insufficient production to meet the demand. Energy resources will be unevenly divided with some regions still prospering with well organised energy production.*		Decline of democracy	[]						
Complacency over current ecological state of Europe and political [?] to "sustainable development" without any proof that any level of development can be sustainable. Unless consumption and human population decline nothing is sutainable. This is ???	Small gain in population of some ?	*Complacency over current ecological state of Europe and political [?] to "sustainable development" without any proof that any level of development can be sustainable. Unless consumption and human population decline nothing is sutainable.*	*contradicts above sentence*	Energy resources will be unevenly divided. But some regions will still prosper with well organised energy resources			*combined with above*	People get stewardship at local level and become protectors of nature	The visibility is promoting this approach in many regions	People at local levels understand the importance of biodiversity and become stewards of nature.					
Collaborative governance of MPAs with SSF suports both marine biodiversity and fisheries (and fishers). Also ensures that MPA management is adapted to local context based on local knowledge	Improves marine ecosystems health in MPAs and fisheries spillover	*Collaborative governance of MPAs with SSF suports both marine biodiversity and fisheries (and fishers). MPA management is adapted to local context based on local knowledge and improves marine ecosystems health in MPAs and prevents spillover in fisheries.*		Redcution of health, overall sicknesses increase, treatment is acessible for the richest, healthcare is more privatized, no publich health		*Overall sicknesses increase with privatization of healthcare making treatments acessible for only the richest and no publich health facilities for the remaining population.*		Informal urbanisation - slums appear and grow across Europe, impacting natural areas, sewage into waterways	Dramatic loss of natural habitat and pollution of waterways	Slums appear and grow across Europe, leading to a dramatic loss of habitat and pollution of waterways.					
Supports human-nature connections, buildings als in urban areas (EU ensures green spaces etc) in cities	Increases urban biodiversity, both through top down government initiaties but also community initiatives and industry	*Green space and infrastructure in urban areas increase biodiversity supported by initiaties from government, community and industry.*		Biodiversity crisis causes shock to society and economy which eventually leads to new actions at all levels to improve its state, but no cooperation at European level		*Biodiversity crisis causes shock in society and economy which eventually leads to new actions at all levels to improve its state, but without any cooperation at the EU level.*		Social enterprises voice risk to disappear [?] inequalities							
Increased use of renewable energy including bioenergy, initially increase pressure on land and biodiversity	Decrease of biodiversity	*Increased use of renewable energy including bioenergy, initially increase pressure on land and biodiversity and have negative impact on nature. The social impact of energy coops is acknowledge and a lot of support is provided.*		Environment is not a priority therefore public awarenees and government support decreases	Increased biodiversity loss - drivers causing even more damage	*Environment is not a priority therefore public awarenees and government support decreases with increased biodiversity loss and various drivers causing even more damage on nature.*		green job opportunities available to youth/skilled workers/ highly educated workers leading to happy public and support to the policies/practices around this scenario	Food democracy at risk	High tech green jobs are available to highly skilled young workers, increasing public support for environmental policies and practices.					
The social impact of energy coops is acknowledge and a lot of support is provided			*combined with one above*	The social and gender gap widens and female head households in poverty as more men are mobilized in the army, gender + social equity gap widens leading to massive poverty		*The social and gender gap widens with more female head households in poverty as more men are mobilized in the army.*	*Might be too extreme to be consistent with underlying SSP3 narrative*	Mining and other extractive activities to support green tech, harm people, societies and ecosystems outside of Europe, destabilising already fragile economies and societies. Probably some of the regions will move away from relationships trade with EU.		Mining and extractive industries support the shift to green technology, but in the process harm people and ecosystems outside of Europe. This destabilizes already-fragile economies who move away from trade relationships with the EU.					

	Science-policy opens up to the pluriverse of knwoledge and worldviews around biodiversity, including but not limited to [inclusion?] of indigenous and traditional knowledge to curriculum, laws, and policy	cultural and biological diversity become parts of everyday life	*Science-policy opens up to the plural knwoledge systems and worldviews around biodiversity. Indigenous and traditional knowledge is considered in curriculum, laws and policy. As a result, cultural and biological diversity becomes part of everyday life.*		Huge risk of gender gap and more participation of women to innovation and technologies. Increase of profit driven enterprises		*More participation of women in innovation and technologies increases profit driven enterprises.*		inequalities are increasing in cities but there is also a shift to rural independent communities.	alternative/independent/biodiverse food cooperations are raising as 'counterhubs' with labour as a value	Inequality increases in cities, contributing to a rise in rural independent communities who focus on alternative means for living sustainably.					
	Solar technology depending on China technology and resources and [?] increasing human rights violation in the supply chain	human rights in the supply chain	*Solar technology depending on China and there is an increasing human rights violation in the supply chain. Overregulations leads to social resistance and distrust towards EU. As a result, populists rise to the center of EU regulations.*							this will make a shift in younger generations (back to the hippy) communes						
	overregulation leads to inefficiency, lots of bad decisions. Overregulations = technocracy divorced from reality, leads to social resistance and distrust towards EU and technocrats and social revolves. Populists rise to center EU regulations			*combined with one above*					high-tech health ⍰ new treatments, new cures. BUT ⍰ no public health, inequality in access to health, no prevention for all, risks of illness are only limited.	no public health, no reduction of illness. Better preventions worths more than better treatment.	A high-tech health sector leads to new treatments and cures, but little attention is given to prevention of illnesses that are worsened by rising inequality.					
	Increased levels of mental health through being more in touch with the natural health and being more focused on wellbeing opposed to economic growth. Then a strong increase in physical health due to less pollutive activities	positive impact on health (societal and individual)	*Humans are recognized as part of nature. As a result people's mental health is improved by being more connected to nature and focused on wellbeing opposed to economic growth. This leads to improved physical health due to less stressful activities and people live longer healthier with technological development. The life quality improves for the society with reduced cost in health investment.*						inequality leads to social unrest with increasing calls for health wellbeing ⍰ protests, civil unrest, decline in voting/ trust in institutions, strikes		Rising inequality leads to social unrest and a decline of trust in governments, with increasing calls for health and wellbeing.					
	people get older due to increased health and wellbeing and technological development. Negative impact on aging population	positive and negative effect as it reduces pressure on ecosystems but influences resilience		*combined with one above*												
	Reduction of sicknesses - zoonoses goes down, public health improves, health promotion goes up and prevention goes up															
	Reduction of health investment and reduction of growth could reduce end of life expenses	Humans are part of nature														
	Higher quality of life and sense of security generate public support…	Innovation in biodiversity solutions need to address the population density in different areas. Quota for amount of inhabitants	*Higher quality of life and sense of security generate public support. Innovation in biodiversity solutions need to address the population density in different areas.*													
		Requires quality of life defined as [wellbeing?]														
	Gender equity becomes a cultural part of sustainable development as women have equal voice to [?] and decision making	Biodiversity becomes even more central theme as gender equity in decision making supports transformative change	*Gender equity becomes an integral part of sustainable development and transformative change.*													
2040-2070	Governments don't experiment with de-growth models in certain regions but we need degrowth because economic growth with population growth will post challenges.	Potential to reinforce current trade etc to maintain EU consumption at the expense of natural resources elsewhere	*Some governments in Europe adopt degrowth economic model. The rest of Europe maintains consumption of natural resources elsewhere and reinforces existing trade relations.*		This is the emblematic pathway to worse scenario that would lead to missing the objectives of sustainability, resilience and security, more innovation for small scale solutons			*More of a comment than addition to the narrative*	Technology development is strong (original event)	Economy develops where the resilient biodiverse food systems start to collapse	Technological development is strong, but food systems begin to collapse.		We have not made on Paris agreement targets resulting into a temperature rise over 2 Celscius. As a result biodiversity levels are collapsing. Food security falls short. health colones.	biodiversity collapses & drags diverse healthy food systemsinteresting biodiver with it	Targets in the Paris Agreement are not met, leading to an over 2 degree Celsius rise in temperatures. Biodiversity tipping points are reached and ecosystems collapse as food insecurity grows. Public awareness increases abou the risks of over-exploitation.	
	The EU is forced to acknowledge that there are inherent trade-offs between sustainability (incl material throughput and land-use) & economic growth. And eventually giving priority to the former, focussing inter alia on regulation of lush lifestyles & harmful sectors of the economy	Considerable land is freed for restoring second-hand nature	*The EU regulates the lifestyle and harmful sectoral use of natural resources and land use, resulting in considerable land freed for restoring nature.*		Policy making is focused on immediate crisis prevention. Therefore short sighted and egoistic.	Biodiversity is declining due to massive climate change and low political priority	*Policy making is focused on immediate crisis prevention and is short sighted and egoistic, resulting in declining biodiversity and massive climate change with low political priority.*		Democratic processes counteract inequalities		Democratic processes counteract the rising inequalities.		There will be a new crisis. The cascade of tipping points in biodiversity (lack of natural resources). health/lack of areas to live with. proper soe food production.	Awareness will hopefully prevent the push towards over-exploiting of the earth		*Added above.*
	Shift from monetary economy to bio-economy (resource-based economy): *primary production; * carbon storage;	Biodiversity protection takes precedence over economic development in political agenda, Risk for onesided focus on CO2 to negatively impact other issues and the biodiversity nexus	*There is a shift in the economic model to bioeconomy and biodiversity protection takes precedence over economic development. The challenges remain with focus on carbon storage with primary production, posing some risks on biodiversity nexus issues.*	*seems to contradict earlier time point with more budget to biodiversity*	Immediate socio economic needs clash with longer term environmental concerns. The fragmented member states of the former EU struggle to care for their natural capital and resrources in any reasonable way as they can no longer effectively externalize the damage	People go and exploit the natural resources in and organically disorganized way, creating substantial strain on biodiversity	*Immediate socio economic needs clash with longer term environmental concerns. The fragmented EU struggles to care for its natural capital and resrources as they cannot effectively externalize the damage. People exploit natural resources in a disorganized way, resulting in substantial strain on biodiversity.*		Focus on tech leads to intensive production concentration around cities. Exodus from rural areas spurs natural restoration (Spured Nature Scenario). Unemployment is high, low purchasing power drives cheep food poor dietary health and huge social costs. Spured nature insufficient to mitigate climate.	biodiversity (intact nature) increases in spare lands. Low around cities.	Technological development leads to intensive production concentrated around cities. The exodus from rural areas improves biodiversity in abandoned land, but people in cities suffer due to lack of employment, low purchasing power, and poor quality food.		biodiversity is maintained for primary for entertainment and educational purposes.	bidiversity iin the wild is neglected.	Biodiversity in the wild is neglected, but a few havens relevant for entertainment and educational purposes are protected.	
	Reallocation of income / wealth from 1% allocated to social security + reparations to the south for adoption. Increase tax = money for the poor			*Doesn't seem relevant tp enrichment.*	Protectionism and trade friction drive conversion of natural habitat to agricultural land to help achieve food security.	Protected areas contract to make way for farmland expansion	*The conversion of natural habitat to agricultural land to help achieve food security but at the cost of farmland expansion in protected areas, negatively impacting biodiversity.*			low diversity and potentially negative impact on health				a few havens for adorable or interesting biodiversity is protected		*Added above.*

Sustainability starts to be preceived by citizens (and used by the populists) as an ideology and creates tensions in society that lead to regional conflicts, Political tensions used by populists & divisions in society , Citizens are [passified?] and nature conservation (and restoration) is taken away from them due to higher level	In the long run, this triggers the population into exploiting their natural surroundings, should they feel their needs are not being met adequately	*With economic crisis constraining resource availability and livelihood, sustainability is perceived as an ideology and creates tension and division in some parts of the society.*	*Doesn't seem to align with underlying SSP1 narrative*	Emphasise self provision of food/locally prodcued/consumed. Positive for health/biodiversity	Locally produced food reduces use of pesticides/emissions/etc.	*Emphasise on self provision of food, local production and consumption leads positive impact on human health and biodiversity with reduced use of pesticides and emission.*		Increasing inequalities and stratification	Unequal public funding; biodiversity not a priority for all	Inequality and lack of social support provides a weak basis for preserving public goals like nature protection, so biodiversity declines further.		Gender inequalities among as they are domininated among ...? by fear on domestic inacome from professional work, acces to ...? conflicts from fossil fuel ...? (cannot really read what is written in the sticker)	Disconnection of human being from nature		*Contribution was difficult to read (on sticky note) and might not make sense*
EU recognises the essential role of local leaders and local authorities, giving more power in decisions to people who lead the way to low emissions local communities	Local governments know the reality from the ground and will preserve and protect biodiversity as the resource to local independence and well-being	*EU recognises the essential role of local leaders and authorities, giving more power to people who can lead the way to low emissions in local communities, which also contributes to preserving and protecting biodiversity and improving human wellbeing.*		Overfishing also in EEZ of other countries on the rise, also IUU, as a way to deal with food prices. Completely unregulated and not monitored	Fisheries collapse	*Overfishing in EEZ and IUU of other countries are on the rise as a way to cope with rising food prices, resulting in the collaps of fisheries completely unregulated and unmonitored.*		low social cohesion provides weak basis for preserving public goals, such as nature/biodiversity.	Biodiversity declines further			Increase e.g. microparticle plluters and ...? / soil decline leads to negative health impact to all ...?	[couldn't read]	An increase in microparticle pollutants, decline in the quality of soil, and other impacts of overexploitation have a negative impact on public health.	
Strong governance systems lead by EU lead to binding agreement to enforce green transition across the world. Steady economic development leads most countries long term, New food trade agreements; new international health regulation, [EU] Leading other regions by positive example	Leads to ecological restoration and greening the planet	*Strong governance systems lead by EU results in binding agreement to enforce green transition across the world. Steady economic development leads most countries to new food trade agreements and new international health regulation long term. EU leads other regions by positive example as a chamption to ecological restoration and greening the planet.*		Plant health rapidly declines	Forest biodiversity decline		*seems disconnected from rest of narrative*	low-educated and unskilled people are dissatisfied, they form movements and sub-cultures to counter technocratic societies. [?] New hippies, nationalists, fake news believers emerge, populists manipulate unskilled people, technology of communication and manipulation, social polarisation	technocracy leads to pseudo solutions having negative environmental impacts and new anthropogenic problems.	Unskilled and uneducated people become dissatisfied with the global elite and form sub-cultures and countermovements. Some of these movements adopt sustainable practices (e.g., food production) but others believe fake news and adopt pseudo solutions that create new environmental issues.		Biodiversity declines rapidly due to climate change and lack of protection. Nobody seem to notice bacause human life happes mostly in aficial space	biodiversity is lost and [???]	Biodiversity declines rapidly due to climate change and a lack of protection, but few people notice because their effects are masked by rapid economic and technological development.	
Integrating [AI?] in policy ensures coherence and consistency in planning + implementation of sustainability	Biodiveristy is consistently mainstreamed due to AI	*Biodiveristy is consistently mainstreamed with AI assisted policy planning and implementation that ensures policy coherence for in policy ensures coherence sustainability across sectors.*		Water wars in souther/eastern Europe due to desertification (e.g. Spain, Greece)	Loss of biodiversity, canalization and retention areas. Water as asset/valuable commodity	*There are water wars in southern and eastern Europe due to desertification (e.g. Spain, Greece), impacting biodiversity.*		Conflicts in poorer regions of Europe increase migration to safer areas	development of high tech hubs create a bigger gap between commodity producing areas and high tech food production hubs.	High tech hubs emerge that create a bigger gap between commodity producing areas and high tech hubs for food production.		Over consumption (focus on increased efficiency) reduces dietary diversity and increases ....? health loss of cultural diversity and homogenitatioin of experiences fules depression increased consumption demand, despite improve efficiency drve futher conversion of intact land. Biodiversity is need...? not saved. ...?	Biodiversity in Europe and out is neither shared nor spared.	Overconsumption and a focus on agricultural efficiency reduces dietary diversity, leading to poorer health and a loss of cultural diversity. Biodiversity in Europe and outside is neither shared nor spared.	
New MS accept move sustainable policies which have matured now & stricter environmental protection as part of their accession process leading to transformation of entire sectors	More access to biodiveristy finance. Addressing the drivers at their core, potentially leading to 'simpler' mitigation (restoration) conservation policies and practices	*New sustainability policies have matured now with stricter environmental protection reinforcement, which leads to transformation across sectors with more access to biodiveristy finance and also addresses the drivers leading to 'simpler' restoration oriented mitigation and conservation policies and practices.*	*What is MS?*	Health systems fail as there is no cross border cooperation in case of emergency, helath inequalities increase: access to helath services, availabilty of medication, lower life age		*Health systems fail as there is no cross border cooperation in times of emergency, resulting in increased health inequalities with access to facilties, availabilty of medication, and lower life expenctancy.*		as Europe doesn't have the amount of naturel resources to cover all it's needs (to implement green tech) it is in big need of cooperating with regions which have those resources.	more equal distribution of wealth worldwide (not just concentrated in specific regions)	Transition toward high tech green Europe increases demands for resources in regions outside of Europe, exploiting ecosystems on a global scale.		Potential use of desalination for water resources increase for food production S&SW Europe. Intensive agriculture mixed with nature prodection areas.		Rise in the use of desalinated water in southern and southwestern Europe increases food production. Intensive agriculture is mixed in with natural protected areas.	
Europe focuses on exanding solar energy development, but Asia possesses access to all materials & technology that creates confusion & loss of trust to governments in EU among citizens, Too much pressure & attention to one technology			*seems to contradict original SSP1 narrative*						can result in exploitation on a global scale			With continued degradation and massive climate change impacts, society becomes used to living in closed, artificial environment. The natural world is all but lost. Those who cannot afford it are left surviving in polluted ...? ...? environment.	the "free of all" of those who do not have the means leads to increased strain on tarual resources – logging etc.	As climate impacts increase, people become used to living an artificial and 'closed' society divorced from nature. Only the elite can afford access to nature. The rest adopt informal means for accessing natural resources, increasing the strain on biodiversity.	
EU addresses its impact to landscapes and seascapes beyond the EU borders, focussing on collaborative relationships with other regions, establishing relevant policies (e.g. for trade, international business practices etc) and addressing (neo)colonial practices	Ecosystems restored; arid areas greened; oceans covered with floating farms, Allows cities to be binding wildlife trade banned - biodiveristy wins!	*EU addresses its impact on landscapes and seascapes beyond the EU borders, focussing on collaborative relationships with other regions, establishing relevant policies for trade, international business practices etc. and addressing (neo)colonial practices. This contributes to ecosystems being restored; arid areas greened; oceans covered with floating farms, and cities binding to banning the wildlife trade around the globe.*						migration within EU leads to a shift strain on natural resources in geographical distribution.	depopulation may incrementally lead to 'rewilding' of certain areas (but also increased strain on others)	Migration within the EU shifts the geographic distribution of natural resource use, rewilding some areas while increasing exploitation of others.		Due to lack of attention to climate change adaption European agricultural and forestry sectors are no longer competitive. Food prices are on the rise, unemployment in rural areas increases.	lack of social & regional food systems in our diet -soil degradation -ecosystem degradation -loss of species	The agricultural and forestry sectors of Europe are no longer competitive due to a lack of climate adaptation. Food prices rise and unemployment worsens in rural areas. The lack of social and regional food systems impacts diets.	
The positive impact of measures taken on biodiversity and therefore in general well-being becomes largely visible, thus gaining more support from the general public/governments		*The positive impact measures on biodiversity and general well-being becomes largely visible, gaining more support from the general public and the governments.*						increasing demand for land – other than agri-use (biofuel, etc.) + ecosystem service use. Change of land ownership (associated with diversifying energy)	Some areas for ES and biodiversity	Increasing demand for land and changing land ownership leaves some areas open for ecosystem services and biodiversity.		Societies are unaware of the risks of biodiversity loss until the moment it collopses A biodiversity- related event takes place that the current syste is not able to deal with e.g. resources are depleted.	Continuous degradation		*Same as above.*
Exessive focus on wellbeing over economic growth creates assymetries between north-south; EU joint green transition dreams starts to break down	Pressure consumption goes up in global south as livelihoods impacts economic growth improves + as these countries become more elite, Southern EU countries return to overconsumption practices that destroy ecosystems; increasing biodiversity loss	*Exessive focus on wellbeing over economic growth creates assymetries between North and South. Southern EU countries return to overconsumption that degrades ecosystems and increases biodiversity loss.*	*Doesn't seem to align with underlying SSP1 narrative*					(pointing to energy companies hedging against price inflation)) driven by market-based demand but also European policy and adequate incentives.	Biodiversity is spared		*Contribution is unclear*	Temperature increase leads to extremes and ecosystem breakdowns. Decrease in production of economically valuable goods (food, wood, energy, ... a collapse of economy. Dramatic increase of poverty	Ecosystems breakdown. Decrease in food, wood, etc. production Economic collapse.	Rising temperatures generate extreme climatic events and ecosystem collapses. There is a decrease in the production of economically valuable goods, resulting in a collapse of the economy. The result is a dramatic increase in poverty.	
									Loss of connectivity and function						

									CSA's will be [???] to maintain food sovereignty	middle class can no longer afford to consume high levels – equivalent of today's global south.	The middle class can no longer afford to consume at high levels, but Community Supported Agricultural systems maintain food sovereignty.					
									gender inequity broadens and from 'leaving no one behind' we leave women + the youth behind	Gender inequity accelerates biodiversity loss	Broad inequality and focus on technological solutions perpetuates gender inequality and results in a biased world, which accelerates biodiversity loss	*Logic linking gender to biodiversity is missing*				
									inequality drives social collapse with those unable to participate in the tech economy going back to land in search of self-sufficiency and greater meaning in lives. Rejection of meaningless high-tech world. More shared lands in marginal areas not occupied by as tech		Inequality drives social collapse, with those who are unable to participate in the tech economy moving back to the land in search of self-sufficiency and to find greater meaning in their lives.					
									a tech intensive future might be designed mainly by men. Now we now that women in tech are less than ¼ of experts. Big risk of a biased world.			*Added to above*				
									overseas territories/ former colonies are disproportionally affected, deciding to be independent further fragmentation	localised policy on biodiversity, more tailor made	Overseas territories and former colonies are disproportionately affected by technological development, leading to further fragmentation. As a result, these regions adopt more localized and tailor-made policies for biodiversity protection.					
									widening gaps lead to a healthy food crisis to poor people major economic/health crisis unfolds	hunger driven poor communities to wildlife consumption and backyard animal production. Diseases spread. Biodiversity + wildlife extinction	Widening gaps between rich and poor lead to food crisis, so poor people cannot access healthy food. Poorer communities are driven to wildlife consumption and backyard animal prodctuion, which spreads diseases and leads to biodiversity and wildlife extinction.					
2070-2100	Phased introduction of resource-caps per capita (material foodprint; water; energy; carbon). Limiting thoughtless and wasteful consumption + reducing desire to work and save. Leading to socially acceptable	Reduced economic activity relieves pressure on environment	*Phased introduction of resource-caps per capita on material foodprint including water, energy and carbon limits thoughtless and wasteful consumption, leading to reduced economic activity and reducing pressure on environment.*		World security is at risk as a failing EU insists on harmful and violent foreign solutions with other regions from trying to imrprove trade policies, initiating wars/coups, halting development/biodiversity/climate finance flows to biodiversity hotspots	biodiversity hotspots around the world are failing, triggering tipping points	*World security is at risk as a failing EU insists on harmful and violent foreign diplomacy with other regions trying to imrprove trade policies, initiating wars and coups and reducing finance into development, biodiversity and climates, eventually triggering tipping points in biodiversity hotspots.*		Europe has become a market leader in green technologies	: It would work if Europe would be also the leader of circular economy	As market leader in green technologies, Europe prepetuates neo-colonial practices of knowledge and technology sharing.		Exports environmental degradation elsewhere in the world -> mining 4 tech, food production, etc. ("bosreally" reinforces current situation)	Biodiversity decline, loss of ecosystem services. Reliance on tech and fossil fuel. Human population decline.	Europe runs out of natural resources and exports its environmental degradation elsewhere.	*I'm not sure I understand where the population decline comes from here?*
	Economic development no longer based on growth: decoupled from resource consumption > otherwise the maths doesn't work. No more GDP!	No more growth; no more consumption. Decrease resource consumption GLOBALLY, Biodiversity is at the core of the indicators of the health of our society	*Economic development no longer based on growth with dcrease resource consumption globally. Biodiversity is the core indicators of the health of our society.*		Faced with global competition and its inherent disadvantages (energy prices, co2 pricing, lack of natural resources, deindustrializes losing millions of jobs in the process). This reduces the economic output but also energy & material demand.	Deindustrialization helps alleviate the damage from manufacturing plants and allows for planned or incremental rewilding of certain areas	*The EU is faced with global competition and its inherent disadvantages (rise in energy prices, carbon pricing, lack of natural resources, deindustrialization leading to loss of millions of jobs). This reduces the economic growth and also demand for energy and materials. Deindustrialization helps alleviate damage from manufacturing plants and allows for planned or incremental rewilding of certain areas.*			selling to who? (this perpetuates neo-colonial practices of knowledge/tech sharing)				Sharp drop in consumption due to population decrese. Drop in emissions		
	Democracy in Europe doesn't only shift in green policy (makers), but also in adaptiveness from EU citizens		*Democracy in Europe doesn't only shift the system towards green policy but also climate adaptation for the citizens.*	*not sure if I understood correctly*	There is a lot of need for collaboration. CO-ops try to support each other from the rich to the poor countries. EU co-ops start to produce their own technologies. Prioritising energy saving and efficiency (vs generation), awareness increases, more respect and consideration future.		*There is a lot of need for collaboration. CO-ops try to support each other from the rich to the poor countries. EU co-ops start to produce their own technologies. Prioritising energy saving and efficiency (vs generation), awareness increases, more respect and consideration future.*		decrease of agriculture intensity (lack of water) in S/S-W Europe (increase of RCP 8)			*Contribution is unclear*	Peak oil	degraded all fossil fuel sources (Antartica, ocean gas, etc.)	Peak oil is reached as all fossil fuels have been degraded.	
	New technologies are inspired by nature and traditional knowledge which stimulate even more biodiveristy conservation		*New technologies are inspired by nature, traditional knowledge, transdisciplinary practice with balanced participation of women, which stimulates more integrative biodiveristy conservation.*						the imperative of EU strategic autonomy ... a shortening of value chains and an end to externalisation of mining and production. We end up with a heavy industrialised economic model with all the consequences.	effectively this leads to further biodiversity loss and strain on natural resources within the EU.	The need for strategic autonomy leads the EU to shorten value chains and endogenize all mining and production activities, leading to biodiversity loss and further increasing strain on natural resources.		Political systems are increasing by tech focussed leading to stronger emphasis on extracting CO2 from atmosphere. Create new carbon markets/new resources available. Growing risk of corruption. Dependency on "funded"-resources	More resources to invest.	Political systems are influenced by technology, leading to a stronger emphasis on extracting CO2 from the atmosphere. New carbon markets and resources are available to invest in biodiversity protection, but they are accompanied by a growing risk of corruption.	
	New technology: hard and soft included in systemic approaches. Balanced participation to women. More women in developing technology and using it and design it. >> solutions coming from integration of technologies + transdisicplinary gender balance	In principle that leads to consider a multidiscipline, inter and transdisciplinary approach to technology in finding solutions should consider biodiversity in mainstream ways and a positive approach. Biodiversity is regenerated.		*combined with one above*					focus on GMO agriculture and application of chemicals leads to exclusion of traditional and natural agriculture promotion of large scale or artificial food production. Exclusion of small-holders.	decrease in biodiversity. Unhealthy food. Disconnection between people and nature.	High-tech solutions focus on high-input and GMO agriculture, which excludes small-holder and sustainable production and promotes large-scale industrial farms. This resuls in a decrease in biodiversity, rise in unhealthy food, and disconnection between people and nature.		Ecosystem collapse. "Marine", human and animal "plant" "diet" decline. Growth a microbial especially decompenses communities, ecological reduce biodiversity, high vertebrate mostly "bird" (...) [Unreadable!]	marine biodiversity	Ecosystems collapse, and the quality of diets reduces. Biodiversity declines.#	

Major shift in agriculture; less productive (for EU export). More [of ao?] (CO2, water) * biodiversity; more water in landschape (depending op crop)	More diverse landscapes, healthy & diverse diets are accesible to everyone, wetlands increase	*With a major shift in the agriculture, more reservoirs and wetland and well-designed energy plantations in rural areas, Europe's landscape has become more diverse with healthy diets accesible to all.*						coops intensify their effort to support their communities especially focusing on the most vulnerable - but it's hard! A lot of focus is put on education and peer to peer learning (to address the gap of public funding to education)	focus is also put on biodiversity value (during training) and events	CSAs increase their efforts to support vulnerable communities, with a focus on education, peer-to-peer learning, and biodiversity value.		Social. The benefits of energy coops are acknowledged, and a lot of support is provided. Coops can really work across all relevant topics for a just energy transition.	Coops can focus on biodiversity protection and reduction of "en" use.	More support for energy cooperatives accelerates just energy transition and in turn builds support for biodiversity protection and reduction of energy use.	
Rural areas being clusteres of energy. supply = use on account of food production			*comebined with one above*					stronger centralised government ensures environmental protection + due to majority not getting needs met, elites keep access to greening spaces – reminiscent of wild land, ownership in [middle ages?]	green space nature protection enhanced due to ownership by elites who can afford to maintain land	A stronger centralized government ensures environmental protection. The elites maintain access to green spaces but the majority are excluded.		Lifeless world, fossil fuel powered low global population extreme inequality and poverty. Total economic break down (low capacity to produce food, wood, etc). Ecosystems collapsed. Biodiversity "gone" every "device depecede" on fossil fuels. Gradual extinction of humanity	humanity extinct or severely reduced. Tribal society.	A total economic breakdown due to low resource availability and ecosystem collapse leads to reduction of human population. A lower human population allows nature to recover.	
Extreme growth in bureaucracy lead to ineffiency what works on paper does not work in reality. Breakdown of the whole 'regulation' idea. People feel their freedom is reduced. Technocrats rise to power and SSP1 shifts towards SSPS4			*Is this relevant for SSP1?*						global implication as elite capture nature + land around the world + exclude people				nature restores as people go extinct.		
All seems to be functioning so well that people might lose interest in sustainability/stop seeing its importance			*Is this relevant for SSP1?*					social revolution, conflicts, war – technologically advanced. Destruction of environment. Initial decline in biodiversity and exhaustion of natural resources. Later some biodiversity recovery.	initial decline, but as human influence decreases, some recovery of biodiversity	Social revolution and conflicts perpetuate destruction of the environment, which later recovers as human influene decreases.	*Not clear why biodiversity recovers from conflict*	[original event] Population grows with many European cities having become economic hubs with efficient transportation	this has different kind of impacts. Demographic growth is not the only risk factor. But the increase of resources demanding urban social classe will lead to a non-sustainable pressure on resources	The growth of urban population, and in particular the urban social class, increases demand on natural resources.	
Collapse of ecosystem and population. Massive extraction technologies make not better. Scenario no better than business as usual. Managed decline in economy to level where [….] only road to sustainability	Failed to understand nature - focus on few species - collapse and extinction		*Is this relevant for SSP1?*					solar and hydro dominate the market. No more climate emissions.	money on the market to restore exterminated species	Renewables like solar and hydroelectric energy dominant the market, reducing greenhouse gas emissions. More money on the market is available to restore exterminated species.		Rapid sea-level rise forces chaotic retreat of low-lying communities "coming" from the coastline. Housing market collapses. Millions of properties abandoned to the sea. Sea-level rise.	urban pollutants released into sea.	Rapid sea-level rise forces a retreat of low-lying communities from the coastline. The housing market collapses and millions of properties are abandoned. Urban pollutants are released into the sea.	
									Europe cannot be an effective and influencing negotiator with little control on global resources.		*Unclear logic for this impact*	We have found a viable way to live on Mars and start a colony there for the (…) in the first instance and them for the rich as a solution for depleted Earth	Bigger gap between rich and poor		*Doesn't reallly fit within this originalSSP narrative (moreso SSP4)*
								increasing social conflicts eventually disrupt the system			*Added above.*		Increase in innovation, a change to the used lessons learned		
								inequality means that poorer groups must resort to other means for meeting their needs. Poorer coastal areas see and increase of illegal and unreported fishing.	Negative impact on fisheries and marine biodiversity in general.	Poorer coastal areas see an increase in illegal and unreported fishing and people struggle to meet their needs, degrading marine biodiversity.		Clean water due to severe treatment, and Eutrofication problems in lakes and seas due to agriculture.	some efforts towards NBS		*Not clear how this is a positive impact*
								some societies / groups / countries come back to less-consumption (agriculture driven) living standards and focus on rural areas development that leads to lowering some sectors of climate emissions.	regional development in rural areas acknowledges biodiversity	Regional development in rural areas increasingly adopt lower-consumption lifestyles, lowering climate emissions and improving rural biodiversity.		Leads to deep sea mining (if not happened yet) at massive scales for RE	deep sea ecosystem completely collapse carbon cycles and sequestration hugely impacted. Ocean dead ☹.	Deep sea mining pursued at massive scales, leading to deep sea ecosystem collapse. Carbon cycles and sequestration are severely impacted.	
								lack of trust between people and communities ⍰ lack of connectivity and interaction between individual ⍰ Europe loses its main fuel: 'people power and unity'.	people turn back to nature. Re-considering the potential of biodiversity, re-connecting, re-uniting.	The EU has lost its main connecting power due to lack of social cohesion. People turn back to the reconnecting and uniting power of nature.		Collapse elsewhere leads to shortages in Europe. Collapse happens (though "diztandaled") to end of "centres". No more food supply or water as ecosystem "sences". Collapse + leads to social stratification as rich get access to resources.	2300: post-collapse scene: decrease population, decrease consumption, increase nature ☺	Economic collapse outside of Europe leads to food and other resource shortages in Europe. Scarcity leads to social stratification as rich get access to resources.	
													(…) tipping point -> collapse in food, water systems leads to Europe tech dependence collapse		
												The youth has no "exploisure"/understanding /"centred" with nature which (…) in very poor health issues including mental health	We're too late?	Youth no longer have access to nature, contributing to declining mental and physical wellbeing.	
												The whole planet will shifter species with (…) forest with (…) big negative impacts in water (…), water security and food production. Impact on health and air quality			*Difficult to read*
												Environmental conditions degrade so much that innovation on health is unable to keep pace. Human health suffers, increase of NCD, breakdown health system	Environmental degradation and human health problem are happening in (…) with strong environmental degradation of ecosystems -> biodiversity loss	Environment conditions degrade so severely that human innovation for masking the effects cannot keep pace. Human health suffers, increasing non-communicable diseases and the breakdown of health systems, and biodiversity loss occurs at scale.	
												A world full of plastic including in the ocean. Negative impacts on fish, soil, air, etc. Health problem despite the budget invested	Nature and tech not able to mitigate impacts of climate change. Adaptation ability is insufficient	Massive spending on technology and adaptation measures, but they are insufficient. Most of the Netherlands loses its land area to the sea.	

														No more Netherlands due to sea-level rise. Restoration of marine ecosystem?		