BIONEXT Guidance to facilitate transformative change in Europe

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Biodiversity – at the heart of sustainable societies

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1. Executive summary

1.1. Overview

BIONEXT is a Horizon Europe project that promotes transformative change by advancing knowledge, practical tools, and guidance to support the integration of biodiversity as a fundamental consideration in cross-sectoral policymaking. This specific deliverable, D4.2 (Guidance to facilitate transformative change in Europe), provides a structured framework to facilitate systemic change towards a nature-positive and sustainable future in Europe. The scope of this Guidance encompasses the "**biodiversity nexus**," examining the critical interlinkages between biodiversity, food, water, health, energy, transport and climate, alongside considerations for **transformative change**. It presents evidence-based policy options that go beyond incremental adjustments by addressing the root causes of biodiversity loss and transforming how natural systems and human well-being are governed, valued and managed.

1.2. Context

This Guidance is founded on the recognition that human well-being is fundamentally dependent on the functioning of natural systems. Yet, the underlying causes of biodiversity loss remain deeply embedded in our current economic goals, sociocultural values, and institutional structures. As a result, past conservation efforts have often fallen short because they have focused primarily on addressing the direct symptoms of biodiversity loss rather than the indirect anthropogenic drivers or "root causes" of the environmental crisis. Addressing these systemic drivers requires approaches that move beyond sectoral boundaries and fragmented decision-making. A **nexus approach** provides such a framework by considering the interconnections between sectors and policy objectives. This enables policymakers to identify and leverage synergies, such as how dietary shifts can simultaneously improve health and reduce pressure on water resources, while making cross-sectoral trade-offs more transparent and manageable.

The central element of the Guidance is a non-exhaustive set of policy options. These options were developed through the triangulation of BIONEXT transdisciplinary research, findings from the IPBES Nexus and Transformative Change Assessments, and extensive stakeholder co-creation processes. The Guidance itself synthesises a diverse range of BIONEXT outcomes, including scientific papers, technical reports, databases, and stakeholder-generated knowledge, translating these findings into policy options.

An additional component of the Guidance is the **BIONEXT Inspiration Tool**, a flexible database designed to support the co-creation of context-specific policy options. Building on 648 transformative actions co-created through BIONEXT, the tool incorporates 16 elements derived from the IPBES Transformative Change and Nexus Assessments, including policy instruments, nexus governance, and sustainability and biodiversity international targets, to allow users to retrieve and adapt tailored actions for specific policy challenges. The synthesis and the alignment of complementary elements were supported by artificial intelligence, followed by a rigorous human validation process. By integrating these diverse knowledge sources, the Guidance offers an operational translation of transformative change principles tailored to the governance levels and institutional context of the European Union (EU).

1.3. Policy Options to drive Transformative Change in Europe

To achieve a nature-positive Europe, policies must move beyond "business as usual" to address root causes of biodiversity loss and reshape institutional arrangements. The following policy options represent the core strategic insights of the BIONEXT project.

Cross-Sectoral Policy Options. Effective transition towards a nature-positive Europe requires integrating multiple nexus elements into policy design and decision-making processes to overcome sectoral silos, avoid negative cascading impacts, and enable a transition towards coherent, integrated governance. The

following cross-sectoral options are ordered to reflect a progression from enabling conditions to place-based interventions:

- **Recognise and integrate diverse values of nature:** Moving beyond extractive approaches to embed intrinsic, relational, cultural, and stewardship values into resource management.
- **Internalise externalities and prevent impact leakage:** Phase out environmentally harmful subsidies and introduce measures that reflect the true environmental and social costs of products. Simultaneously, trade and procurement policies require ensuring Europe does not externalise its environmental footprint to other regions.
- **Support resource efficiency and strategic downscaling:** Support circularity and, where necessary, the strategic reduction of production in environmentally intensive sectors to ensure that human activities remain within planetary boundaries.
- **Localised infrastructure and lifestyle planning:** Support the transition to more sustainable lifestyles by shortening supply chains and promoting approaches such as the "15-minute city" to improve access to services while reducing travel demand, emissions and resource use.
- **Promote sustainable mobility:** Integrate renewable electrification with "mobility sufficiency"—reducing car and air travel—and promote active transport (walking and cycling) to improve urban air quality and mental health.
- **Mainstream nature-based Solutions:** Integrate nature-based solutions across climate, water, and land-use policies to address societal challenges, while simultaneously providing benefits for human well-being and biodiversity. This includes, for example, investing in green/blue infrastructure like urban wetlands to manage stormwater and using riparian restoration to enhance carbon sequestration.
- **Adopt integrative spatial planning:** Effectively coordinate land and sea use to avoid conflicts between climate mitigation and biodiversity, including by directing infrastructure away from high-biodiversity corridors and climate refugia.

Sectoral Policy Options to Support Biodiversity. To address the root causes of biodiversity loss, individual sectors must move beyond "business as usual" and consider policy options that better integrate and support biodiversity objectives:

- **Food Sector:** Further and fundamentally **reform the Common Agricultural Policy (CAP)** to prioritise ecological resilience and biodiversity outcomes, including by realigning payments to reward regenerative practices. Additional policy options include mainstreaming **food sovereignty** by phasing down synthetic fertilisers, supporting dietary shifts to reduce meat consumption, and adopting a "living local" norm that reduces reliance on ecologically damaging food imports.
- **Water Sector:** Prioritise **nature-based solutions,** for instance, by restoring "natural sponges" (riparian zones and peatlands) to manage floods more effectively than traditional grey infrastructure; and by implementing large-scale programmes to **restore free-flowing rivers** through dam removal to reconnect floodplains.
- **Health Sector:** Institutionalise the **"One Health" approach**, including by shifting the sector towards preventative care that balances the health of people, animals, and ecosystems. This includes regulating the pharmaceutical industry to reduce environmental pollution arising from pharmaceutical production, manufacturing activities, and the composition of the medication.
- **Energy Sector:** Support **decentralised energy communities** by increasing local ownership of generation and storage; and promote **dual-use land policies**, such as agrivoltaics (combining solar with agriculture), to optimise spatial efficiency and reduce habitat fragmentation.
- **Transport Sector:** Integrate mandatory biodiversity criteria into transport infrastructure planning and development; and restrict long-distance air travel and private jets, while investing in sustainable alternatives, such as high-speed rail networks.

- **Climate Sector:** Scale up carbon sinks through **rewilding** heterogeneous forests and wetlands to enhance both carbon sequestration and biodiversity intactness.

Policy Options for EU Policy Instruments. Analysis of 75 EU policy instruments suggests that while the European Green Deal has increased cross-sectoral recognition, significant gaps remain.

- **Operative provisions:** Consider strengthening cross-sectoral integration by incorporating references to nexus interlinkages into operative provisions, implementation mechanisms, and reporting requirements, rather than limiting them to preambular language.
- **Behavioural insights:** Systematically incorporate behavioural science into policy design and implementation to improve policy effectiveness through incentives and consumer-focused interventions.
- **Monitoring frameworks:** Develop and adopt harmonised monitoring frameworks and indicators aligned with climate, biodiversity and ecosystem health objectives to support consistent tracking, monitoring, evaluation and adaptive management across Member States.

Strategic Considerations and Embedding Justice. To strengthen the effectiveness of these policy options, broader legislative reforms at the EU level could support their implementation and long-term impact:

- **Rights of Nature:** Introduce legislation that recognises the legal rights and intrinsic worth of ecosystems to ensure they have legal agency and representation in courts.
- **Exnovation mechanisms:** Move beyond promoting "green" alternatives to actively phasing out unsustainable practices, such as halting subsidies for polluting industries.
- **Mandatory impact reporting:** Implement mandatory biodiversity impact reporting for private companies to increase transparency and motivate nature-positive business models.

Just outcomes - understood through the distributive, recognition and procedural dimensions of justice – are frequently reflected in and impacted by biodiversity transformations but are rarely addressed explicitly as policy objectives. Embedding justice requires:

- **Making justice explicit:** Justice should not be an assumed byproduct of participation; it must be an explicit policy objective. This requires addressing power asymmetries, clarifying who bears the costs of transformation, and recognising "nature-positive stewards" who are already engaged in care-based practices. Participatory processes must also ensure that diverse perspectives are genuinely able to shape decisions and influence outcomes.
- **Governing conflict:** Move beyond consensus-seeking to create transparent processes where competing interests and visions of the future can be negotiated and adapted over time.

1.4. Implementation

Successful examples of transformative change in Europe suggests that lasting change is most likely when policies address underlying values, behaviours and governance systems, rather than relying solely on technical fixes. Key **characteristics of success** identified across various case studies include:

- **Inclusive and participatory governance:** High-performing cases, such as the Stiemer Vallei in Genk, utilised "co-governance" models involving citizens and private partners in co-financing and managing natural resources.
- **Economic realignment:** Shifting from extractive models to payments for ecosystem services or new sustainable business models (e.g., Continuous Cover Forestry in Finland) provides financial stability for nature-positive transitions.

- **Legislative and policy pressure:** Strong policies, such as the UK's Biodiversity Net Gain, serve as essential catalysts for shifting corporate mindsets by making ecological principles a requirement for development.
- **Mindset Shifts:** Moving from viewing nature as a "problem" or purely an economic resource to seeing nature as a valuable asset or a health provider (e.g., "Nature on Prescription" in Belgium) is critical for long-term sustainability.

Opportunities to embed transformative principles exist within the current EU policymaking process, including:

- **Impact Assessments:** These provide a key institutional opportunity to systematically evaluate the social and environmental trade-offs of policy options, ensuring that equity and justice are central.
- **Strategic foresight:** This tool allows the European Commission to explore alternative futures and navigate systemic risks, preparing for future crises beyond reactive models.
- **Participatory mechanisms:** Moving beyond mere consultation toward genuine co-creation fosters ownership of policy outcomes and strengthens democratic legitimacy.
- **Funding and Innovation:** EU funding instruments, such as Horizon Europe and the LIFE Programme, can play an important role in enabling experimentation, knowledge co-creation, and the scaling of context-specific innovations, including through "living labs".

1.5. Key takeaways

- ✓ **Policies do not yet adequately tackle root causes**: Existing European policies are often insufficient because they focus on the direct symptoms of biodiversity loss rather than the indirect drivers or root causes, such as unsustainable consumption and the dominant economic growth paradigm.
- ✓ **Bridge the implementation gap**: There is a persistent disconnect between EU-level commitments and local execution, often due to a lack of institutional capacity, resources, and administrative expertise.
- ✓ **Mainstream biodiversity across the nexus**: Biodiversity must be treated as a foundational priority embedded across all public policy rather than an isolated environmental "endpoint".
- ✓ **Overcome sectoral silos**: Siloed governance leads to policy incoherence where incentives in one sector (e.g., agricultural subsidies) directly undermine biodiversity protection in another.
- ✓ **Explicitly embed justice and plurality**: Sustainability and justice are "two sides of the same coin". Policies must deliberately engage with questions of fairness, address power imbalances, and make distributional impacts visible and negotiable.
- ✓ **Utilise Integrative Spatial Planning**: Coordinating land use through multifunctional planning is essential to avoid conflicts between climate mitigation, food security, and biodiversity protection.
- ✓ **Foster adaptive learning**: Transformative change is a dynamic process; governance needs to move beyond stability-oriented approaches to create reflexive systems that learn from experimentation and successful real-world cases.

2. Introduction

2.1. Project overview

The Horizon Europe Biodiversity Nexus: Transformative Change for Sustainability (BIONEXT) project aims to mainstream biodiversity into cross-sectoral policymaking and provide concrete options on how to initiate, accelerate and upscale biodiversity-relevant transformative change in society through the development of knowledge, tools and practical guidance. The project provides evidence to support the transition to a sustainable society in Europe, where the interlinkages between biodiversity, food, water, health, energy, transport and climate (the biodiversity nexus) are fully recognised, and nature and biodiversity are a part of everyday decisions and policymaking.

BIONEXT includes a series of key outcomes:

- **Advanced understanding of actionable transformative change**: Through transdisciplinary research, BIONEXT operationalises signposts for achieving just transformative change and explores concrete, implementable options that enable real-world action.
- **Co-created nature-positive visions for Europe**: Multiple desirable futures reflecting diverse value perspectives and societal and cultural contexts have been developed through workshops and focus groups held in cities across Europe.
- **Just Transition Pathways**: Co-created pathways outline transformative actions that support nature-positive visions and advance the Sustainable Development Goals, with attention to their scalability and justice implications within the biodiversity nexus.
- **Innovative Nexus Modelling Framework**: Captures and simulates the interlinkages in the biodiversity nexus, assessing the effectiveness of transformative actions in relieving trade-offs and strengthening synergies.
- **Practical Support in the BIONEXT Pathways App**: A novel decision-support tool that consolidates project outcomes and enables users to explore and harness transformational building blocks to design just transition pathways within the biodiversity nexus.

BIONEXT aims to contribute to science brokerage, capacity building and strengthened collaboration with the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), the European Union (EU), national policymakers, and civil society.

All the outcomes mentioned above will be publicly available through the Pathways App by the end of the project, in August 2026. The detailed list includes scientific papers, policy briefs, stakeholder co-created narratives, databases, technical reports and deliverables, and modelling datasets. The already public and upcoming outcomes are available here.

2.2. The BIONEXT Guidance: objective, scope and target audience

The **BIONEXT Guidance** aims to support the transition towards a nature-positive future in Europe by enhancing biodiversity conservation and promoting the sustainable use of biodiversity and ecosystem services. Building on the project outcomes, it presents cross-sectoral policy options and key transformative actions co-created within BIONEXT to advance transformative change across the biodiversity nexus. These policy options are designed to support efforts to address biodiversity loss and ecosystem service decline by responding to key challenges and opportunities within the EU policy landscape.

Drawing on BIONEXT's transdisciplinary research and stakeholder engagement, the Guidance provides a structured, non-prescriptive synthesis of evidence, strategic considerations, and real-world examples to inform policy development and implementation. It is designed as a policy-orientated resource for decision-makers, providing actionable support for policymakers and other stakeholders. The Guidance has been

co-created through collaboration with a diverse range of stakeholders, including BIONEXT partners and stakeholders, policymakers, experts from the European Commission, and European National Focal Points to IPBES and the Convention on Biological Diversity.

A key component of this co-creation process was a survey conducted with the abovementioned stakeholders and policymakers, which directly shaped the Guidance (Appendix B). The survey findings informed the scope, clarified key concepts and definitions, and identified the priorities and expectations of end-users. By integrating these insights from the outset, the Guidance provides a targeted evidence base aligned with current decision-making needs and designed to support transformative change in Europe.

The Guidance is designed as a practical resource that links evidence, actions, sectors, and policy frameworks to support collective reasoning and decision-making. It is not intended to provide a complete map of all possible policy options or causal relationships. As its content reflects the specific scope of this project, some relevant approaches may not be included. Consequently, the absence of a particular action, pathway or policy option should not be interpreted as a lack of relevance or importance.

The Guidance is primarily oriented towards EU and national policymakers; however, it also intended to be useful for local policymakers, stakeholders and IPBES experts working across the biodiversity nexus, understanding that in enabling transformative change there is a role for all (IPBES, 2024b).

The Guidance acknowledges that to contribute to transformative change, existing EU policies need to move beyond incremental adjustments and address the root causes of biodiversity loss through a fundamental reorganisation of societal systems. In doing so, the project's findings align with and complement widely recognised IPBES recommendations on addressing indirect drivers and enabling systemic change. This involves strengthening the content of policies, bridging gaps in implementation, and enhancing enforcement mechanisms across the biodiversity nexus.

The expected added value of this Guidance includes:

- ✓ Operational translation of transformative change principles, frameworks and response options
- ✓ Structured trade-offs and synergies across sectors: a nexus analysis identifies critical interdependencies and supports their translation into actionable policy options
- ✓ Implementation feasibility logic: what combination of actions, instruments and actors fit together
- ✓ Adapting global knowledge to governance level, institutional constraints and political feasibility

2.3. Navigating the Guidance

The central component of this Guidance is policy options for supporting transformative change through mainstreaming biodiversity across decision-making sectors and EU-level policies. Deliverable 4.2 is the result of an iterative and collaborative development process within the BIONEXT consortium, and it features a structure that allows users to delve into the background, methods, or focus directly on the core component: the policy options.

The logic and structure of this Guidance document need to be understood in three main blocks:

Block 1. Context

Section 3 sets out the conceptual and methodological background to the guidance. Section 3.1 includes the conceptual framework, and Section 3.2 presents an overview of BIONEXT activities and outcomes. Section 3.3 describes the knowledge triangulation, covering the BIONEXT co-creation processes, the use of the IPBES Nexus and Transformative Change Assessments, and the integration of BIONEXT knowledge. The last part includes the description of two tracks: synthesis of outcomes and the development of a BIONEXT Inspiration Tool for the co-creation of policy options.

Section 4 introduces the technical background, i.e., context and foundations for policy options. Section 4.1 examines the benefits of a biodiversity nexus and transformative change approach, including connections to the Kunming-Montreal Global Biodiversity Framework (KMGBF). Section 4.2 identifies key needs and gaps in the European policy landscape, drawing on insights from the BIONEXT approaches, stakeholder and policymaker consultations, and an analysis of relevant EU legal and policy frameworks. Finally, Section 4.3 highlights cross-sectoral synergies and trade-offs, making these interactions visible to support the development of the policy options.

Block 2. The theory in action

Section 5 focuses on policy options to support transformative change in Europe and represents the core component of the Guidance. Sections 5.1 and 5.2 present policy insights in a structured format, covering cross-sectoral and biodiversity-positive sectoral options, respectively. Section 5.3 summarises the results of co-created context-specific policy options, and Section 5.4 proposes policy options and recommendations for EU policy instruments. Finally, Section 5.5 highlights strategic considerations for any policy option, including cross-sectoral governance and legal frameworks, participation enablers, and how to embed justice in policies.

Section 6 includes complementary elements to guide the implementation of policy options. Section 6.1 shows the consequences of different levels of action and inaction, based on the BIONEXT modelling analysis. Section 6.2 compiles exemplary case studies and their critical enablers for the successful implementation of transformative change, as well as some regional considerations for policy tailoring. Finally, Section 6.3 focuses on entry points for transformative change principles within the EU policy system.

Block 3. Closing

The final section, Section 7, synthesises the final remarks of the Guidance, including follow-up work that emerged during the project but was beyond its scope, reflections on the policy options and their transformative potential and implementation, and conclusions.

3. Methodological approach

3.1. Conceptual framework

Transformative change is needed to address the major challenges facing nature and humankind, including biodiversity loss, climate change, and social injustices. In the BIONEXT context, **transformative change** is understood as *"fundamental, system-wide shifts in views, structures and practices in ways that address the underlying causes of biodiversity loss and nature's decline"* (BIONEXT Glossary). Achieving such change requires more than incremental improvements; it involves significant shifts in policies, governance, and institutional arrangements, as well as changes in societal norms, values, and behaviours. These transformations must occur across multiple sectors and scales to effectively address the systemic drivers of biodiversity loss.

Central to this Guidance is the recognition that meaningful change needs to take place across interconnected sectors. The **biodiversity nexus** refers to the interdependent relationships between people and nature, highlighting how human resource use impacts biodiversity, and how changes in biodiversity, in turn, affect human well-being. It encompasses the linkages between biodiversity and key sectors such as food, water, health, energy, transport and climate. By explicitly framing these interconnections, the nexus approach provides a foundation for more integrated and informed decision-making, helping to identify synergies, manage trade-offs, and support more coherent and coordinated policy responses.

Within this context, policy options provide an entry point for action, including opportunities to manage nexus elements more synergistically. A **policy option** refers to a distinct, feasible, and evidence-informed course of action that policymakers and other decision-making actors can adopt to address a specific policy problem or achieve a defined and measurable outcome. Such options typically involve the selection and use of specific policy instruments, based on criteria such as institutional competence, costs and benefits, equity considerations, implementation capacity, and expected outcomes. In the BIONEXT context, policy options are understood as approaches that contribute to transformative change for biodiversity and ecosystem services in the context of climate change.

A subset of these, **transformative policy options**, is particularly important for achieving system-wide change. Transformative policy options are designed to drive fundamental, system-level change rather than incremental improvements in existing states, processes, or practices. They move beyond "business as usual" by addressing root causes and challenging prevailing norms, while reshaping power structures, behaviours, and institutional arrangements that contribute to unsustainable outcomes.

Transformative policy options rely on a range of policy instruments, often combined into coherent policy mixes, and typically involving the engagement of diverse actors across sectors and governance levels. **Policy instruments** are the various mechanisms or interventions – such as formal rules and laws, economic incentives, social norms, and institutional processes – used by decision-makers, including governments, public authorities, intergovernmental organisations, companies, and other actors, to influence behaviour and achieve policy objectives. IPBES distinguishes four main categories of policy instruments: legal and regulatory; economic and financial; social and cultural; and rights-based and customary instruments (IPBES, 2024a; see Appendix for full descriptions).

Together, these concepts form an integrated framework for this Guidance. The biodiversity nexus provides the systems perspective; transformative change defines the overarching ambition; policy options articulate possible courses of action; transformative policy options set the level of transformative intervention required; and policy instruments enable implementation. By combining these elements, the Guidance supports the development of coherent, cross-sectoral, and effective responses capable of delivering long-term and meaningful change for biodiversity and society.

Further clarification of key terms and concepts used in this Guidance is provided in Appendix A.

3.2. Overview of BIONEXT activities and outcomes

BIONEXT is composed of six specialised work packages (Figure 1).

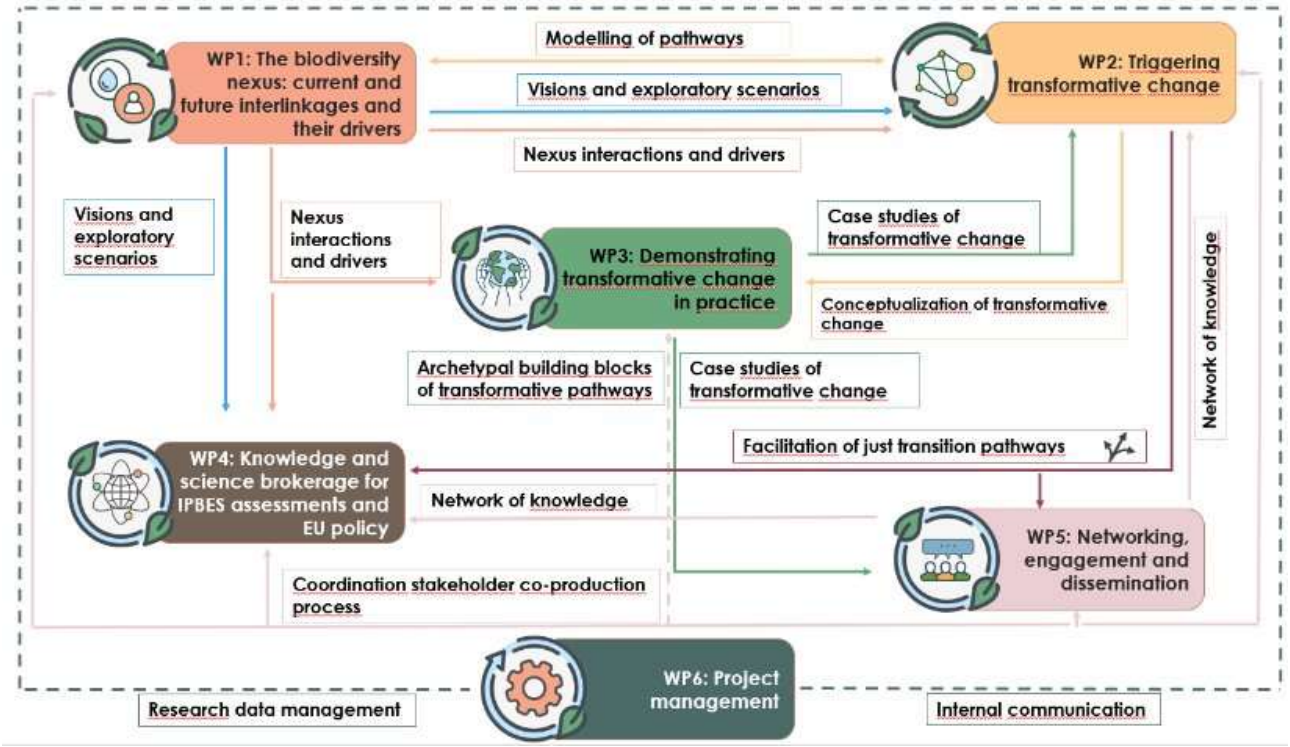


Figure 1. BIONEXT work packages and their interlinkages

The biodiversity nexus: current and future interlinkages and their drivers: Work Package 1 (WP1) applied a nexus approach to analyse the interconnections between biodiversity and nexus elements. It reviewed past and present interlinkages across biodiversity, water, food, energy, transport, health, and climate, consolidating fragmented evidence and identifying knowledge gaps relevant to the IPBES Nexus Assessment (D1.1: Understanding the role of biodiversity in the climate, food, water, energy, transport and health nexus in Europe). WP1 also engaged European stakeholders through a workshop to co-create exploratory future scenarios of the causes of biodiversity loss, alongside desirable visions of positive futures for biodiversity and people (D1.2: Report on scenarios and visions). In addition, WP1 developed an innovative nexus modelling framework to simulate sectoral interlinkages and identify pathways for transformative change towards sustainable, nature-positive futures (D1.3: Report on the modelling framework application).

Triggering transformative change: WP2 focused on understanding and enabling transformative change across ecological, technological, and socio-economic systems. It advanced conceptual understanding of justice and transformative change within the biodiversity nexus (D2.1: Conceptual framework on transformative change). Building on this, WP2 explored practical options to enable just transformative change across policy, the private sector, and civil society (D2.2: Transformative change from below? Linking biodiversity governance with the diversity of bottom-up action). Through stakeholder engagement and co-creation processes, WP2 also developed transition pathways for key nexus interlinkages (D2.3: A scheme of co-created transition pathways in the biodiversity nexus) and generated policy-relevant insights and action points addressing the multidimensional aspects of justice in transformative change (D2.4: Composting conflict: a BIONEXT zine and in-depth case studies).

Demonstrating transformative change in practice: WP3 examined real-world examples to identify and analyse transformative processes. It compiled a broad set of case studies from open-source repositories (D3.1: Collection of cases) and developed a coded database capturing key transformative factors and

processes (D3.2: Database of transformational elements). Based on this analysis, WP3 identified and prioritised archetypes of transformative processes, including success and failure factors across contexts (D3.3: Archetypes database). WP3 is also developing the BIONEXT Pathways app, which is designed to support users in exploring and comparing these transformative archetypes (D3.4: Decision-support tool).

Knowledge and science brokerage for IPBES assessments and EU policy: WP4 compiled and synthesised knowledge to support IPBES assessments and EU policy processes. It delivered state-of-the-art scientific evidence for the IPBES programme of work up to 2030 (D4.1: Documents and databases for IPBES assessments) and is assessing the implications for EU policy, supporting transformative change towards improved conservation and sustainable use of biodiversity and ecosystem services (D4.2: Guidance).

Facilitating nexus by networking, engagement, and dissemination: WP5 coordinated stakeholder engagement and the project's communication, dissemination, and exploitation strategy. It established and maintained a Network of Scientists and a Network of Knowledge (D5.1: Network established and working). WP5 is also evaluating knowledge integration (D5.2: Evaluation framework for knowledge integration), for this purpose, it hosted the creation of the Reflexivity Task Force of the project. In collaboration with WP3, WP5 is also co-developing a multi-criteria decision-support module for the Pathways app (D5.3: Decision-support module).

Project management: WP6 ensured coordination of the overall workflow, internal communication, and collaboration between partners, the steering group, and the advisory board. It also supported the translation of project outputs into policy-relevant insights through the development of policy briefs:

- Exploring Transformative Solutions for Biodiversity and Sustainability.
- What policymakers need to learn from bottom-up biodiversity action.
- Interlinkages between biodiversity, climate, food, water, energy, transport and health: A concentrated dose for policymakers.
- Exploring long-term biodiversity futures in Europe: Using the future to inform policy and decision making today.
- Why policies relevant to biodiversity risk overlooking justice – and how to address it.

At present, the BIONEXT project has produced more than 10 scientific papers, more than 7 technical reports, more than 5 databases, and 5 of 10 policy briefs. From which, key policy-relevant outcomes were considered for the Guidance, as described in Section 3.3.3.

3.3. Knowledge triangulation

The Guidance was developed through the triangulation of the BIONEXT co-creation process, the Nexus and Transformative Change IPBES assessments (NXA and TCA, respectively), and the synthesis and integration of BIONEXT knowledge presented in the outcomes of the work packages (Figure 2).

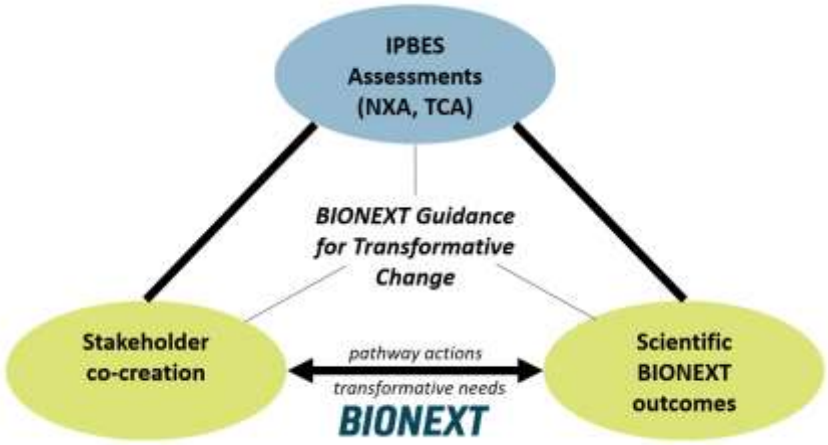


Figure 2. Knowledge triangulation for the BIONEXT Guidance

3.3.1. BIONEXT co-creation process

The Guidance co-creation process has two main lines of activities grounded on a workshop series carried out over the four years of the project (Figure 3).

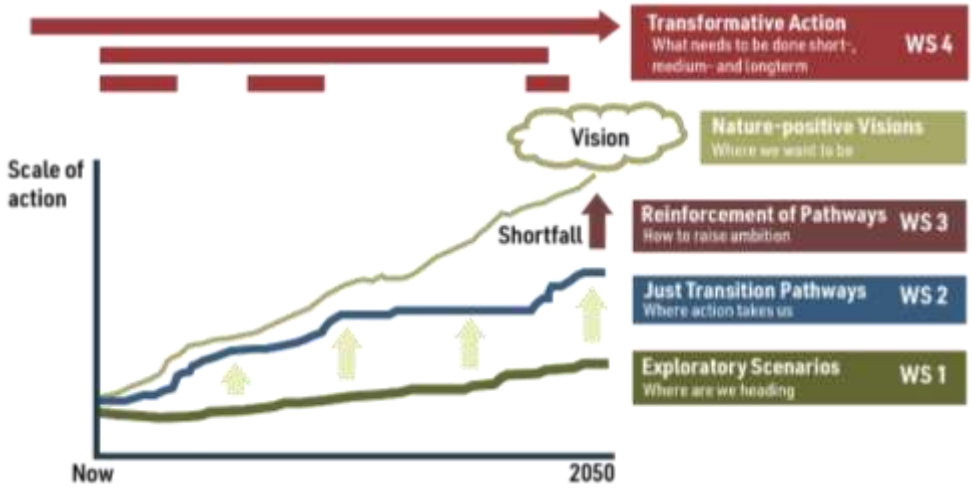


Figure 3. Workshop series in the BIONEXT project

The first line considers transformative actions co-created during the first three years of the project and guided by the IPBES Nature Futures Framework (IPBES, 2025). In workshop 1 (May 2023 in Santorini, Greece), stakeholders identified desired visions for Europe for 2050 (Deliverable 1.2). In workshop 2 (May 2024 in Schoorl, Netherlands), stakeholders backcast the visions and defined specific actions and outcomes for three nature-positive pathways (Deliverable 2.3; de Pater et al., 2025). In workshop 3 (May 2025 in Teplice, Czechia), stakeholders reinforced the pathways by adding new transformative actions, based on their previous qualitative and quantitative assessment. All workshops were complemented by webinars to iteratively refine and validate the results.

The three pathways for nature-positive outcomes (Deliverables 2.3, 1.3) are:

- Pathway 1: ***NaturAll*** (Nature for Nature) is centred on maximising space for nature and implementing deep social sufficiency measures
- Pathway 2: ***Dòigh Nàdair*** (Nature as Culture) highlights biocultural landscape management, community stewardship, and widespread behavioural change rooted in local contexts
- Pathway 3: ***Return to Nature*** (Nature for Society) is based on technological innovation, circular economy instruments, and the widespread use of nature-based solutions

All the deliverables, scientific publications and policy briefs associated with these workshops were used as input for the different sections of the Guidance. The transformative actions were, in addition, used to generate a flexible inspiration tool to co-create context-specific policy options (Section 3.3.3.2).

The second line of co-creation activities is centred on the Guidance. A survey aimed to standardise key policy-related terms between the BIONEXT project, stakeholders, and policymakers, and to retrieve the expectations on the Guidance was distributed in March 2026 between the BIONEXT stakeholders, EU and national policymakers, and IPBES and CBD national focal points. The answers (n=17) were used to reformulate key definitions (Section 3.1) and determine the content to be included in the Guidance. The outline of the survey is available in Appendix B.

In addition, the second day of Workshop 4 (May 2026 in Antwerp, Belgium) was focused on enhancing and refining the content of the Guidance. Through different sessions and activities, BIONEXT stakeholders, members of the project consortium and invited policymakers discussed the content of the different sections. The activities included the identification of real-world cases in which biodiversity is affected by policy-implementation issues, which was the starting point for stakeholders to become BIONEXT ambassadors in front of policymakers and after the project. From these cases, stakeholders, policymakers and BIONEXT members co-created policy options using the inspiration tool (Section 3.3.3.2). Other activities involved presentations, World Cafés to discuss the Guidance content, and a reflexivity session. The input received during the workshop was analysed and integrated into the final version of the Guidance.

3.3.2. Uptake and use of the IPBES Nexus and Transformative Change Assessments

BIONEXT has been strongly linked to the IPBES Nexus Assessment (IPBES, 2024a) and the Transformative Change Assessment (IPBES, 2024b), reflecting the project's core focus on nexus thinking and transformative change as key approaches to addressing biodiversity loss. On the one hand, BIONEXT contributed to these assessments by providing direct input (Deliverable 1.1) and through having members of the BIONEXT consortium as authors in these assessments under different roles. On the other hand, the Guidance makes active use of their findings and recommendations.

For instance, the Guidance draws on key definitions derived from these two assessments to both complement BIONEXT findings and fill knowledge gaps beyond the project's scope. These concepts were integrated into the co-created transformative actions and used to link them to key dimensions of transformative change, including the underlying causes of biodiversity loss, visions, challenges, approaches, as well as nexus categories, such as nexus governance and nexus actions (response options). The definitions of these terms as used in the Guidance are detailed in Appendix A.

3.3.3. Integration of BIONEXT knowledge

To synthesise the knowledge generated in BIONEXT, key thematic outcomes from the six work packages were selected, as indicated in Table 1. The detailed list of outcomes considered is presented in Appendix C.

Table 1. Summary of BIONEXT outcomes that can inform policy options

Work package	Thematic outcomes	Key characteristics
1	Nexus interlinkages and simulations of the Nexus Modelling Framework	• Interlinkages in the biodiversity, food, water, health, energy, transport and climate change nexus • Simulated transformative actions and milestones through the Nature Futures Framework of IPBES
2	Transformative change research	• Intervention modes • Transformative justice actions • Empirical evidence for transformative change and justice

3	Real-world cases with transformative potential	• Social interventions • Nexus interventions
4	EU policy review	• Nexus synergies and gaps in binding EU legislative instruments • Nexus synergies and gaps in non-binding EU policy instruments
5	Assessment tool for CBD targets	• Transformative change actions that contribute to EU targets submitted to CBD • Transformative change interventions that contribute to EU targets submitted to CBD
6	Policy briefs	• Key messages for policymakers from outcomes of WP1-5
1, 2, 3	Pathway actions	• Co-created transformative actions

The different outcomes within these work packages provided insights to design policy options by responding to a sequential set of questions linked to WHAT, HOW, WHEN, WHO (inspired by IPBES, 2024b), as illustrated in Figure 4.

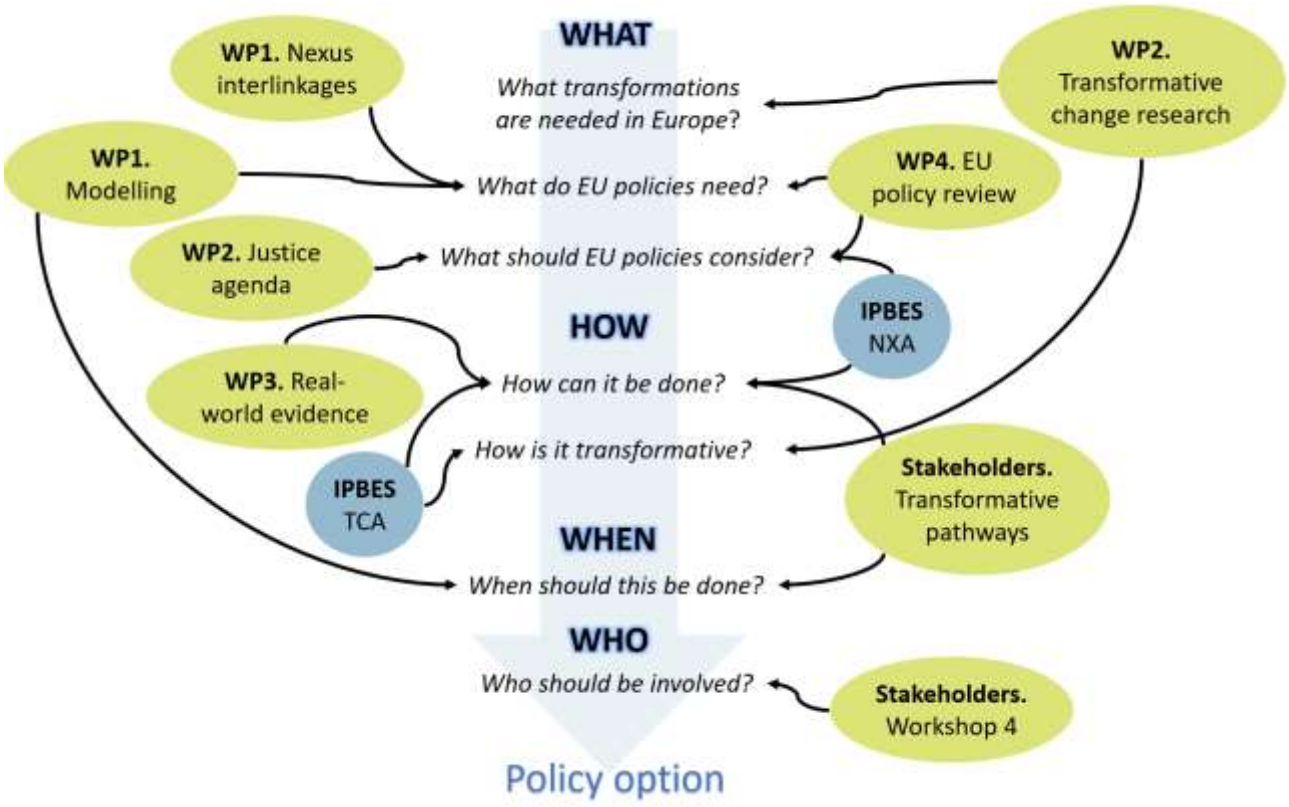


Figure 4. Conceptualisation of the integration of WP outcomes to answer essential questions related to a policy option

The practical synthesis and enrichment of the selected BIONEXT outcomes were supported by the artificial intelligence (AI) through dual-track development, running two sequential pipelines side-by-side before merging their results into the Guidance document. One track (Figure 5, left-central side) included all selected outcomes, except for the transformative actions, and the second track (Figure 5, right side) focused on the complementation of the BIONEXT transformative actions. The detailed description of these developments is provided in Sections 3.3.3.1 and 3.3.3.2, respectively.

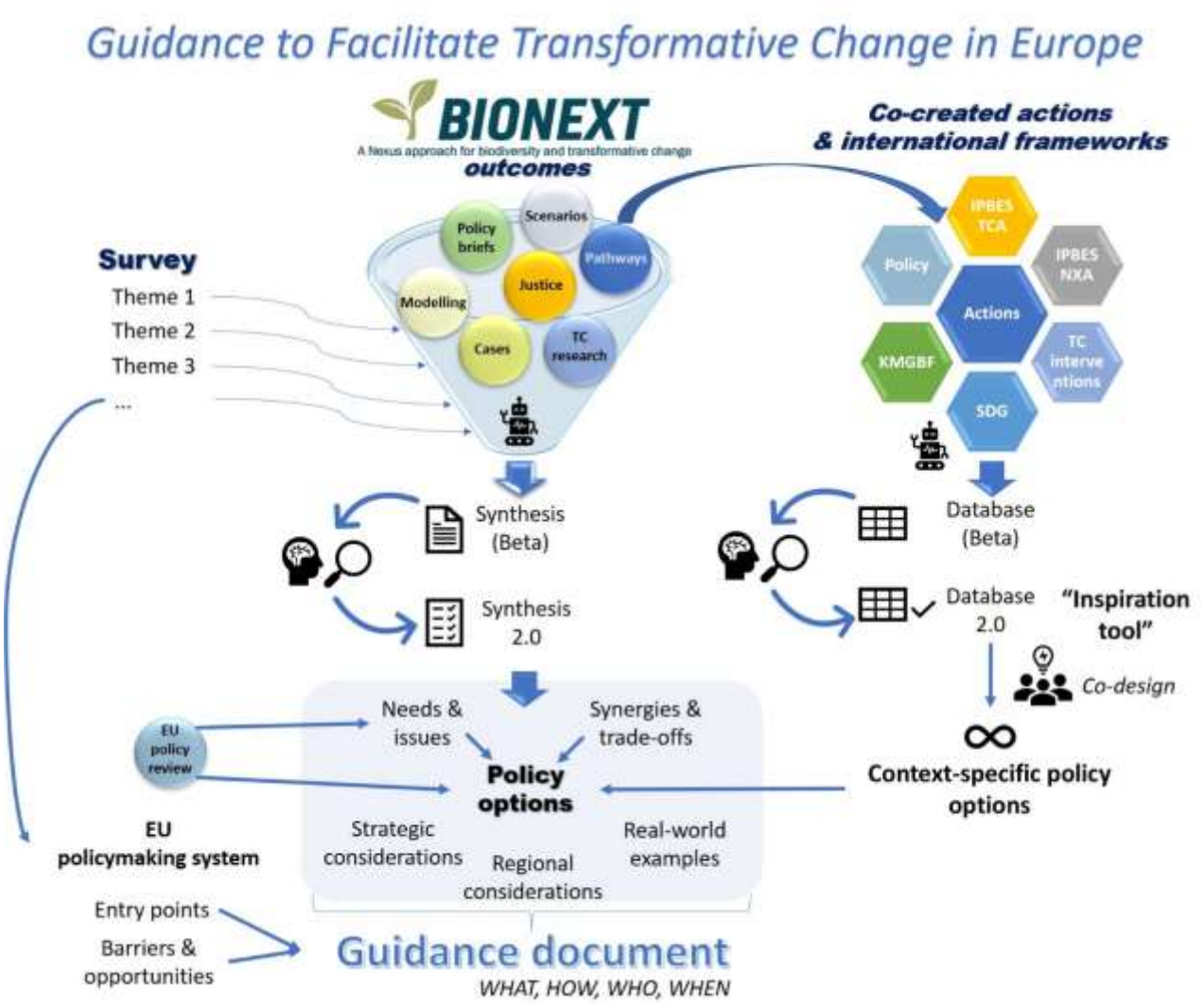


Figure 5. AI-supported dual-track methodological approach for synthesising and enriching BIONEXT knowledge for the Guidance. The process followed two tracks: 1) synthesis of BIONEXT outcomes, guided by a survey (left-central side of the figure; see Section 3.3.3.1 for a detailed description), and 2) complementation of the BIONEXT transformative actions through a tool designed to inspire the co-creation of policy options (right side of the figure; see Section 3.3.3.2. for a detailed description). The outputs of both tracks were subsequently integrated into the Guidance document.

3.3.3.1 Track 1: Synthesis of outcomes

The selected outcomes were organised in thematic packages according to the project's work packages and insights gathered through the Guidance survey (Appendix B). These thematic packages were designed to capture areas where BIONEXT researchers could provide relevant insights and evidence. These insights were translated into crucial questions to retrieve key problems and/or key solutions reported in the different outcomes (Table 2). In the case of the outcome 'EU policy review', part of the 'policy perspective' thematic package, AI-supported synthesis was deemed unsatisfactory and was therefore processed exclusively by humans. The survey also revealed the analysis of the EU policy-making system as a prominent theme, which was also treated without AI assistance.

Each thematic package was used to create notebooks in NotebookLM with the model available in April 2026 (Google, 2026). The crucial questions listed in Table 2 were asked individually to retrieve the information from the selected outcomes. The AI answers were structured in templates with instructions assigned for validation to one or more work package members, who were also key authors of the respective selected outcomes. Authors were requested to consider the AI input as a starting point and correct or add all the necessary content, including if a question was not pertinent to the outcomes. During the validation process, for the outcomes connected to the transformative pathways, authors also

generalised the actions strongly tied to pathway perspectives so that they can be used indistinctly from their pathway of origin.

Once all validations were received, the content was manually reorganised and distributed in the different sections of the Guidance, mainly: benefits of the nexus and transformative change approaches, synergies and trade-offs between the nexus elements, policy needs or issues, policy options, real-world examples and regional considerations. Outcomes that were not finished or available in a final draft version in April 2026 were not processed through the AI but were incorporated later manually (see Appendix C).

In general, authors considered the synthesis of the AI responses with an average of 85% of accuracy. In a few cases, hallucination or misinterpretation was identified, and authors corrected a significant part or the entire text. Only the retrieval of information from the EU policy review (mostly available in csv files) was fully discarded due to its lack of precision and was conducted manually. For the rest of the thematic packages, authors considered the AI as a useful starting point, ratifying the need for human control in this type of method.

Table 2. Summary of the organisation of BIONEXT outcomes

Thematic package	Responsible Work Package	Crucial questions	Selected outcomes (titles and links in Appendix C)
Nexus perspective	WP1	1. Considering the definition of policy instruments (Appendix A). Where are existing European policies insufficient, and what new policy instruments are needed to fill systemic gaps? 2. What are the benefits of mainstreaming biodiversity into European sectoral policies (food, water, climate, health, energy, transport)? 3. Considering the definition of policy option (Appendix A). What trade-offs and synergies exist between sectors (biodiversity, water, food, health, climate, transport, energy, finance, education, etc.), and how can policy options manage or optimise them? 4. How can policy sectors (biodiversity, water, food, health, climate, transport and energy) be combined (policy mixes) to maximise positive impact and avoid unintended consequences on biodiversity and nature? 5. Considering the definition of policy option (Appendix A). What are the concrete, feasible policy options that can be implemented to address biodiversity loss across sectors (food, water, energy, health, transport, climate)? 6. What region-specific considerations across Europe are necessary to design and implement policies that effectively mainstream biodiversity across sectors? (discarded after suggestion in validation) 7. Question 7. What future scenarios (pathways) illustrate different levels of action vs inaction and their consequences?	Kim et al., (2024); Kim et al., (2024) SM; Deliverable 1.3; Policy brief 3
Scenarios perspective	WP1		Lazurko et al. (2025b); Raymond et al. (2025)
Transformative change perspective	WP2	1. Considering the definition of policy instruments (Appendix A). Where are existing European policies insufficient, and what new policy instruments are needed to fill systemic gaps? 2. How can existing EU policies be strengthened, better implemented or enforced to contribute to transformative change? 3. What are the benefits of mainstreaming biodiversity into European sectoral policies (food, water, climate, health, energy, transport)? 4. Why is transformative change needed in Europe, and what are the benefits of implementing it through the support of policies? 5. Considering the definition of policy option (Appendix A). What trade-offs and synergies exist between sectors (biodiversity, water, food, health, climate, transport, energy, finance, education, etc.), and how can policy options manage or optimise them? 6. How can policy sectors (biodiversity, water, food, health, climate, transport and energy) be combined (policy mixes) to maximise positive impact and avoid unintended consequences on biodiversity and nature? 7. Considering the definition of policy option (Appendix A). What are the concrete, feasible policy options that can be implemented to address biodiversity loss across sectors (food, water, energy, health, transport, climate)?	Deliverable 2.1.; Deliverable 2.3.; Deliverable 2.4.; Milestone 2.4 (MS 7); Policy brief 1; Policy brief 2; Hebinck et al. (2026); Lazurko et al. (2025a); de Pater (2025); de Pater et al. (2025); Valve et al. (2025); Valve et al. (2025) SM.
Evidence-based perspective 1	WP2	1. What case studies or examples of best practice are there to show that transformative actions work in the real world, and why do they work? 2. What region-specific considerations across Europe are necessary to design and implement policies that effectively mainstream biodiversity across sectors and enable transformative change?	Context Czechia; Focus group Czechia; Interviews Czechia; Interviews Greece; Focus group Netherlands; Interviews Netherlands; Interviews UK; Interviews Belgium;

Thematic package	Responsible Work Package	Crucial questions	Selected outcomes (titles and links in Appendix C)
			Narrative Finland; Background Finland; Narrative Netherlands; Narrative Belgium
Evidence-based perspective 2	WP3	1-8. What are the five cases that have transformative change interventions that best match at least one of these categories [definitions of the subcategories in each of the main eight categories of transformative change interventions, see Appendix A]? (i.e., one question per each of the main categories) Additional instructions: In the identification of cases, consider the implementation of interventions through the support of policy options. Organise the cases in a ranking (from the best match to the worst). Interpret the spreadsheet according to the description of the fields provided (from Deliverable 3.2).	Deliverable 3.2 (full database of 31 cases)
Policy perspective (fully processed by humans)	WP4	1. Considering the definition of policy instruments (Appendix A). Where are existing European policies insufficient, and what new policy instruments are needed to fill systemic gaps? 2. Considering the definition of policy option (Appendix A). What trade-offs and synergies exist between sectors (biodiversity, water, food, health, climate, transport, energy, finance, education, etc.), and how can policy options manage or optimise them? 3. How can policy sectors (biodiversity, water, food, health, climate, transport and energy) be combined (policy mixes) to maximise positive impact and avoid unintended consequences on biodiversity and nature? 4. Considering the definition of policy option (Appendix A). What are the concrete, feasible policy options that can be implemented to address biodiversity loss across sectors (food, water, energy, health, transport, climate)?	UNEP-WCMC (2025)

3.3.3.2 Track 2: Tool to inspire the co-creation of policy options

The second track aimed to include flexibility in the Guidance for the co-design of context-specific policy options through an "**inspiration tool**" based on the 648 co-created transformative actions. Therefore, the focus was on complementing the transformative actions with 16 elements (identified as *complementary components* in the "Type of information represented" column of Table 3) derived from existing frameworks and aligned with the respective transformative actions. These frameworks included the IPBES nexus and transformative change components, policy components, and targets and goals of international biodiversity and sustainability policies, as described in Table 3.

The initial association between the actions and the 16 complementary elements was performed using the large language model Qwen3.5, specifically the 397B parameter Mixture-of-Experts version (Tongyi Lab, 2024). The model was employed via a prompt (available upon request), in which instructions on the role, context, definitions as the source of truth (Appendix A), and desired outputs were indicated. The main requested task was to determine the best fit of the categories in each complementary element, based on the intent of the action.

Strict protocols on data governance were indicated to avoid the use of external data, except for the definitions on SDGs and KMGBF targets, and general knowledge on Transformative Change, Nexus Approach and IPBES Frameworks. The creativity mode was set to zero, including a 'do not guess' request. Given the large number of actions and complex definitions, and to avoid context limits, the logic was applied in 13 batches of 50 entries each. A random sample of 10% of the output (n=65) was manually validated by BIONEXT members to confirm alignment with the definitions.

The execution of the prompt was deployed as a local, on-premise instance hosted exclusively at the Karlsruhe Institute of Technology (KIT)'s secure internal infrastructure. This guaranteed that all the BIONEXT transformative actions remained strictly within KIT's firewall at all times. No data was transmitted to external third-party servers, Alibaba Cloud, or any public internet endpoints during

processes. In addition, the model operated in static inference mode, i.e., no user data was retained or used for future model training.

The completed spreadsheet was constituted as the raw version of the **inspiration tool** to co-design policy options for specific contexts. The current version of the tool (Figure 6) works on the basis of filters by column and the preliminary identification of the field roles as input, output or complement. In Table 3, these roles are suggested by indicative priority, but in practice, except for the actions, all the fields can be inputs or outputs depending on how deterministic the available information is for the given context.

The use of the tool is structured into six steps (Figure 6). (1) Identify and define a biodiversity-related policy problem and its context. (2) Identify key input characteristics associated with the problem. Where the problem is not clearly linked to a specific characteristic, such as contributing to an SDG or promoting bottom-up actions, etc., users are encouraged to select values listed as *Primary input* in the "Recommended role for the use of the inspiration tool" column in Table 3. (3) Enter the selected input characteristics as filters in the spreadsheet. (4) Retrieve the resulting actions and associated outputs, beginning with the primary outputs. If the number of resulting actions is still too large, apply additional filters to further refine the results. (5) Discuss the selected outputs with experts, stakeholders, and/or policy-makers to co-design tailored actions for the specific problem. Policy instruments and nexus governance should be considered central components to this process. Additional elements of the tool, such as actors, can be incorporated as appropriate, and the proposed actions should be adapted and refined as needed. (6) Formulate the final policy option based on the outcomes of these discussions.

The tool and the approach illustrated in Figure 6 were used in Workshop 4 following facilitation questions. The activity resulted in 4 cases that demonstrate the use of the tool in practice and new policy options for specific contexts or situations in Europe. These outputs are presented in Section 5.3 and Appendix D.

Table 3. Metadata of the inspiration tool

Field name in the inspiration tool	Description with the number of categories or possible values in brackets (full definitions and coded values in Appendix A)	Type of information represented	Source	Recommended role for the use of the inspiration tool
Action	Transformative action (n=648)	Original database from stakeholder input (de Pater et al.)	BIONEXT stakeholder workshops 2 and 3	Primary output
Pathway	Nature Futures Framework pathway perspective (n=3)			Contextual information, if required
Time slice	Year of implementation (n=3)			Secondary output
Nexus element	Elements in the biodiversity nexus (n=7)			Input OR output
BD loss	Underlying causes of biodiversity loss (n=3)	Complementary component	IPBES TCA	Primary input
TC vision	Transformative change visions by 2050 (n=5)		IPBES TCA	Primary input
TC challenge	Overarching societal challenges to transformative change (n=5)		IPBES TCA	Primary input
TC approaches	Transformative change approaches (n=6)		IPBES TCA	Secondary input OR output
Ways of	Ways of shifting (n=3)		IPBES TCA	Secondary input OR output
Actors	Key actors for transformative change (n=8)		IPBES TCA	Secondary input OR output
TC direction	Direction of transformative change intervention (n=2)		IPBES TCA	Secondary input OR output
TC principle	Key principles of transformative change (n=4)		IPBES TCA	Tertiary input OR output
TC strategies	Strategies and actions for transformative change (n=5)		IPBES TCA	Tertiary input OR output
TC policy	Type of transformative policy (n=2)		WP4	Tertiary input OR output
TC intervention	Interventions for transformative change (n=8)		WP2, WP5	Primary output
Policy instrument	Types of policy instruments (n=4)		IPBES	Primary output

Field name in the inspiration tool	Description with the number of categories or possible values in brackets (full definitions and coded values in Appendix A)	Type of information represented	Source	Recommended role for the use of the inspiration tool
Nexus governance	Components of nexus governance (n=5)		IPBES NXA	Primary output
Nexus action	Actions or policies to address specific challenges or opportunities across the nexus (response options) (n=10)		IPBES NXA	Primary output
SDG	Sustainable Development Goals (n=17)		UN	Tertiary input OR output
KMGBF	Targets of the Kunming-Montreal Global Biodiversity Framework (n=23)		CBD	Tertiary input OR output

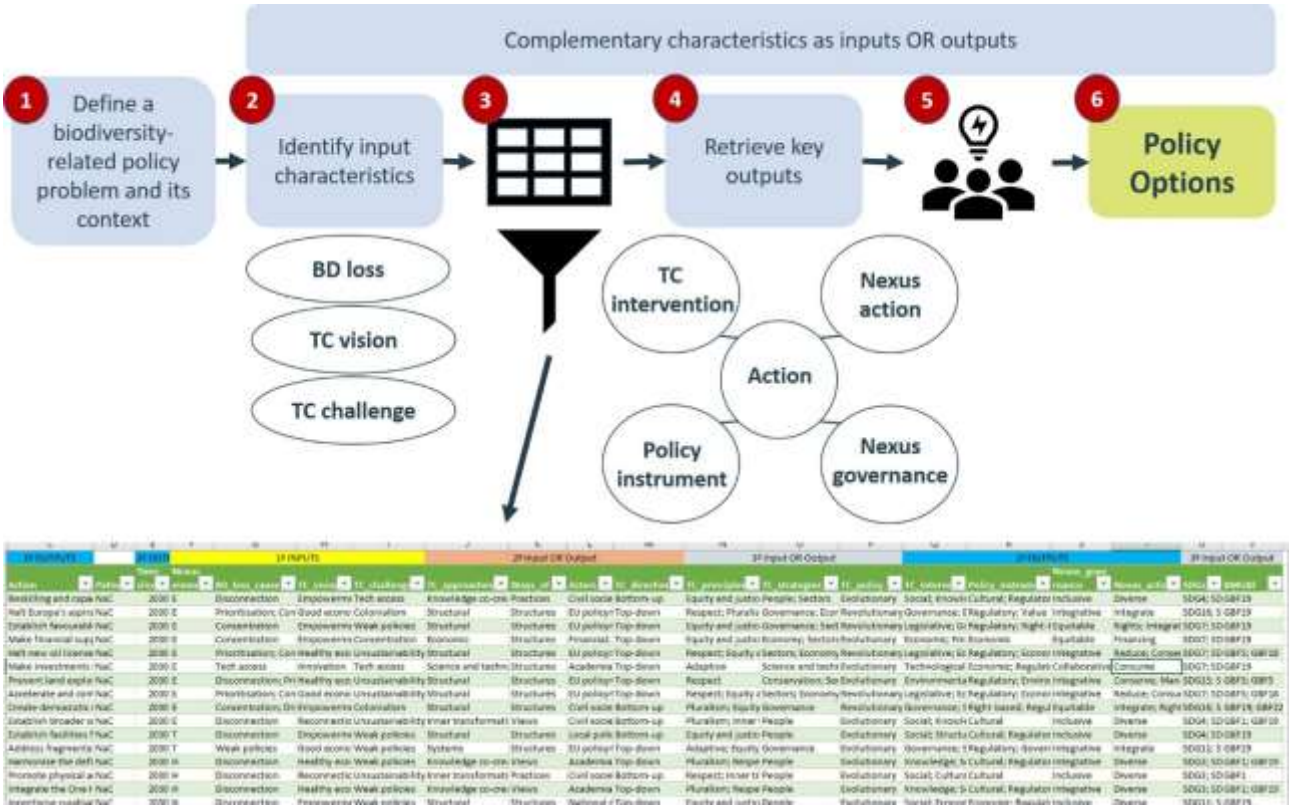


Figure 6. Operational use of the inspiration tool in its current raw spreadsheet format, considering primary inputs and outputs

4. Context and foundations for policy options

4.1. Understanding the benefits of Biodiversity Nexus and Transformative Change approaches for policymaking

4.1.1. Benefits of supporting the biodiversity nexus and transformative change through policies

Mainstreaming biodiversity into European sectoral policies, such as food, water, climate, health, energy, and transport, is essential for achieving transformative change and halting nature's decline (Deliverable 2.1; Lazurko et al., 2025; Policy Brief 1). This approach recognises that biodiversity is not an isolated environmental issue but the foundational heart of sustainable societies, underpinning every aspect of human life (Deliverable 2.1; Policy Brief 2).

In turn, transformative change is required in Europe because the accelerating decline of biodiversity, driven by climate change, natural resource extraction, pollution, and land-use change, has reached a point where a 'business-as-usual' trajectory is no longer tenable (Deliverable 2.3; Policy Brief 1). Current scientific evidence underscores that human existence is fundamentally dependent on the functioning of natural systems, yet biodiversity loss is deeply embedded in societal systems, including our economic goals, sociocultural values, and institutional structures (Deliverable 2.3; Hebinck et al., 2026; Policy Brief 1). Previous conservation efforts have largely fallen short because they have focused on addressing the direct symptoms of biodiversity loss rather than the indirect anthropogenic drivers or 'root causes' of the crisis (Deliverable 2.1; Lazurko et al., 2025). However, given the non-linear and systemic nature of transformative change, such change cannot be 'implemented' or 'managed' in a straightforward manner, but policies play a crucial role in enabling, steering, and creating the conditions for such change to emerge (Deliverable 2.1, Hebinck et al., 2026).

Supporting this change through the implementation of policies and a biodiversity nexus approach offers several critical benefits:

1. Addressing root causes and enabling "exnovation"

Policy frameworks can play a key role in enabling fundamental, system-wide reorganisation by addressing the underlying drivers of biodiversity loss. This requires not only addressing direct pressures, but also reshaping the institutional, economic, and cultural conditions that sustain them (Deliverable 2.1; Lazurko et al., 2025). In practice, this involves moving beyond the promotion of 'green' alternatives to creating the conditions for the phase out of unsustainable practices, a process known as exnovation (Hebinck et al., 2026; Deliverable 2.3; Policy Brief 1). Such measures may include using regulatory instruments to dismantle the conditions that enable ecological exploitation and halting subsidies for polluting industries (Deliverable 2.3; Policy Brief 2). By targeting the underlying drivers of biodiversity loss, policies can make sustainability the 'norm rather than the altruistic exception' (Policy Brief 1).

2. Achieving policy coherence across the nexus

Mainstreaming biodiversity into the core strategies of sectors like food, water, climate, energy, transport, and health moves beyond siloed decision-making, where individual sectors act in isolation, towards more holistic policy coherence, but this requires adequate institutional capacity and coordination mechanisms (Deliverable 2.1; Policy Brief 1, Policy Brief 2, Valve et al. 2024; Kim et al., 2024; Kim et al., in prep.). This approach allows policymakers to identify synergies (win-win solutions) where possible, while making trade-offs more explicit and manageable across sectors (Deliverable 2.1; Lazurko et al., 2025a; Policy Brief 1; Lazurko et al., 2025b; Raymond et al., 2025). This can support policy mixes that both promote nature-positive practices, including by strengthening support for actors already engaged in them, and facilitate the phase-out of environmentally harmful activities (Deliverable 2.1, Deliverable 2.4, Policy Brief 5).

3. Fostering social and ecological justice

A primary benefit of policy-supported transformation is the more explicit integration of justice and plurality into governance processes (Deliverable 2.4; Lazurko et al., 2025; Policy Brief 5; de Pater, 2025). However, justice is often assumed rather than actively governed (Deliverable 2.4). Besides recognising that justice and sustainability are "two sides of the same coin", policies need to deliberately engage with questions of fairness, responsibility, and recognition, rather than relying on indirect proxies such as participation or economic feasibility (Deliverable 2.4; Policy Brief 5). This contributes to:

- **Strengthening the role of marginalised actors**: Inclusive governance models can enhance the representation and meaningful participation of those most affected by environmental changes, including Indigenous Peoples and local communities (Deliverable 2.1; Deliverable 2.4; Lazurko et al., 2025; Milestone 2.4; de Pater, 2025). However, participation does not automatically lead to just outcomes. If their participation is primarily used to secure social acceptance, rather than to shape decisions, it risks reproducing existing power asymmetries (Deliverable 2.4; Policy Brief 2). Meaningful contributions to justice require participatory processes that explicitly address power, clarify responsibilities, and ensure that diverse perspectives genuinely influence outcomes (Deliverable 2.4, Policy Brief 5).
- **Making distributional impacts visible and negotiable**: Policies can support the development of transparent criteria and deliberative processes that clarify who bears the costs and who benefits from transformation. Rather than assuming that equitable outcomes will emerge, this requires making trade-offs and potential inequalities explicit, and creating space to negotiate them over time (Deliverable 2.1; 2.4; Milestone 2.4; Policy brief 5).
- **Recognising and supporting Nature's Rights and stewardship**: Policy approaches can strengthen transformative change by broadening how human-nature relationships are understood and governed. This includes recognising and supporting “nature-positive stewards” – that is, actors already engaged in care-based practices such as ecological restoration, community-led conservation, regenerative agriculture, Indigenous and local stewardship practices etc. – through legal, financial, and institutional mechanisms. It may also involve granting ecosystems a more formalised status through the recognition of Nature’s Rights. Together, these approaches move beyond viewing nature solely as an instrumental resource, helping to embed intrinsic and relational values in decision-making while strengthening accountability towards ecosystems and future generations (Deliverable 2.3; 2.4; Hebinck et al., 2026; de Pater, 2025).
- **Governing conflict and plurality**: Biodiversity transformations inevitably involve trade-offs and the emergence of winners and losers. Avoiding conflict through voluntary or consensus-based approaches does not resolve these tensions but can make them less invisible. Policy frameworks that acknowledge plurality and create mechanisms for negotiation, contestation, and adaptation are therefore essential to achieve both legitimacy and long-term sustainability (Deliverable 2.4).

4. Enhancing resilience and long-term well-being

Policy-supported transformation can contribute to strengthening the adaptive capacity and resilience of social-ecological systems (Deliverable 2.1). This is exemplified by the "One Health" approach, which integrates the health of people, animals, and ecosystems into a single policy framework, shifting the health sector toward preventative, nature-based care (Deliverable 2.1; 2.4; Milestone 2.4). Furthermore, anticipatory governance approaches (such as co-created transition pathways) can support policymakers in navigating deep uncertainties, fostering collective learning and preparing for future crises in ways that go beyond reactive models (Deliverable 2.3; de Pater, 2025; Policy brief 5).

5. Scaling alternative practices

Policies frameworks and instruments can play an important role in enabling the development, sustainability, and wider uptake of transformative alternatives, including those that already exist but remain marginalised or overlooked (Policy Brief 1; Deliverable 2.1; Valve et al., 2025). This includes supporting bottom-up initiatives—such as agroecology, circular business models, and local community stewardship—through financial, regulatory and institutional measures that reduce barriers and create

more enabling conditions. Rather than solely focusing on scaling innovation from niche to mainstream, policy support can also recognise and strengthen "nature-positive stewards". By doing so, policies can help stabilise and scale these practices, support local economies, and foster more reciprocal relationships between communities and their environments (Policy Brief 1; Deliverable 2.3; Valve et al., 2025; Hebinck et al., 2026).

In summary, by addressing biodiversity in combination with at least two or three other nexus elements, initiatives are significantly more likely to succeed in supporting transformative change and avoiding the negative cascading impacts of sectoral silos (Policy Brief 1; Valve et al., 2025).

4.1.2. Benefits for international biodiversity frameworks

Three broad relationships between intervention types and the EU biodiversity targets submitted to the Convention on Biological Diversity under the KMGBF were identified from the assessment of the significance of interventions in driving transformative change for biodiversity (Mustajoki et al., in prep.). The interventions (see definitions under 'TC interventions' in Appendix A) are concrete policy-relevant actions derived from key enablers of change (Hebinck et al., 2023).

- **Knowledge, social, governance, and value-related interventions** primarily act as enabling conditions for transformative change by building capacity (e.g., Target 20, hereafter T20), strengthening participation and inclusion (e.g., T22, T23), and fostering awareness, learning, and societal support (e.g., T16, T21).
- **Economic, legislative, and technological interventions** are relevant to the structural and systemic transformations needed to reshape production and consumption systems (e.g., T15, T16), redirect financial flows (e.g. T18, T19), and create the institutional conditions that enable long-term change (e.g., T14).
- **Economic, technological, governance-related, and environmental interventions** contribute directly to ecological outcomes, including restoration (e.g. T2, T11, T12), conservation (e.g. T1, T3, T4, T8, T11), sustainable resource management (e.g., T5, T10), and pollution reduction (e.g., T7). Progress towards these outcomes typically depends on the interaction of multiple interventions operating within complex socio-ecological systems.

Overall, the results suggest that enabling interventions are more frequently reflected in current approaches to transformative change, while the deeper structural and systemic transformations (particularly those required to reshape economic and production systems, and deliver ecological outcomes) remain more challenging to achieve through biodiversity policy alone.

4.2. Needs and gaps in the European policy landscape

Needs and gaps in European policies were identified from three main sources: (1) BIONEXT outcomes, (2) a survey shared with BIONEXT stakeholders and policymakers, and (3) an analysis of EU policy instruments. These needs and gaps were then classified into 11 main groups (Figure 7). Groups 9, 10 and 11 are exclusive insights of individual sources. In the following subsections, each of these groups is described by source.

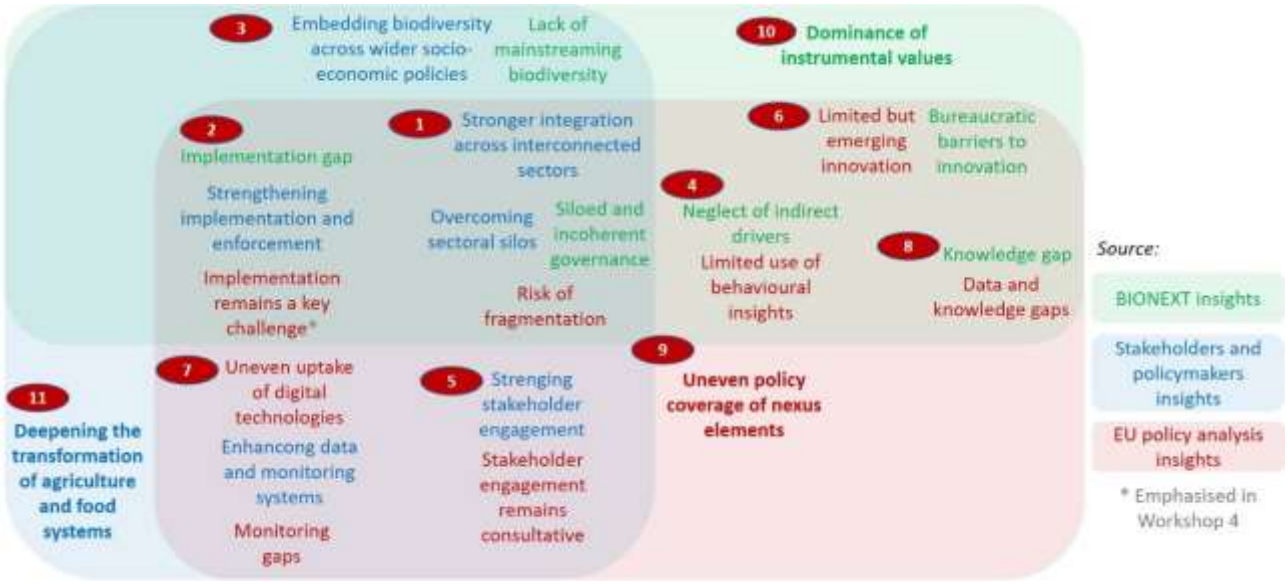


Figure 7. Needs and gaps in European policies

4.2.1. Insights from the Biodiversity Nexus and Transformative Change approaches in BIONEXT

Existing European policies are often insufficient to enable transformative change because they are typically developed and implemented in sectoral silos and rely on top-down governance models. As a result, they frequently fail to address the root causes of biodiversity loss, such as the dominance of the economic growth paradigm and anthropocentric values (Deliverable 2.1; Policy Brief 1). Governance approaches grounded in sectoral silos tend to favour incremental change and short-term priorities over more systemic transformations (Deliverable 1.3).

Areas in which existing policies are insufficient:

- Siloed and incoherent governance (*Group 1*): Environmental goals are frequently secondary to the primary objectives of sectors like agriculture, energy, and transport (Deliverable 2.1; Policy Brief 1). This leads to policy incoherence, where incentives in one sector (e.g., agricultural subsidies) directly undermine biodiversity protection in another (Deliverable 2.1). Thus, sectoral compartmentalisation fails to account for the complex interdependencies between sectors, which can lead to unintended negative consequences for biodiversity (Deliverable 1.3; Kim et al., 2024).
- Implementation gap (*Group 2*): There is a persistent disconnect between EU-level commitments and local execution, often due to a shortage of institutional capacity, expertise, and resources within public administrations (Deliverable 2.1; Policy Brief 2; Valve et al., 2025), as well as power imbalances among stakeholders, which can reduce the legitimacy of policy pathways (Raymond et al., 2025).
- Lack of mainstreaming (*Group 3*): Biodiversity is frequently treated as an isolated environmental "endpoint" or an optional consideration rather than a foundational consideration that needs to be embedded across core strategies in public policy (Deliverable 1.3; Kim et al., 2024). Similarly, biodiversity loss and climate change are treated as isolated crises rather than deeply entangled challenges (Lazurko et al., 2025b).
- Neglect of indirect drivers (*Group 4*): Most policy frameworks tend to support gradual adjustments and focus on addressing direct drivers (e.g., pollution). However, they often fail to dismantle the indirect drivers that are the true underlying causes of biodiversity loss, such as unsustainable consumption patterns, resource-intensive and unsustainable economic models, the displacement of environmental impacts associated with technological developments outside of Europe, and other sociocultural, economic and institutional factors (Deliverable 2.1; Lazurko et al., 2025; Deliverable 1.3; Lazurko et al., 2025b).

- **Bureaucratic barriers to innovation** (*Group 6*): Complex bureaucratic procedures and regulations with unclear or difficult-to-interpret requirements and obligations often hinder bottom-up initiatives and "niche" innovations with transformative potential (Valve et al. 2025; Policy Brief 2).
- **Knowledge gap** (*Group 8*): There is a significant gap between available scientific evidence on the biodiversity nexus and its actual application in decision-making (Kim et al., 2024; Policy Brief 3). Furthermore, models used for policy assessments often treat sectors independently, limiting their ability to simulate the synergies and trade-offs in nature-positive pathways (Deliverable 1.3). There is also a lack of clear definitions and meaningful, ecosystem-specific indicators for binding regulations (Raymond et al., 2025).
- **Dominance of instrumental values** (*Group 10*): Existing policies predominantly frame nature as an instrumental resource for human use, marginalising intrinsic and relational values (Deliverable 2.1; de Pater, 2025), as well as neglecting the agency of nature and biodiversity to drive changes, viewing them only as impacts or outcomes (Lazurko et al., 2025b).

4.2.2. Insights from stakeholders and policymakers

Insights from stakeholders and policymakers in the Guidance survey indicate that, despite a robust EU environmental policy framework, biodiversity-related challenges persist due to fragmented, sector-specific approaches and limitations in implementation. These findings highlight areas where more coordinated, cross-sectoral, and transformative action is needed:

- **Stronger integration needed across interconnected sectors** (*Group 1*): EU policies continue to address biodiversity-related nexus elements largely in isolation, despite strong interdependencies. Greater integration – for example, across water, food, and energy systems – is increasingly required to deliver co-benefits for biodiversity, climate, health, transport, and overall resilience.
- **Overcoming sectoral silos to improve policy effectiveness** (*Group 1*): While the EU has robust environmental and sustainability frameworks on paper (e.g. the Biodiversity Strategy, Green Deal, Nature and Water Directives), their practical integration across directives and sectors remains limited. Political, administrative, and technical constraints hinder coordinated implementation.
- **Strengthening implementation and enforcement** (*Group 2*): Shortcomings are often less related to policy design than to persistent challenges in implementation and enforcement, shaped by capacity constraints, lobbying pressures, and siloed decision-making.
- **Embedding biodiversity across wider socio-economic policies** (*Group 3*): Addressing cumulative pressures and long-term risks requires reforms across wider socio-economic and sectoral policy frameworks. Biodiversity considerations need to be more systematically embedded in sectors such as energy, transport, health, foreign policy, and macro-economic planning, where biodiversity protection, when included, often functions as a supporting rather than a primary objective.
- **Strengthening stakeholder engagement** (*Group 5*): Deeper public education and engagement that goes beyond awareness-raising, alongside enhanced private-sector involvement, are needed to support effective policy implementation.
- **Enhancing data and monitoring systems** (*Group 7*): Stronger data systems, indicators, and monitoring tools are required to support implementation, assess progress, and enable adaptive management across policy areas.
- **Deepening the transformation of agriculture and food systems** (*Group 11*): Agricultural policy, particularly the Common Agricultural Policy (CAP), remains central to achieving transformative change. Despite some progress, further reform is needed to better address biodiversity-nexus interactions, reward ecosystem restoration, reduce pollution, strengthen pollination, and align food systems with biodiversity and climate objectives.

4.2.3. Insights from EU policy analysis

European Union (EU) legal and policy instruments relevant to the biodiversity nexus were analysed to assess how, and to what extent, nexus elements are addressed. In total, 75 EU instruments were reviewed– 48 binding and 27 non-binding – covering multiple thematic areas (UNEP-WCMC, 2025).

Non-binding acts set strategic direction but are not legally enforceable, relying on legislative or other measures for implementation. Binding acts establish legal obligations for Member States (and often monitoring and reporting roles for the European Commission) and frequently operationalise commitments set out in non-binding instruments.

While many instruments, particularly those adopted following the 2019 European Green Deal, are increasingly cross-sectoral, several key insights emerge (UNEP-WCMC, 2025):

1. **Risk of fragmentation (*Group 1*)**: Only a limited number of binding instruments reference all nexus elements (e.g. the *EU Climate Law*, *Taxonomy Regulation*, *Recast Renewable Energy Directive*, *Energy Governance Regulation*, *Nature Restoration Regulation*). However, inclusion of a nexus element does not imply equal emphasis, as most retain a primary thematic focus (e.g. climate in the *EU Climate Law*). References across instruments signal linkages but not necessarily prioritisation or operationalisation, and may partly reflect contextual cross-referencing between policies in the preambles. The distinction between preambular and operative provisions is therefore important: preambles often acknowledge cross-policy connections, whereas operative provisions determine whether integration translates into action. In practice, several instruments reference all nexus elements in their preambles but omit key areas, notably transport and health, in their operative provisions. Instruments that incorporate multiple nexus elements within their operative provisions are more likely to enable meaningful cross-sectoral action, whereas those that do not may remain largely non-operational. Workshop 4 participants also noted that, in practice, securing references to biodiversity or nexus concepts in legislative preambles can already represent an important step towards future policy integration.
2. **Implementation remains a key challenge (*Group 2*)**: Workshop 4 participants emphasised that effective biodiversity mainstreaming depends not only on EU policy but also on implementation by Member States. They also noted that ambition for cross-sectoral integration may be weakened during negotiation and implementation, highlighting the importance of governance arrangements that support coordination across policy sectors and levels of decision-making.
3. **Limited use of behavioural insights (*Group 4*)**: Despite growing recognition, behavioural approaches remain underutilised. Some instruments (e.g. *Circular Economy Action Plan*, *Clean Energy package*) stress the role for consumer behaviour and behavioural economics in supporting policy effectiveness.
4. **Stakeholder engagement remains consultative (*Group 5*)**: Engagement mechanisms are widespread but largely limited to consultation, with fewer examples of participatory or co-creative approaches. Workshop 4 discussions further highlighted that institutional mandates and sector-specific responsibilities can constrain cross-sectoral collaboration, even where consultation mechanisms exist.
5. **Limited but emerging innovation (*Group 6*)**: Innovative mechanisms addressing multiple nexus elements are most evident in biodiversity- and climate-focused non-binding instruments, and in biodiversity-, climate-, and food-related binding instruments. They are less frequently identified in instruments focused on food, transport, and water (non-binding), and health, water, or energy (binding).
6. **Uneven uptake of digital technologies (*Group 7*)**: Digital tools, including AI, are increasingly recognised as enabling improved data collection, monitoring, and policy implementation, but uptake remains uneven. Several instruments also highlight the opportunities presented by

circularity and life-cycle approaches, alongside digitalisation in areas such as ocean monitoring, energy systems, and climate data.

7. **Monitoring gaps (*Group 7*):** There is a persistent need for stronger monitoring frameworks, including improved tools, methods, and indicators. For example, the *EU Pollinators Initiative* and the *EU Forest Strategy* for 2030 call for more robust indicators aligned with ecosystem health and climate and biodiversity thresholds.
8. **Data and knowledge gaps (*Group 8*)**: Non-binding instruments often highlight the need for improved data, research, and valuation methods. Key gaps include understanding the drivers of environmental degradation and improving climate risk data. *Forging a Climate-Resilient Europe* underscores the need for more robust data on climate risks and losses to support informed decision-making, while the *Green Infrastructure Strategy* calls for advances in ecosystem service valuation to better capture the economic and social benefits of nature.
9. **Uneven policy coverage of nexus elements (*Group 9*)**: In non-binding instruments, climate and health are the most frequently referenced nexus elements, followed by energy and food, and then water, with biodiversity and transport appearing less often. In binding instruments, health is the most frequently referenced, followed by water, biodiversity, climate, food, transport, and energy. References to transport in binding instruments have declined post-Green Deal, potentially reflecting shifts in framing, increased use of non-binding instruments, or changing legislative priorities.

4.3. Making cross-sectoral synergies and trade-offs visible for policy options

Many policy options have unavoidable trade-offs for biodiversity associated with negative externalities. In many cases, these trade-offs can be managed, but ideally, policy interventions need to seek to identify co-benefits (or synergies) for biodiversity across the nexus. This section summarises a number of trade-offs and synergies that have been identified by the BIONEXT project, including those derived from the views and opinions of participants in Workshop 4. These trade-offs and synergies are organised according to each of the nexus elements and their relationship to biodiversity, and can be used as a starting point for the formulation of complementary cross-sectoral policy options.

Food and Biodiversity:

- **Trade-off:** Expansion of agricultural land, mono-cropping, and high chemical inputs have increased European food, feed and fibre production, but have also contributed to biodiversity loss through habitat conversion and pollution (Lazurko et al., 2025). Lower-impact production systems, such as agroecology, can reduce these pressures, but large-scale adoption may reduce productivity and increase reliance on imports unless accompanied by changes in diets, reduced food waste and improvements in resource efficiency (Workshop 4, 2026). Greater reliance on imports could transfer biodiversity pressures outside Europe through indirect land use change (Workshop 4, 2026).
- **Trade-off**: European demand for imported food and feed commodities can contribute to environmental degradation and biodiversity loss elsewhere through displacement effects (indirect land use change) (Workshop 4, 2026). For example, imported soybeans used for animal feed have been linked to agricultural expansion in biodiversity-rich regions of South America, such as Brazil (Workshop 4, 2026).
- **Trade-off**: Ambitious expansion of strictly protected areas (e.g., covering 50% of land) may restrict food production within designated boundaries (Deliverable 1.3). Without changes in consumption patterns or production systems, this could increase pressure on remaining agricultural land and potentially encourage intensification in other locations, reducing local habitat diversity or productive forest areas in those locations (Deliverable 1.3).

- **Synergy**: Adopting agroecological and pastoralist practices can support biodiversity while contributing to food security and nutrition, particularly when combined with approaches that promote local and seasonal diets (Lazurko et al., 2025; Milestone 2.4).
- **Synergy**: More resource-efficient farming systems, including intercropping, poly-cropping and Control Environment Agriculture (CEA) can reduce pressures on land and biodiversity (Workshop 4, 2026). CEA refers to farming systems that use technologies to control and optimise environmental conditions, enabling crops to be cultivated outside their natural or preferred environments, such as in greenhouses and vertical farms (UNDP, 2025). CEA can decouple some food production from land use and improve water and nutrient efficiency, although its application currently remains largely limited to high-value horticultural crops (Workshop 4, 2026).

Water and Biodiversity:

- **Trade-off**: Traditional water infrastructure causes ecological fragmentation and flow alterations that harm ecosystems (Lazurko et al., 2025).
- **Synergy**: Utilising nature-based solutions like restoring free-flowing rivers and "natural sponges" (riparian zones and peatlands) improves water availability and quality while providing flood and drought protection (Lazurko et al., 2025; Milestone 2.4).
- **Synergy**: Tree planting using ecologically appropriate species and locations can provide co-benefits for biodiversity, flood management and the protection of critical infrastructure, such as housing (Workshop 4, 2026).

Energy, Biodiversity, Food:

- **Trade-off**: Energy infrastructure and resource extraction (such as peat or fossil fuels) reduce habitat quality and can increase competition for land (Lazurko et al., 2025).
- **Trade-off**: Rapid expansion of land-based renewables (solar and wind) can create conflicts with biodiversity and land use goals due to the footprint of infrastructure and associated habitat fragmentation (Deliverable 1.3; Kim et al., 2024).
- **Synergy**: Implementing agrivoltaics (combining solar production with agriculture) and energy sufficiency approaches can contribute to reducing demand and freeing up land for nature restoration (Lazurko et al., 2025; Milestone 2.4).

Health and Biodiversity:

- **Trade-off**: The health sector contributes to environmental pressures through high energy use, waste, and pharmaceutical pollution (Deliverable 2.1; Lazurko et al., 2025).
- **Synergy**: Promoting a "One Health" approach that balances the health of people, animals, and ecosystems can create co-benefits across sectors while supporting a transition towards preventative, nature-based care that reduces the need for resource-intensive curative treatments (Deliverable 2.1; 2.3; Lazurko et al., 2025; Milestone 2.4).

Health, Biodiversity, Transport:

- **Trade-off**: Infrastructure such as roads and railways causes species mortality and restricts movement (Lazurko et al., 2025).
- **Synergy**: Strengthening local economies reduces the need for long-distance travel, and prioritising active mobility (such as cycling) and electrified public transport improves biodiversity by reducing habitat pressure (Lazurko et al., 2025; Milestone 2.4).

Energy, Water, Biodiversity:

- **Trade-off**: While renewable energy reduces climate forcing, it can increase industrial water demand (e.g., for cooling or manufacturing) or lead to negative biodiversity impacts through associated resource extraction and supply chains (e.g., mining for battery materials) (Deliverable 1.3; Kim et al., 2024).

- **Synergy**: Agrivoltaic systems can produce both renewable energy and food or feed crops (including pasture). Whilst yields can be depressed due to shading by the solar panels, in hot and arid regions of Europe this shading effect can have benefits for grazing animals and for reducing water losses through evapotranspiration (Workshop 4, 2026).

Finance, Education, and the Nexus:

- **Trade-off**: Dominant economic models focused on GDP growth and short-term profit often serve as indirect drivers of biodiversity loss (Deliverable 2.1).
- **Synergy**: Reorienting education toward ecological literacy and active citizenship fosters a culture of stewardship (Lazurko et al., 2025; Milestone 2.4). Financial policy reforms can redirect funding from large polluters toward local energy communities and sustainable agricultural practices (Milestone 2.4).

5. Policy options to drive Transformative Change in Europe

This section forms the core of the BIONEXT Guidance, providing a structured, actionable set of elements to drive transformative change in **Cross-sectoral and Sectoral policy options** (Sections 5.1 and 5.2) across conservation, food, water, health, climate, energy and transport sectors in Europe to support biodiversity. To navigate the complexities of systemic transition, each sector is presented in five parts. First, the ***Current landscape*** outlines the baseline of scientific knowledge and policy context, followed by ***Critical challenge(s)***, derived from section 4.2, which identifies the key needs currently blocking progress. Together, these two parts represent the *what*: *what is the current situation?* and *what transformations are needed?*, respectively.

Next, a set of ***Strategic policy pptions*** derived from the different BIONEXT outcomes offers concrete routes for structural reform, representing the how: *how to achieve transformation?* It is important to note that the effectiveness of the policy options depends on institutional capacity, governance arrangements, and the extent to which they are aligned with broader societal and economic transformations. In addition, the lists of policy options are not exhaustive; they only reflect the main messages of the project. When possible, policy options are organised sequentially to help identify *when action is needed?* This approach explores how certain actions can create the enabling conditions for others, helping policymakers sequence measures and build momentum for transformative change.

Case evidence: success in action highlights proven interventions from cases analysed in work package 3, including the specific policy enablers that made them possible. The final element identifies the ***Key actors for action***, required to co-design and implement these changes on the ground, in response to *Who needs to act?* The same pattern of key actors to support the design, implementation and monitoring of policy options persists across nexus sectors (sections 5.2.1 to 5.2.7). The central actors for European nature-positive futures are EU and national policymakers, as most of the policy options have an important top-down approach. Nevertheless, civil society, including farmers, grassroot and social movements, play a fundamental role in the co-creation and implementation of policy options through bottom-up approaches. Indigenous Peoples, local communities and academia play an essential role in relation to options linked to education and capacity building about biodiversity-centred knowledge. Finally, donors, foundations, and the private sector have an important role in mobilising financial resources and supporting the implementation of related initiatives.

Finally, the section also presents ***Co-created policy options*** (Section 5.3) for four cases developed by participants of Workshop 4, general ***Policy options and recommendations for EU policy instruments***, derived from the specific EU policy analysis (Section 4.2.3) and refined in Workshop 4, and ***Strategic consideration for policy options*** (Section 5.5) as fundamental complements for any policy options, in response to the barriers in Section 4.2. Importantly, this final subsection highlights how to embed justice in policies.

5.1. Cross-sectoral policy options

Current landscape

Across the nexus, biodiversity is more often adversely affected by interactions with other nexus elements than it is a source of negative impacts itself, while simultaneously providing important benefits for health, food and climate. The current EU nexus state is coupled: high baseline GHG emissions (6.51×10^{12} kg CO_2e), fossil-fuel energy (1.24×10^{13} kWh), agricultural emissions (3.18×10^{12} kg CO_2e), water withdrawals (2.60×10^{11} m^3) and conventional-car activity (4.28×10^{12} km) coexist with biodiversity indicators below 1.0, especially the lower ecosystem index (JUNIPER EU-level baseline, 2020). Energy and transport require stronger and urgent integration within biodiversity governance frameworks, while

health offers a useful One Health entry point for improving cross-sectoral policy coherence (Keune et al., in review; Kim et al., in prep.).

The EU's approach to biodiversity, water, food, energy, health, climate, and transport is embedded within a broad and continually evolving legal and policy landscape. The European Green Deal (2019) has been a key development in promoting coherence across these nexus elements, including all nexus elements in its scope. Several non-binding instruments, including the *New Approach for a Sustainable Blue Economy (2021)*, the *New EU Strategy on Adaptation to Climate Change (2021)*, the *Chemicals Strategy (2020)*, *Farm to Fork Strategy (2020)*, *Green Infrastructure Strategy (2013)* and related European Commission Communications also reference all nexus elements. Among binding instruments, the *EU Climate Law (2021)*, *EU Taxonomy Regulation (2020)*, *Recast Renewable Energy Directive (2018)*, *Energy Governance Regulation* (2018) and the *EU Nature Restoration Regulation (2024)* are the only acts that reference all nexus elements. Collectively, these policies strengthen policy coherence across nexus elements and integrate biodiversity objectives across sectors, although individual instruments often retain a primary nexus thematic focus (UNEP-WCMC, 2025). Despite this progress, further efforts are needed to accelerate the shift from policy coordination towards truly integrated governance that fully accounts for cross-sectoral interdependencies and trade-offs.

Critical challenges

Cross-sectoral policy options need to **transition from sectoral silos to coherent, integrated governance** that accounts for interdependencies. These policy options require focusing on building institutional capacity, expertise and resources at the local level to ensure EU commitments translate into actual execution to **bridge the implementation gap**. Furthermore, policies need to **address indirect drivers** to dismantling the underlying causes of biodiversity loss. Finally, policies require reflecting **knowledge integration** by closing the gap between scientific evidence and decision-making, including the consideration of cross-sectoral models and indicators that can simulate synergies and trade-offs. More details in Section 4.2.

Strategic policy options

The cross-sectoral policy options are ordered to reflect their interconnections and potential dependencies within a broader transformation process. Following the logic applied in the pathways mechanisms analysis, the sequence begins with enabling conditions – such as values, governance arrangements and economic incentives – that shape decision-making across sectors and create the conditions for change. It then progresses towards more transformative actions that influence production and consumption patterns, infrastructure systems and societal behaviours, before concluding with place-based interventions that deliver outcomes within specific landscapes and socio-ecological contexts.

The ordering does not imply a strict sequence of implementation. Rather, it highlights how some actions can enable, reinforce or increase the effectiveness of others. For example, recognising diverse values of nature, strengthening participatory governance, and internalising environmental and social externalities may support the implementation of more ambitious measures relating to production systems, infrastructure planning and ecosystem management. At the same time, many options are mutually reinforcing and can be pursued in parallel.

1. **Recognise and integrate diverse values of nature in decision-making**: Move beyond predominantly extractive and instrumental approaches to natural resource governance by recognising and embedding a wider range of nature's values, including intrinsic, relational, cultural and stewardship values, across policy development, planning and resource management. Support decision-making processes that reflect the multiple ways in which people relate to and depend on nature, while promoting long-term stewardship, intergenerational responsibility and social-ecological resilience. This could include participatory valuation approaches, rights-based

governance, and the integration of Indigenous and local knowledge systems where appropriate (overarching BIONEXT takeaway).

2. **Embed participatory and equitable governance**: Promote inclusive and participatory approaches to natural resource governance through mechanisms such as citizen assemblies and community-led initiatives, including energy communities. Importantly, bottom-up participatory approaches need to be accompanied by coordination mechanisms that connect local governance to regional, national and EU levels, enabling effective cross-scale collaboration and implementation (de Pater et al. in review; Workshop 4, 2026).
3. **Internalise environmental and social externalities**: Phase out environmentally harmful subsidies and introduce pricing, taxation, procurement, and regulatory measures that reflect the environmental, health, and social impacts of products and activities across their value chains (Workshop 4, 2026).
4. **Prevent the externalisation of environmental and social impacts**: Strengthen trade, procurement, traceability, due diligence, and supply-chain policies to ensure that Europe's consumption and production do not shift pollution, biodiversity loss, resource depletion, greenhouse gas emissions, or social harms to other regions (Workshop 4, 2026).
5. **Support resource efficiency and strategic downscaling of production**: Support improved resource efficiency through circularity and, where appropriate, the strategic reduction of production in environmentally intensive sectors, prioritising sustainable levels of resource use and human consumption within planetary boundaries while ensuring a just transition for affected workers and communities (Workshop 4, 2026).
6. **Localised infrastructure and lifestyle planning**: Design infrastructure, services, and communities to support more localised and sustainable lifestyles. This includes shortening supply chains, reducing travel demand and resource use, shifting to localised, community-driven food and energy systems, and improving access to services, amenities and wellbeing (e.g., 15-minute city approaches) (Workshop 4, 2026).
7. **Promote sustainable mobility and clean transport**: Integrate renewable electrification with mobility sufficiency (reducing car use and aviation) and promote active transport (walking and cycling) to improve urban air quality (e.g., PM2.5) and mental health while mitigating climate change (Deliverable 1.3; Kim et al., 2024 SM).
8. **Mainstream nature-based solutions**: Embed nature-based solutions across biodiversity, climate, water, energy, food, health, and land-use policies, while exploring their application in other sectors (e.g., defence, critical infrastructure), to strengthen ecosystem services, deliver multiple co-benefits, and address interconnected environmental and societal challenges. For example:
    - **Invest in green and blue infrastructure**: such as green roofs and urban wetlands, to improve building energy performance, manage stormwater, enhance biodiversity, and provide mental health benefits through increased contact with nature (Kim et al., 2024; Policy Brief 3). Exposure to biodiverse environments can also support immune-system regulation through exposure to microbial diversity and improve physical health, such as through forest therapy programmes (Kim et al., 2024).
    - **Protect and restore ecosystems**: including riparian zones, wetlands, peatlands and forests, to enhance biodiversity, provide ecosystem functions that support flood and drought management, strengthen ecosystem resilience, contribute to carbon sequestration and to sustainable biomass production (Lazurko et al., 2025; Valve et al., 2025; Deliverable 1.3; Kim et al., 2024; Policy Brief 3).
9. **Adopt integrative spatial planning**: this can avoid cross-sectoral conflicts, for example between climate mitigation objectives and biodiversity protection by directing infrastructure away from high-biodiversity areas, ecological corridors, and climate refugia (Deliverable 1.3).
10. **Apply context-based land sparing and land sharing**: Apply land-use strategies tailored to local ecological, cultural and socio-economic contexts, with meaningful community engagement in

planning and decision-making. Policy options such as sustainable intensification in high-yield zones can "spare" land for strict nature protection, while land sharing integrates biodiversity into productive multifunctional landscapes where ecosystem services are most needed (Raymond et al., 2025).

Case evidence: success in action

Cross-sectoral transformative interventions typically occur between biodiversity, water and climate, alongside interventions on other nexus elements and social dimensions (Deliverable 3.2; Deliverable 3.2 SD). For example, in Alentejo (Portugal), a project centred on agro-silvo-pastoralism combines conservation and organic agriculture, improved irrigation systems, crop diversification, and the introduction of drought-resistant plant species to boost climate adaptation and resilience. These actions were enabled by the recognition of Montado do Freixo do Meio as a protected habitat under the *EU Habitats Directive (92/43/EEC)*, and as a Private Protected Area, belonging to the Portuguese Network of Protected Areas (Appendix E.2). However, energy, health and transport remain the nexus elements addressed least frequently in the evidence (Deliverable 3.2; Deliverable 3.2 SD).

5.2. Sectoral policy options to support biodiversity

5.2.1. Biodiversity conservation sector

Current landscape

Biodiversity is mainly pressured by other nexus elements through land or water use change, degradation, climate change and infrastructure fatalities, while also underpinning benefits for food, water, climate and health (Kim et al., 2024; Ioannou et al., 2026 [preprint]; JUNIPER EU-level baseline, 2020). By 2020, at European level, there is a low extinction or ecosystem collapse risk, although the pressure is stronger on ecosystems (Red List Index of Ecosystems = 0.71 out of 1) than species (Red List Index = 0.86 out of 1) (JUNIPER EU-level baseline, 2020). Therefore, biodiversity targets need to be built into sectoral policies, not added afterwards (Kim et al., in prep.).

EU biodiversity policy is grounded in legislative instruments centred on species and habitat conservation, including the *Habitats Directive* (1992), the *Birds Directive* (2009), the *EU Wildlife Trade Regulations* (1997, 2006), the *Invasive Species Regulation* (2014), and the *Marine Strategy Framework Directive* (2008). Although many instruments remain biodiversity-specific, recent developments under the 2019 European Green Deal have strengthened the integration of biodiversity across other policy thematic areas. In particular, the *EU Biodiversity Strategy* for 2030 (2020) and the 2024 *Nature Restoration Regulation* reinforce the links between biodiversity, climate action, water management, and sustainable food policies (UNEP-WCMC, 2025).

Critical challenge

Biodiversity policy needs to shift from treating biodiversity as an isolated endpoint or optional consideration to a foundational priority embedded across all public policy.

Strategic policy options

The options are organised according to a progression from enabling conditions to more systemic and transformative interventions. Early actions focus on establishing the legal, institutional and societal foundations for change, including rights-based approaches, participation, capacity-building and knowledge generation. This is followed by systems-based assessment and planning approaches to support evidence-informed decision-making, before moving towards the integration of biodiversity objectives across policy and financial systems. The final option emphasises the coherence and coordination of reforms across governance, finance and sectoral policies, recognising that transformative

biodiversity outcomes depend not only on individual policy measures but also on their alignment and interaction across sectors and scales.

1. **Strengthen legal protections for nature and environmental rights:** Recognise and strengthen the rights of nature and the human right to a clean and healthy environment within legal and governance frameworks. Explore the adoption of ecocide legislation and other accountability mechanisms to address severe environmental harm, support access to environmental justice and promote the long-term protection and restoration of ecosystems (Workshop 4).
2. **Strengthen capacity, participation and knowledge for biodiversity action**: Invest in awareness raising, inclusive participation, knowledge co-production and institutional capacity to support the effective implementation of biodiversity policies and accelerate progress towards EU-level biodiversity targets aligned with the KMGBF. These measures can help address implementation gaps and strengthen the effectiveness, legitimacy and societal uptake of biodiversity action, whether through improvements to existing governance arrangements or more substantial institutional and policy reforms (Mustajoki et al., in prep.)
3. **Embed systems-based assessment in biodiversity planning and decision-making**: Require the use of integrated assessment approaches, such as multi-criteria decision analysis (MCDA), transformative-change assessment tools and scenario analysis, to inform biodiversity policy, planning and investment decisions. These approaches can help identify effective combinations of actions, assess trade-offs and synergies, and prioritise interventions that support transformative change towards biodiversity targets (Mustajoki et al., in prep.).
4. **Mainstream biodiversity and nature-positive decision-making**: Integrate biodiversity considerations across all policies and decision-making, including agriculture, forestry, fisheries, and other resource-dependent sectors, to ensure that ecosystem services and natural resources are used within ecological limits while supporting livelihoods, human wellbeing, and the recovery and enhancement of nature (Workshop 4).
5. **Integrate biodiversity impacts, dependencies and risks into financial systems**: Establish frameworks for governments, financial institutions and businesses to assess and disclose direct and indirect impacts and dependencies on biodiversity and ecosystems, as well as associated environmental and financial risks. Align public and private finance, investment decisions and capital allocation with nature-positive outcomes, while avoiding the displacement of environmental pressures to other regions (Workshop 4).
6. **Align governance, finance and policy reforms for biodiversity**: Ensure that reforms to economic incentives, financial systems, sectoral policies and governance arrangements are implemented in a coordinated and mutually reinforcing manner. Greater policy coherence can help overcome institutional fragmentation and system lock-ins, creating an enabling environment for transformative biodiversity action and progress towards a nature-positive future (Mustajoki et al., in prep.).

Case evidence: success in action

Transformative interventions centred on biodiversity have included greening strategies, nature-based solutions, ecological restoration, ecological agriculture, marine or forest conservation, or invasive species control (Deliverable 3.2). For example, the Tullstorp Stream Project in Sweden focused on re-naturalising the riverbed and restoring the wetlands in the region, to achieve ecological, economic and social benefits (Deliverable 3.2). The initiation of actions and funding acquisition was enabled by the *EU Water Framework Directive (2000/60/EC)*, which classified the Tullstorp Stream as being in a poor ecological state and requiring significant restoration work (Appendix E.2).

5.2.2. Food sector

Current landscape

Food-related land-use change, crop production, habitat loss and agricultural degradation are important negative pathways to biodiversity, while biodiversity supports food through pollination, habitats and ecosystem services (Kim et al., 2024). As of 2020, at the EU level, crop production (5.45 x 10^{11} kg), animal production (2.97 x 10^{11} kg) and agricultural GHG emissions (3.18 x 10^{12} kg CO2e) exert substantial pressures on land, water, climate and biodiversity (JUNIPER EU-level baseline, 2020). Food policy needs to shift toward biodiversity-friendly farming, lower nutrient and pesticide pressures, dietary/livestock transitions, and protected or restored habitats within agricultural landscapes (Kim et al., in prep.).

EU food policy is increasingly situated within a broader sustainability agenda, extending beyond traditional concerns of food safety to encompass and embrace agricultural production, environmental protection, animal health and public health (e.g. the *EU General Food Law* (2002) and the *Animal Health Law* Regulations (2016)). Recent developments under the 2019 European Green Deal, particularly the 2020 *Farm to Fork Strategy* and the reforms to the *Common Agricultural Policy (2021)*, have strengthened the alignment of food policy with biodiversity, climate, water and public health objectives, implying a move towards a more interconnected approach to food systems governance (UNEP-WCMC, 2025). However, further reforms are necessary to prioritise ecological resilience and biodiversity outcomes.

Critical challenge

Food policy requires achieving a deep transformation of agriculture (e.g., through further CAP reform) that prioritises ecosystem restoration and pollution reduction over narrow economic targets.

Strategic policy options

The food-system options are ordered to reflect a progression from foundational reforms in agricultural governance and production systems to changes in consumption patterns and, ultimately, broader food-system transformation. The sequence begins with CAP reform and shifts in agricultural practices, followed by measures targeting diets and food consumption. It then moves to integrated food-system transition strategies that combine supply- and demand-side interventions before concluding with food-system localisation, which represents a wider restructuring of food provisioning, trade relations and food-system resilience. While these measures are complementary and can be implemented in parallel, the ordering highlights how changes in production and consumption can create enabling conditions for more systemic transformations of the food system.

1. **Reform the Common Agricultural Policy (CAP)**: Transition the CAP to prioritise nature restoration and ecological resilience over purely economic output. Realign CAP payments and incentives to reward biodiversity conservation, ecosystem restoration, agroecological and regenerative farming practices, climate resilience and the delivery of public goods. Phase out or reform subsidies that incentivise environmentally damaging practices and intensive production systems, shifting support towards smaller farms, diversified farming systems, and biodiversity-positive land management (Deliverable 2.3; 2.4; Milestone 2.4; Deliverable 1.3; Policy Brief 3; Raymond et al., 2025).
2. **Mainstream agroecology and food sovereignty**: Establish agroecology as a shared practices-based standard for all European food production, supported by the progressive phase-down of synthetic fertilisers and other environmentally harmful agricultural inputs, alongside increased reliance on organic and ecological alternatives (Deliverable 1.3; Raymond et al., 2025). This shift supports health and biodiversity while ensuring food security through local, seasonal and resilient food systems (Deliverable 2.3; Lazurko et al., 2025).

3. **Sustainable intensification and precision technology**: Use precision technologies in high-yield agricultural zones to moderate pesticide and nitrogen fertiliser use, thereby reducing runoff and "sparing" land for strict nature protection (Raymond et al., 2025).
4. **Dietary shift policies**: Implement regulatory and economic instruments, such as the differential taxation of meat and unhealthy foods, to support strong reductions in meat consumption by 2050 (on the order of 43% to 59% in the BIONEXT pathways) (Deliverable 1.3; Raymond et al., 2025).
5. **Regulate consumption and waste**: Implement bans on ultra-processed foods and fast food, while using taxation to limit food waste and disincentivise the industrial livestock industry (Deliverable 2.3; Milestone 2.4; Raymond et al., 2025).
6. **Support sustainable food system transitions**: Combine policies promoting dietary shifts (particularly reduced meat consumption) with support for low-input agroecological and sustainable farming systems to reduce reliance on intensive livestock production, nutrient pollution from fertilisers, irrigation demands and greenhouse gas emissions (Deliverable 1.3; Kim et al., 2024).
7. **Food system localisation**: Adopt a "living local" normal by significantly reducing reliance on food imports to improve European self-sufficiency and reduce externalised environmental footprints (Deliverable 1.3).

Case evidence: success in action

Transformative interventions involving the food sector typically focus on changing production and consumption patterns to foster sustainable agriculture and food sovereignty. These interventions are frequently associated with economic interventions due to the widespread need to address food security in the context of climate change and biodiversity loss (Deliverable 3.2; Vaňo, Jungwirth Březovská, Viesca-Ramirez, et al., 2026). For example, in Alentejo (Portugal), a sustainable agro-silvo-pastoral system has been implemented to change production and consumption patterns through sustainable farming. The aim is to build food sovereignty, foster climate change adaptation, and establish a positive relationship with nature (Deliverable 3.2). The actions were enabled by the recognition of Montado as a habitat protected by the *EU Habitats Directive (92/43/EEC)*, and as a Private Protected Area, belonging to the Portuguese Network of Protected Areas (Appendix E.2).

5.2.3. Water sector

Current landscape

Water quantity, quality and flow alteration are tightly linked to biodiversity: dams, hydropower, degraded water quality, acidification and irrigation can damage freshwater habitats and species, while ecological flows and water quality support biodiversity (Kim et al., 2024). At the EU level, as of 2020, total water withdrawal (2.60×10^{11} m^3) and a Water Exploitation Index of 7.64% does not indicate overall water scarcity, as values below 10% are generally considered to represent low aggregate water stress. However, these aggregate indicators may hide important regional, seasonal and sectoral stress (Ioannou et al., 2026 [preprint]; JUNIPER EU-level baseline, 2020). Policy needs to set biodiversity-relevant thresholds for flows, river continuity, nutrient control and water restoration, across different regions, seasons and sectors (Kim et al., in prep.).

Water policy is closely linked to biodiversity conservation and health, reflecting its cross-cutting role within the EU policy framework. Achieving good water status and ensuring the sustainable management of water resources remain central objectives of EU environmental policy. The *Water Framework Directive (2000)*, the *Groundwater Directive (2006)*, the *Urban Wastewater Treatment Directive (1991)*, and *the Environmental Quality Standards Directives (2008)* comprise the legislative framework for protecting water resources, improving water quality, and supporting integrated river basin management, while the *Marine Strategy Framework Directive (2008)* addresses the protection of marine ecosystems and biodiversity. More recent developments under the 2019 European Green Deal, including the *EU Blue*

Economy Agenda (2021) and the adoption of the *EU Nature Restoration Regulation* (EU 2024/1991) and the European Ocean Pact 2025[1], have reinforced the role of healthy aquatic and marine ecosystems in supporting climate resilience, sustainable economic growth, and the sustainable use of natural resources. The *Nature Restoration Regulation* provides a legally binding framework for ecosystem restoration, including specific provisions for the restoration of terrestrial, coastal, and freshwater ecosystems (Article 4), as well as the restoration of river connectivity and the natural functions of associated floodplains (Article 9). Water has remained consistently one of the most prominent nexus elements across both pre-and post-Green Deal binding instruments, highlighting its enduring cross-sectoral importance within EU policy (UNEP-WCMC, 2025).

Critical challenge

Water policy needs to bridge the gap between strategic mentions and operational action by including water-related biodiversity protections in the binding operative provisions of legislation.

Strategic policy options

The water policy options are ordered to reflect a progression from addressing key pressures on water systems to restoring ecosystem condition.

1. **Establish sufficiency-based abstraction:** Use progressive taxation on water use above established ecological thresholds and ban abstraction in sensitive areas to protect groundwater status (Deliverable 2.3; Milestone 2.4; Raymond et al., 2025).
2. **Strengthen coastal and estuarine water treatment regulation**: Implement and enforce water treatment and pollution control regulations to improve coastal and estuarine water quality, reduce risks to human health from contaminated water and seafood, and protect ecosystem health and biodiversity (Workshop 4).
3. **Restore free-flowing rivers and wetlands:** Implement large-scale river and wetland restoration programmes, including the removal of obsolete dams and weirs where appropriate, to reconnect rivers with their floodplains, improve biodiversity, enhance natural water retention, and strengthen resilience to floods and droughts, while contributing directly to the implementation of the *Nature Restoration Regulation*'s binding freshwater ecosystem restoration and river connectivity targets (Lazurko et al., 2025; Deliverable 2.3; Milestone 2.4; Raymond et al., 2025; UNEP-WCMC, 2025).

Case evidence: success in action

Transformative interventions involving the water sector typically include water ecosystem restoration and sustainable management, while infrastructure creation and improvement are also very common (Deliverable 3.2). For example, in the Attica Region (Greece), a case study focuses on wetland restoration, the sustainable use of water resources, and pollution control. The aim is to strengthen the resilience of wetlands and their adaptation to climate change (Deliverable 3.2). The interventions were enabled by the *Attica Wetland Action Plan*, which integrated priority actions foreseen by existing legislation and fell under existing national strategic, policy and programming frameworks (Appendix E.2).

[1] The European Ocean Pact was adopted after the policy instrument analysis had concluded.

5.2.4. Health sector

Current landscape

Biodiversity supports health through green/blue spaces, air-quality regulation, recreation and ecosystem services, while invasive species, zoonotic/vector-borne disease and pollution create risk pathways (Kim et al., 2024). In Europe, indicators such as Length of Life (79.77 years) and Quality of Life Index (184.97) – the latter representing a composite contextual benchmark – illustrate potential links between environmental conditions and human wellbeing (Ioannou et al., 2026 [preprint]; JUNIPER EU-level baseline, 2020). Health policy needs to integrate biodiversity restoration, green-blue infrastructure, contaminant monitoring, and One Health surveillance with water, food and urban planning (Kim et al., in prep.).

Protecting human, animal and plant health is a central objective of EU policy. Key instruments, including the *General Food Law (2002)*, the *Animal Health Law (2016)*, the *Regulation on Official Controls (2017)*, and the *Veterinary Medicinal Product Regulation (2019)*, provide the legislative framework for public health protection, food safety and disease prevention. Under the 2019 European Green Deal and the One Health Approach, policy developments have further strengthened the integration of health with biodiversity, food, water and climate objectives. At the same time, dedicated health-focused initiatives, such as the *European One Health Action Plan against Antimicrobial Resistance (2017)*, the EU *Chemicals Strategy (2020)*, the *Pharmaceutical Strategy for Europe (2020)* and the *Zero Pollution Action Plan (2021)* demonstrate the prominence of health as a cross-cutting policy objective (UNEP-WCMC, 2025).

Critical challenge

Health policy requires transitioning from acknowledging health-nature links in preambles to including them in legally enforceable operative provisions and core socio-economic strategies.

Strategic policy options

The health-related policy options are ordered to reflect a progression from overarching governance frameworks to more specific interventions and implementation measures.

1. **Institutionalise a "One Health" approach**: Institutionalise a policy framework that balances the health of people, animals, and ecosystems, shifting the sector toward preventative, nature-based care, and creating One Health units for rural areas (Deliverable 2.3; 2.4; Lazurko et al., 2025; Deliverable 1.3). Framing environmental challenges through their implications for human, animal and ecosystem health may also provide a powerful basis for public engagement, policy integration and support for transformative action (Workshop 4).
2. **Adopt an integrated approach to pollution prevention**: Embed pollution prevention and mitigation measures across policy sectors to reduce air, water, noise and waste pollution, protect ecosystem health, and minimise associated risks to human and animal health. This requires including consideration of pollution pressures arising from activities such as tourism, transport, agriculture and industry (Workshop 4).
3. **Regulate the pharmaceutical industry**: Implement laws to cap the profits of pharmaceutical companies and enforce higher standards for prescribing medication to reduce environmental pollution (Deliverable 2.3; Milestone 2.4).
4. **Equitable Access Mandates**: Implement policies to achieve significant increases in green space per capita to support mental and physical health (Deliverable 1.3; Kim et al., 2024; Policy Brief 3)

Case evidence: success in action

Transformative interventions involving health are typically addressed in association with food security and climate adaptation. Thus, in many cases, health is considered a positive outcome of cross-nexus

interventions, such as urban regeneration (Deliverable 3.2). For example, in Barcelona (Spain), urban greening and urban regeneration with a focus on social justice are paired with the construction of climate shelters in the city to improve public health (Deliverable 3.2). Some of these actions are part of the *Barcelona Tree Master Plan* 2017-2037. The plan is aligned with the goal of the *Barcelona Green Infrastructure* and *Biodiversity Plan* 2020 (GIBP, adopted in 2013), recently updated with the *Barcelona Nature Plan* 2030 (Appendix E.2).

5.2.5. Energy sector

Current landscape

Renewables can benefit climate when they displace fossil fuels, but energy also exerts strong negative biodiversity pressure through hydropower, bioenergy, land take, infrastructure and habitat fragmentation (Kim et al., in prep.). However, the EU remains highly dependent on fossil fuels, with total energy demand of 1.54 x 10^{13} kWh and fossil fuels accounting for about 81% of this demand (1.24 x 10^{13} kWh), resulting in substantial energy-related emissions (2.48 x 10^{12} kg CO2e (JUNIPER EU-level baseline, 2020). The policy response needs to pair demand reduction and rapid decarbonisation with biodiversity-sensitive siting, water safeguards and systematic trade-off assessment for renewable infrastructure (Kim et al., in prep.).

The transition to a secure, competitive, and climate neutral energy system is a central objective of EU energy policy. The revised R*enewable Energy Directive (2018), the Energy Efficient Directive (2012-recast 2023), the Electricity Directive* (2019) and *Electricity Regulation (2019),* and *the Energy Union Strategy* (2015) provide the legislative and strategic framework for promoting renewable energy, improving efficiency, integrating electricity markets and reducing greenhouse gas emissions. Although energy remains one of the less frequently referenced nexus elements in binding instruments reviewed, recently adopted legislation suggests a closer alignment between energy and climate objectives, and increasing interactions with biodiversity, water, food and transport (UNEP-WCMC, 2025).

Critical challenge

Energy policy requires overcoming the tendency to make environmental goals secondary to sectoral ones by systematically embedding biodiversity into energy planning and infrastructure.

Strategic policy options

The energy policy options are ordered to reflect progression from strategic transition measures to more specific implementation approaches. The sequence begins with actions that establish the intended direction of and enabling conditions for the energy transition, including fossil fuel phase-out measures and integrated spatial planning. It then moves to approaches that guide renewable energy deployment and strengthen community participation and ownership. The final options focus on specific implementation pathways, including multifunctional renewable energy systems and sustainability standards for bioenergy.

1. **Adopt phase-out measures:** Halt new oil licenses, ending subsidies for polluting industries (Deliverable 2.3; Deliverable 2.4).
2. **Use integrated spatial planning to deliver a nature-positive energy transition**: Apply integrated spatial planning approaches to guide the siting of renewable energy infrastructure alongside the expansion of protected areas. This helps reconcile climate mitigation and biodiversity protection objectives by directing development away from high-biodiversity areas, ecological corridors, and climate refugia, while identifying locations where renewable energy deployment can proceed with minimal ecological impact (Deliverable 1.3).
3. **Biodiversity-aware renewable energy development**: Integrate renewable energy siting rules, biodiversity safeguards, and strategic environmental assessments into energy planning to manage trade-offs between renewable energy expansion and habitat integrity. Regularly review

and adapt plans to ensure environmental impacts are minimised (Deliverable 1.3; Raymond et al., 2025).

4. **Decentralised energy communities**: Create a legislative environment that supports energy communities and increases local ownership of energy generation, budgets, and storage, while ensuring initiatives are tailored to local cultural contexts and developed through participatory, community-led approaches (Deliverable 1.3).
5. **Encourage multi-functional land use for renewable energy**: Encourage agrivoltaics (the combined use of land for both agriculture and solar energy production) and place photovoltaics on existing buildings, including homes, industrial sites, and farm infrastructure, to increase energy cost-effectiveness, optimise spatial efficiency and reduce habitat fragmentation (Deliverable 1.3; Raymond et al., 2025).
6. **Sustainable bioenergy standards**: Focus bioenergy production on small-scale second-generation crops and residual forest products rather than monoculture plantations, while increasing the use of recycled biowaste (Raymond et al., 2025). Prioritise bioenergy use in sectors where direct electrification is not feasible, such as emergency services and certain industrial and transport applications, to minimise land-use pressures and biodiversity impacts (Workshop 4).

Case evidence: success in action

Transformative interventions that include the energy sector are related to the use of renewable energies, energy saving and efficiency (Deliverable 3.2). For example, in Italy, the Waterevolution project involved the transformation of the shipbuilding industry toward more sustainable production, while reducing energy consumption and CO2 emissions (Deliverable 3.2). Instead of using existing policies to enable these changes, the project contributed to developing a cross-sectoral communication platform (Appendix E.2).

5.2.6. Transport sector

Current landscape

Transport is one of the strongest negative pressures on biodiversity, through mortality, movement barriers, genetic isolation, habitat loss, noise, pollution and invasive species pathways; green and active transport can create co-benefits. In Europe, conventional-car activity (4.28×10^{12} km), transport emissions (8.51×10^{11} kg CO2e), and associated NOx, $PM_{2.5}$ and SO_x emissions mean that transport remains a major source of climate, air-quality and habitat pressures (JUNIPER EU-level baseline, 2020). Policy needs to prioritise modal shift, demand reduction, ecological corridors, roadkill mitigation and marine ballast-water controls (Kim et al., in prep.).

While maintaining its core focus on mobility, connectivity and infrastructure, EU transport policy has progressively incorporated climate, energy and environmental objectives, particularly under the 2019 European Green Deal and related initiatives, such as the *Sustainable and Smart Mobility Strategy (2020)*. Despite this evolution, transport remains one of the least frequently referenced nexus elements in post-Green Deal legislative instruments. This may suggest that transport objectives are increasingly being advanced through dedicated policy frameworks and/or non-binding strategies rather than through cross-sectoral environmental legislation. Alternatively, it may reflect shifts in terminology and policy framing, persistent challenges in policy integration, or changing legislative priorities within the broader sustainability agenda (UNEP-WCMC, 2025).

Critical challenge

Transport policy needs to address the declining visibility of transport in binding biodiversity-related acts by re-integrating it into the operative mandates of new policy frameworks.

Strategic policy options

The transport policy options are ordered to reflect a progression from reducing demand for high-impact transport and promoting modal shift, to transforming passenger and freight transport systems, and finally to improving the environmental performance of transport infrastructure.

1. **Restrict long-distance air travel and private jets:** Implement caps on long-distance air travel and private jets while investing in high-speed rail connectivity to make trains the primary means of European transport (Deliverable 2.3 Milestone 2.4; Lazurko et al., 2025b).
2. **Redesign urban mobility**: Create car-free zones and low-emission zones in cities, complemented by subsidies for electrified public transport and improved bike connectivity, including safe accessible cycle paths (Deliverable 2.3; Milestone 2.4).
3. **Shift freight transport to lower-impact modes**: Encourage the movement of cargo from road transport to lower-emission alternatives, such as canals and railways, to reduce emissions, air pollution, energy demand, and transport congestion (Workshop 4).
4. **Integrate mandatory biodiversity criteria**: Require nature-positive standards in transport infrastructure (e.g., managing rail verges for pollinators) (Deliverable 2.3; Lazurko et al., 2025; Milestone 2.4).

Case evidence: success in action

Transformative interventions involving the transport sector are linked to changes in urban infrastructure and dynamics to improve mobility and make it more sustainable, as well as implementing active mobility in cities (Deliverable 3.2). For example, in Italy, the Waterevolution project involved the transformation of the shipbuilding industry toward more sustainable production, also establishing cooperation with maritime companies to promote sustainability and marine conservation (Deliverable 3.2). Instead of using existing policies to enable these changes, the project contributed to developing a cross-sectoral communication platform (Appendix E.2).

5.2.7. Climate sector

Current landscape

Climate change strongly and negatively influences biodiversity and food systems, while ecosystem restoration and biodiversity conservation can support carbon storage and mitigation (Kim et al., 2024). Based on EU 2020 baseline data, GHG emissions (6.51×10^{12} kg CO_2e) are largely driven by the agriculture/food sector (3.18×10^{12}), followed by energy (2.48×10^{12}) and transport (8.51×10^{11} kg CO_2e), highlighting the cross-sectoral nature of the emissions driving climate change and its associated biodiversity risks (JUNIPER EU-level baseline, 2020). Therefore, climate policy needs to combine emissions reductions with biodiversity-positive adaptation, restoration, land-use safeguards, and biodiversity-sensitive renewable deployment (Kim et al., in prep.).

Climate policy has become one of the principal drivers of recent EU legislation, particularly following the adoption of the 2019 European Green Deal. The *EU Climate Law* (2021) and related energy and decarbonisation legislation establish climate neutrality as a cross-cutting objective influencing policy areas such as energy, transport, food systems, and biodiversity conservation. This is reflected in the fact that climate is the only nexus element explicitly referenced in all post-Green Deal binding acts, illustrating its central role shaping recent legislative developments (UNEP-WCMC, 2025).

Critical challenge

Climate policy requires moving from treating climate and biodiversity as separate crises to managing them as deeply entangled challenges, where biodiversity is a primary objective in climate acts.

Strategic policy options

The climate policy options are highly interconnected and should be viewed as complementary rather than sequential.

1. **Scale up carbon sinks through rewilding**: Focus on heterogeneous forest restoration and rewilding in mountains, forests, peatlands, and wetlands to enhance both carbon sequestration and biodiversity intactness simultaneously (Policy Brief 3; Deliverable 1.3; Kim et al., 2024; Raymond et al., 2025).
2. **Integrate ecosystem restoration and sustainable biomass production**: Combine ecosystem restoration (forests and peatlands) measures with sustainable biomass production to support climate mitigation through carbon sequestration while contributing, under appropriate safeguards, to renewable energy supply (Kim et al., 2024; Policy Brief 3; Deliverable 1.3).
3. **Strategic tree planting**: Implement the vision to plant 3 billion additional trees using a climate-resilient mix of native tree species, arranged to maximise ecological benefit rather than timber volume (Raymond et al., 2025).

Case evidence: success in action

Transformative interventions involving climate are addressed through other nexus elements (notably biodiversity and water), recognising that action in these areas will also benefit climate change adaptation and/or mitigation. This is driven by the need to address climate change in view of its impact on human health and wellbeing, as well as agricultural productivity (Deliverable 3.2). For example, in Attica Region (Greece) a polyvalent approach to addressing the climate challenge is implemented. It works not only on a biophysical level, but also on a social level, fostering awareness-raising and education on climate change adaptation (Deliverable 3.2). The interventions were enabled by the *Attica Wetland Action Plan*, which integrated priority actions foreseen by existing legislation and fell under existing national strategic, policy and programming frameworks (Appendix E.2).

5.3. Co-created policy options

The co-creation process conducted in Workshop 4 generated a range of approaches for developing targeted policy options using the BIONEXT inspiration tool. The following summarises the resulting policy options. Policy options are not directly comparable, as groups used different approaches and achieved different levels of detail and development. Rather, they illustrate the diverse ways in which BIONEXT knowledge can inform the co-creation of context-specific policy options. The synthesis of each of these cases is available in Annex D.

1. Case: Derrinlough Wind Farm (Ireland)

Participants of this case co-created 14 context-specific policy options; the following are a selection of those most relevant to the nexus elements in the case (biodiversity and energy):

- **Reform energy taxation and pricing**: Fundamentally rethink energy pricing and taxation systems to better reflect environmental and social costs, moving away from models that implicitly subsidise high consumption towards more equitable and nature-positive frameworks.
- **Strengthen evidence-based land-use decisions**: Enable renewable energy development while ensuring land-use decisions are guided by robust, transparent impact assessments that capture cumulative environmental and biodiversity impacts and incorporate diverse stakeholder perspectives.
- **Develop credible market-based mechanisms**: Explore biodiversity and environmental credit systems to support transformative change, ensuring robust standards to prevent

greenwashing and prioritising local environmental benefits. Emerging examples, such as regenerative agriculture in the United States and water credit systems in Washington, highlight the potential of these approaches. While market mechanisms can help address gaps in government action, strong safeguards are needed to ensure credibility and maximise local ecological and social co-benefits.

2. **Case: Financing nature-conscious health-promoting agriculture in the EU**

Participants of this case co-created 1 policy option:

- Support participatory and consultative governance processes (e.g. citizen initiatives) to facilitate the implementation of food-system transitions.

3. **Case: Renewable energy projects based on wind and solar within the EU**

Participants of this case co-created 2 policy options:

- Strengthen regulation on community engagement and consultation processes.
- Mandate the incorporation of socio-cultural aspects in existing Environmental Impact Assessment legislation.

4. **Case: Logic of the water crisis in the Mediterranean**

Participants of this case co-created 8 policy options organised into 3 sequential policy packages:

- Policy Package 1 - Economic subsidies & regulatory controls: Shift public funds away from industrial agriculture towards landscape management and sustainable practices.
- Policy Package 2 - Capacity building & community creation: Financial incentives are insufficient on their own; they must be accompanied by educational, cultural, and community-building efforts to guide farmers into their new roles.
- Policy Package 3: Elevating farmer status & pride.

5.4. Policy options and recommendations for EU policy instruments

The following policy options are derived from the analysis of EU legal and policy instruments (UNEP-WCMC, 2025) described in section 4.2.3, and have been further refined through consultation with EU policymakers and BIONEXT stakeholders during Workshop 4:

1. **Strengthen nexus policy integration and multi-nexus innovation**: Address uneven coverage across nexus elements, where this would promote transformative change, by systematically embedding underrepresented nexus elements – particularly biodiversity, transport, and energy – across both binding and non-binding instruments to achieve more holistic policy frameworks. Promote and scale up innovative policy approaches that deliver benefits across multiple nexus elements, and support their development and uptake through targeted investment and the use of living labs as environments for testing, co-creating, and scaling integrated solutions.
2. **Translate recognition into action**: Ensure that references to multiple nexus elements in preambular sections, especially relating to policy commitments, are consistently carried through into operative provisions, with clear and appropriate obligations, targets, and implementation mechanisms.
3. **Promote cross-sectoral policy design**: Reduce sectoral policy division by developing instruments that explicitly require coordination across sectors, supported by integrated governance frameworks and joint accountability mechanisms.
4. **Close data and knowledge gaps**: Invest in targeted research, harmonised data systems, and improved methodologies, particularly on climate risk, ecosystem services valuation, and drivers of environmental degradation. Strengthen data sharing to support evidence-based decision-making. Efforts also need to focus on making scientific evidence more accessible and actionable for policymakers (Workshop 4, 2026). This may include:

- **Embedding behavioural insights in policy**: Systematically incorporate behavioural science into policy development and implementation to improve effectiveness, including through incentives and consumer-focused interventions. Behavioural approaches need to be accompanied by clear, targeted and solution-oriented communication strategies that would build public understanding, trust and engagement (Workshop 4, 2026)
- **Mainstreaming digital innovation:** Expand the use of digital tools, including the responsible and ethical use of AI, for data collection, modelling, and monitoring, while supporting interoperability and accessibility across sectors. In parallel, further research is needed to assess and minimise the environmental footprint of AI and digital technologies, ensuring their net impact is positive before large-scale deployment. Safeguards need to accompany the use of digital technologies to minimise misinformation, information overload, and potential unintended behavioural impacts (Workshop 4, 2026).

5. **Strengthen monitoring and indicator frameworks**: Develop robust, standardised indicators aligned with climate, biodiversity, and ecosystem health thresholds, and ensure consistent monitoring and reporting across policy areas. Further efforts – supported globally through initiatives such as the Bern Process – could improve the alignment of indicators across biodiversity-related multilateral environmental agreements (MEAs), helping countries streamline reporting, reduce duplication, and generate more coherent data to better track, manage, and ultimately improve biodiversity outcomes.
6. **Deepen stakeholder engagement:** Move beyond predominantly consultative approaches towards more participatory and co-creative mechanisms, ensuring inclusivity, engagement via communication tailored to diverse audiences (Workshop 4, 2026), and stronger ownership of policy outcomes.

5.5. Strategic considerations for policy options

The considerations presented in this section intend to fill the gaps and needs in European policies and break down the barriers (Section 4.2). They should be considered as fundamental complements for any policy option.

5.5.1. Cross-sectoral governance and legal frameworks

- **Cross-sectoral conditionalities**: Policies ensuring that interventions in one domain (e.g., energy or transport) systematically account for their impacts on biodiversity, water, and food systems (Deliverable 1.3).
- **Sequence actions**: Policy mixes can prioritise early demand-side actions (e.g., dietary changes and mobility reduction) and "no-regret" efficiency measures to achieve immediate gains while enabling longer-lead investments like energy grid upgrades and agroecology transitions (Deliverable 1.3).
- **Embrace plural portfolios**: Portfolios need to be context-specific, selecting and combining different elements (e.g., biocultural management, strict protection, or innovation-led efficiency) to match local values and institutional capacities (Deliverable 1.3; Lazurko et al., 2025b).
- **Long-term sustainability frameworks**: Legal reforms designed to "lock in" nature-positive gains need to ensure governance commitment persists beyond 2050 and financial incentives that shift markets away from resource-intensive and environmentally damaging practices (Deliverable 1.3).
- **Make justice an explicit policy objective**: Explicitly define what constitutes fair and just outcomes within specific policy contexts and link biodiversity objectives to social outcomes. Avoid relying on implicit assumptions that feasibility, economic viability, participation, consensus-building or stakeholder acceptance automatically result in just outcomes (Deliverable 2.4; Policy Brief 5).

- **Legally recognise rights of nature**: Introduce legislative reforms within the legal competencies of the EU, that recognise legal rights for nature and biodiversity, including water bodies and ecosystems, shifting them from being purely instrumental resources towards entities with legal agency and intrinsic worth, and enabling their representation in courts (Deliverable 2.3; Deliverable 1.3).
- **Mandate sustainability and impact reporting**: Implement mandatory biodiversity impact reporting for private companies to increase transparency and motivate the adoption of nature-positive business models (Deliverable 2.1; 2.3; Valve et al., 2025).
- **Redesign evaluation logics**: Shift from short-term, output-based evaluation to adaptive evaluation frameworks that value learning, reflexivity, and long-term transformative impact. Monitoring frameworks need to assess not only environmental and economic outcomes, but also how decision-making power, responsibilities, costs and benefits are distributed across actors over time (Hebinck et al., 2026; Deliverable 2.4; Policy Brief 5).
- **Enforce mechanisms against the abuse of natural resources**: Apply progressive taxation on water use above established thresholds and Europe-wide bans or caps on ecologically harmful goods and activities (Milestone 2.4; Deliverable 2.3; Deliverable 1.3). Furthermore, these instruments need to account for societal needs, environmental limits and negative impacts both within and beyond Europe (Lazurko et al., 2025b).
- **Fund intermediation and bridging services**: Create and fund independent intermediary bodies to help local, bottom-up initiatives navigate complex regulations, secure funding, bridge the gap between high-level EU policy and local action, and learn from successful examples in other regions (Policy Brief 2; Valve et al., 2025). These financing tools and social safety nets need to ensure that communities and workers are supported through the transition to sustainable industries (Deliverable 1.3).
- **Adopt integrative spatial planning**: Use blue-green networks and multifunctional land-use planning to ensure that infrastructure development does not inadvertently undermine biodiversity (Valve et al., 2025; Deliverable 2.1).
- **Develop spatially explicit biodiversity strategies**: Strength spatial guidance to prioritise ecological corridors, climate refugia, and high-biodiversity areas, reducing land-use conflicts with food and energy goals (Deliverable 1.3).
- **Science-Policy-Society interface**: Institutionalise collaboration, experimentation, collective learning and the broader uptake of context-specific innovations to ensure policy mixes are attuned to diverse place-based knowledge and Indigenous and Local Knowledge (ILK) (Hebinck et al., 2026; de Pater, 2025; Policy Brief 1; Deliverable 1.3).
- **Ecological literacy and education**: Establish policy-led initiatives to reinforce public awareness of the interdependencies across the nexus, helping to drive the behavioural changes (e.g., dietary shifts and mobility sufficiency) that underpin successful transformations (Deliverable 1.3). This includes, for example, empowering local communities to participate in watershed management to foster non-material connections to water while improving ground and surface water status (Raymond et al., 2025).

5.5.2. Participation enablers

Participation enablers

Importantly, trade-offs across sectors often reflect competing values, interests, and distributional consequences, and therefore require governance approaches that are transparent, participatory, and attentive to power and equity.

- **Address power asymmetries**: Use participatory methods to bring broad frameworks such as the European Green Deal closer to citizens, ensuring that policy implementation responds to local needs and is perceived as legitimate by the public. Participation requires not merely being used

to secure legitimacy or acceptance of policy decisions. Participatory processes need to explicitly address power asymmetries, clarify responsibilities, increase transparency around whose perspectives influence outcomes, and create meaningful opportunities for actors to shape decisions rather than simply comment on them (Deliverable 2.3; Milestone 2.4; Policy Brief 5; Deliverable 2.4; Deliverable 1.3; Raymond et al., 2025).

- **Integrate Indigenous and Local Knowledge (ILK)**: Validate and incorporate ILK as a legitimate knowledge system in formal decision-making to generate context-specific and culturally appropriate solutions (Deliverable 2.3; de Pater, 2025).
- **Adopt pluralism as a guiding principle**: Embed deliberative democratic processes and co-creative knowledge systems into the policy development cycle to recognise and align transformations with multiple value orientations (relational and intrinsic, not just instrumental) to ensure more just and effective outcomes (Lazurko et al., 2025; de Pater, 2025; Deliverable 1.3).
- **Recognise and formalise the role of "nature-positive stewards"**: Recognise and support actors already engaged in stewardship and transformative practices. Align regulations, incentives and monitoring systems with long-term care practices, while identifying and removing administrative, financial and policy barriers faced by those already contributing to nature-positive transitions (Hebinck et al., 2026; Deliverable 2.4; Policy Brief 5)
- **Establish clearer criteria for accountability**: Move governance away from anthropocentric models to those accountable to future generations and ecosystems, establishing transparent criteria for who is included in decision-making and ensuring they are held responsible for transboundary impacts (de Pater, 2025).
- **Create governance arrangements capable of dealing with conflict**: Biodiversity transformations inevitably involve trade-offs and entail winners and losers. Governance needs to, therefore, move beyond consensus- or stability-oriented approaches and create transparent processes through which competing interests, values, responsibilities and visions of the future can be negotiated, revisited and adapted over time (Deliverable 2.4; Policy Brief 5).
- **Make distributional impacts visible**: Clarify who bears costs and who receives the benefits of biodiversity policies and transitions. Policy design needs include mechanisms to identify, discuss and respond to emerging inequalities and unintended distributional effects (Deliverable 2.4; Policy Brief 5).

5.5.3. Embedding justice in policies

Justice is frequently present in biodiversity transformations but rarely addressed explicitly as a policy objective (Deliverable 2.4; Policy Brief 5). Instead, it is often embedded indirectly through concerns about feasibility, participation, economic viability or stakeholder acceptance. While these considerations can contribute to fairer outcomes, they do not automatically result in just transformations. As a result, biodiversity policies may unintentionally reinforce existing inequalities or reproduce existing power relations, even when ecological objectives are achieved (Deliverable 2.4; Policy Brief 5).

Furthermore, justice outcomes are often shaped as much by broader institutional arrangements, governance cultures, property relations, dominant knowledge systems and existing power structures as by the policy instruments themselves (Deliverable 2.4; Policy Brief 5). Similar policy ambitions may therefore result in different justice outcomes depending on the social, ecological, cultural, and institutional contexts in which they are implemented. Embedding justice in biodiversity policy consequently requires explicit attention to whose knowledge, values and relationships with nature are recognised and legitimised, including consideration of non-human and intergenerational interests; who is able to influence decision-making processes; how costs, benefits and responsibilities are distributed; and how accountability for biodiversity impacts is organised.

Additionally, trade-offs, conflicts, and competing visions of desirable futures are inherent features of transformative change rather than obstacles that can be designed away (Deliverable 2.4; Policy Brief 5). Governance approaches that primarily prioritise consensus, stability, or feasibility may reduce visible conflict within policy processes, while underlying distributive, procedural, and recognition injustices persist or are reinforced. This highlights a broader tension between ambitions for transformative change and governance approaches that prioritise feasibility, stability, and incremental change. Policy options need, therefore, to create opportunities for deliberation, negotiation, adaptation, and reflexive learning, enabling competing claims and perspectives to be acknowledged and addressed over time.

Finally, justice should not be understood as a fixed criterion that can be achieved through a predefined set of policy instruments. Rather, it is a relational and context-dependent phenomenon that emerges through ongoing interactions between actors, institutions, values, and transition dynamics (Deliverable 2.4; Policy Brief 5). Effective policy options, therefore, require continuous reflection on what constitutes a just transformation in a given context, alongside mechanisms that enable policies and governance arrangements to adapt as societal and ecological conditions evolve.

6. Exploring the implementation

Cross-sectoral policy options and enabling conditions presented in Section 5 are particularly relevant to support a better implementation of EU policies. As a complement to this, we further present insights from modelling pathway actions, other critical enablers of successful transformative actions in the real world, and entry points and challenges for transformative change in the EU policy-making process.

6.1. Modelling-based analysis of the consequences of different levels of action vs inaction

6.1.1. The consequences of inaction (baseline trajectory)

Inaction is characterised by a continuation of current policy architectures that prioritise short-term economic gains and sectoral compartmentalisation (Deliverable 1.3). The following are critical consequences of this path:

- Mis-estimated impacts: Models that treat sectors independently often mis-estimate the magnitude and direction of environmental impacts, as they fail to capture the complex interdependencies of the nexus (Deliverable 1.3).
- Exacerbated biodiversity loss: The lack of coherent, cross-sectoral policy consideration for biodiversity leads to continued degradation through unsustainable land and water use, and insufficient climate mitigation action (Kim et al., 2024).
- Missed Synergies: Inaction fails to leverage "win-win" solutions, such as how dietary shifts can simultaneously improve health, reduce water stress, and mitigate climate change (Deliverable 1.3).

6.1.2. Pathway actions and their consequences

Pathway 1: NaturAll (Nature for Nature) – High “space for Nature” and sufficiency action

This pathway represents the most ambitious approach to biodiversity protection, centred on maximising “space for nature” and implementing deep societal sufficiency measures (Deliverable 1.3).

- Levels of action: It assumes the largest expansion of protected areas across the pathways, with 50% of Europe's land allocated to conservation and 37.5% designated as strictly protected. This spatial protection is combined with the most ambitious demand-side measures, including large dietary shifts (up to 59% reduction in meat consumption), deep cuts in air travel (70%), major reductions in car use, and substantial behavioural savings in water and energy use (Deliverable 1.3).
- Consequences: This pathway delivers the largest biodiversity gains, particularly for species, alongside the greatest overall reduction in greenhouse gas (GHG) emissions and significant decreases in water withdrawals. These outcomes arise from the strong synergy between strict protection, reduced consumption, and clean mobility. At the same time, food production is modelled to intensify outside strictly protected areas to meet demand, creating land-use trade-offs that require careful spatial planning and social governance. Preventative healthcare and improved environmental conditions further reinforce health and wellbeing benefits under this pathway (Deliverable 1.3).

Pathway 2: Dòigh Nàdair (Nature as Culture) – Biocultural and localised action

This pathway achieves nature-positive outcomes by reducing environmental pressures at source through biocultural landscape management, community stewardship, and widespread behavioural change rooted in local contexts (Deliverable 1.3).

- **Levels of action**: It emphasises re-ruralisation, biocultural principles, and the widespread adoption of agroecology and low-input, mixed farming systems. These changes are paired with substantial dietary shifts (reduced meat consumption), a strong move towards local lifestyles and supply chains, and behavioural energy and water savings embedded in community-owned systems. Food systems are re-localised to move toward full European self-sufficiency by 2050, with food imports largely phased out. Mobility shifts from passenger cars (-86%) and air travel to rail use and active travel (Deliverable 1.3).
- **Consequences**: The pathway delivers a substantial improvement in ecosystem condition, including a marked increase in the Red List Index of Ecosystems (+21%), driven by diffuse pressure reduction across agriculture, mobility, energy and water systems. Protected areas expand moderately and are largely semi-strict, allowing multi-functional landscapes to contribute to both food provision and biodiversity. Together, lower pollution, reduced disturbance, and targeted restoration enhance air quality, and provide health and quality of life benefits (Deliverable 1.3).

Pathway 3: Return to Nature (Nature for Society) – Innovation and Circular Action

This pathway advances nature-positive outcomes through technological innovation, circular economy instruments, and the widespread use of nature-based solutions, aiming to decouple resource use from service provision (Deliverable 1.3).

- **Levels of action**: It relies on high agricultural yield increases (up to +40% through technology), circular economy measures such as material budgets and efficiency-oriented pricing, and the broad deployment of nature-based solutions for flood and drought management. These measures are complemented by rapid electrification of energy and transport systems, expansion of renewable energy (solar and wind), shared low-carbon mobility, and efficiency gains that reduce fossil fuel dependence and overall resource intensity (Deliverable 1.3).
- **Consequences**: By reducing total land and material pressures, this pathway enables the largest increase in abandoned and rewilding land (+12%) because high-tech efficiency allows societal needs to be met using a smaller land footprint. Biodiversity improves substantially outside protected areas as land is freed for natural regeneration and pollution declines, supported by green infrastructure and nature-based solutions. The pathway achieves substantial reductions in greenhouse gas emissions and improvements in air quality and wellbeing, while largely maintaining food, energy, and mobility services. However, the rapid deployment of large-scale renewable infrastructure may create local siting conflicts, highlighting the need for careful spatial planning and governance (Deliverable 1.3).

Table 4. Summary of comparative consequences by 2050

Nexus element	NFN (Nature for Nature)	NAC (Nature as Culture)	NFS (Nature for Society)
Core logic	Maximise space for nature through strict protection and deep sufficiency	Reduce pressures at source through biocultural management and local lifestyles	Decouple resource use from services via innovation, circularity and efficiency
Biodiversity outcomes	Largest gains in species protection via extensive strict protected areas	Largest improvements in ecosystem condition through diffuse pressure reduction	Moderate gains; biodiversity improves mainly outside PAs as land is freed for regeneration
Protected areas & land use	~50% of land protected (37.5% strict); strong spatial constraints	Moderate expansion; mainly semi-strict, multifunctional landscapes	Moderate growth in protected areas; largest increase in abandoned/ rewilding land
Food systems	Food production intensifies outside strict protected areas to meet demand	Localised, agroecological systems; near-complete self-sufficiency	High yields through technology enable food provisioning on smaller land footprint
Climate mitigation	Largest overall emissions reduction via demand contraction and mobility sufficiency	Large reductions via behavioural change and local living	Strong reductions via electrification, efficiency and circularity

Water outcomes	Large reductions in withdrawals from behavioural savings and protection	Gains from agroecology, reduced pollution and efficiency	Largest industrial and system-wide water savings via circular design
Transport & mobility	Deep cuts in aviation; strong sufficiency; conventional car use largely eliminated	Very large reduction in car use through local supply chains and lifestyles	Shared, low-carbon, efficiency-oriented mobility systems
Health & wellbeing	Strong benefits from improved environments and preventative care	Strong air quality, lifestyle and community health benefits	Improvements from cleaner air, green infrastructure and reduced pollution
Main trade-offs	Land-use pressure outside strict PAs; governance complexity	Lower material throughput may constrain some services	Local land-use and siting conflicts for renewables
Key governance challenges	Managing spatial trade-offs and social acceptance of strict protection	Coordinating localised systems and equity across regions	Steering innovation spatially to avoid biodiversity conflicts

6.2. Transformative change in the real world

6.2.1. Real-world examples

Figure 8 summarises case studies and examples of best practices across Europe that demonstrate how transformative actions can be successfully implemented. Examples 1-5 show that transformation works when it moves beyond simple technical fixes to address the underlying values, governance structures, economic models, and justice considerations that shape how costs, benefits, responsibilities and decision-making power are distributed across society (more details in Appendix E.1 – Deliverable 2.2, Valve et al. 2022; Deliverable 2.4). Cases 6-14 demonstrate how transformative change can generate positive impacts across the biodiversity nexus while delivering broader benefits for society, highlighting policy options that can be operationalised through specific policy instruments (more details in Appendix E.2 – Deliverable 3.2; Vaňo, Jungwirth Březovská, Viesca-Ramirez, et al., 2026).

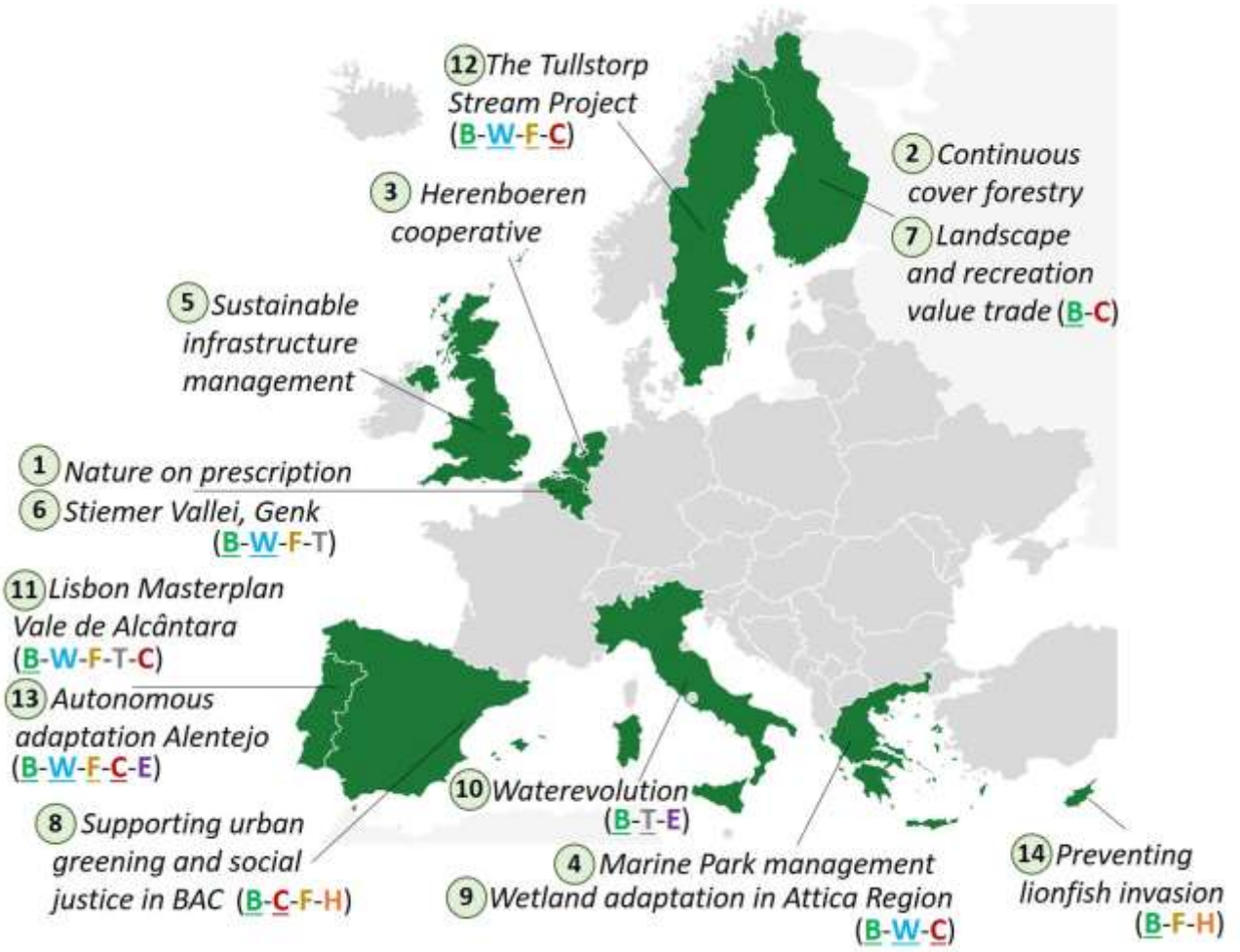


Figure 8. Exemplary case studies in Europe that include transformative interventions. Numbers indicate the case number, and the coloured letters the nexus elements involved in the case and interventions: biodiversity (B), food (F), water (W), health (H), climate (C), energy (E) and transport (T). Underlined elements denote dominant sectors in the case study

Critical enablers of successful transformative actions in the real world

- ✓ **Inclusive and Participatory Governance**. Transformation is successful when it is **socially embedded**. Success in the Greek Marine Park (case 4) was driven by "community buy-in" and included local stakeholders—such as fishermen and hoteliers—on the board of directors (interviews Greece, T2.2). In Belgium (*Case 1*), grassroots spaces like community gardens function as catalysts because they are **co-governed and accountable** to the local community (narrative Belgium, T2.4).
- ✓ **Legislative and Policy Pressure**. Strong legal frameworks often act as the necessary "stick" to drive change. In the UK (*Case 5*), **legislative mandates** for measurable biodiversity gains forced engineers to adopt ecological principles (interviews UK, T2.2). Similarly, EU laws are cited as a more powerful driving force for national policy than voluntary international declarations (interviews Belgium, T2.2).
- ✓ **Economic Realignment and Financial Autonomy**. Actions work when they align ecological health with economic survival. In Finland (*Case 2*), continuous cover forestry is gaining ground because it can be **economically viable** for nutrient-rich peatlands while avoiding the costs of ditch maintenance (background Finland, T2.4; narrative Finland, T2.4). In Greece (*Case 4*), the Marine Park achieved financial autonomy through self-financing mechanisms like entry tickets and souvenirs, reducing its dependence on inconsistent state funding (interviews Greece, T2.2).
- ✓ **Shifting Mindsets and "Aha Moments"** (*Case 1* & *Case 3*). Transformation often stems from a change in values, for example, citizens experiencing an "aha moment"—a combination of local

data and emotional connection (focus group Czechia, T2.2). This shift from viewing nature as a resource to be used ("instrumental value") to a relationship to be cultivated ("relational value") is a cornerstone of successful transformation (narrative Belgium, T2.4; narrative Netherlands, T2.4).

- ✓ **Leadership and "Marathon Runners"** (*Case 1 & Case 2*). The presence of "champions"—passionate individuals in key positions—is vital. These people act as "marathon runners" with the persistence to push boundaries, connect different sectors, and navigate the "political hurdles" of government bureaucracy (interviews Belgium, T2.2; interviews Finland, T2.4).
- ✓ **Novel economic partnerships, stimulating entrepreneurship, cross-sectoral involvement**. In Belgium (*Case 6*), formal policy shifts are used to restructure municipal finances. The economic interventions included the allocation and mobilisation of capital and resources, and the development of new business models and innovations (Deliverable 3.2).
- ✓ **Payments for ecosystem services (PES)**. In Finland (*Case 7*), financial policy instruments were used to reorient a municipality's economy. Additional economic interventions in this case include the implementation of market interventions (PES) and the shift in the focus from short-term to long-term economic interests (Deliverable 3.2).
- ✓ **A fair greening model**. In Spain (*Case 8*), a wide range of social transformative interventions were applied, particularly dismantling outdated socio-economic pathways, encouraging behavioural change in citizens and consumers, and ensuring inclusion and participation (Deliverable 3.2).
- ✓ **Strengthening social resilience and inclusion**. In Belgium (*Case 6*), a co-production approach brought benefits for a collaborative governance model and built social cohesion (Deliverable 3.2), representing a primary example of social interventions (Deliverable 3.2).
- ✓ **Co-governance model**. The Belgian case (*Case 6*) also stands out for its governance interventions, establishing effective policy and governance structures for long-term change, fostering cross-sectoral collaboration, and adopting alternative governance models (Deliverable 3.2).
- ✓ **Legislation evolution to address degradation and climate drivers**. In Greece (*Case 9*), legislative interventions focused on creating new and updating existing legislation to better address environmental degradation and climate-related drivers, while strengthening implementation and enforcement (Deliverable 3.2).
- ✓ **Innovation to assess and reduce environmental and energy footprints**. In Italy (*Case 10*), technological interventions included the application of a sophisticated technological model to reshape the global maritime industry (Deliverable 3.2).
- ✓ **Enhancing spatial planning for sustainability**. In Portugal (*Case 11*), environmental interventions were applied for urban development through spatial planning to optimise land use and efficiency and create resilience, changing the rules of the system (Deliverable 3.2).
- ✓ **Restoring ecosystems impacted by climate change**. In Sweden (*Case 12*), environmental interventions established biodiversity-positive mechanisms across more than 50 wetlands while maintaining sustainable agricultural production (Deliverable 3.2).
- ✓ **Shifting social norms and ethics**. In Portugal (*Case 13*), value interventions in food production were led by an agricultural company, following the ethics of agroecology, while engaging the community (Deliverable 3.2).
- ✓ **Science-based interventions and knowledge co-production**. In Spain (*Case 8*), knowledge interventions included innovating research approaches, co-producing knowledge, advancing fundamental research, experimenting and scaling, and facilitating information sharing between diverse actors (Deliverable 3.2).
- ✓ **Using citizen science**. In Cyprus (*Case 14*), knowledge interventions were based on citizen science and digital tools to enable a system response to ecological threats (Deliverable 3.2).

Furthermore, the success of case studies 6 to 14 is linked to the various roles played by different entities. **Governments and public administrations** usually fund projects, although this often happens when they are leading or co-leading them. They also play other roles, such as designers, implementers and

managers. **International entities**, notably the EU, commonly appear as project funders, but international scientific entities also contribute to the design of initiatives. The most frequently consulted entities include **key stakeholders**, the general public or local communities, and **academic entities**. However, academic entities also occupy prominent positions in the leadership, design and implementation of strategies. Lastly, **businesses and private companies** are important funders and implementers of projects.

6.2.2. Regional considerations for policies

Designing and implementing policies for transformative change in Europe requires a nuanced understanding of the unique historical, institutional, and geographic contexts of different regions. Biodiversity transitions are shaped not only by regional ecological and institutional conditions, but also by context-specific governance cultures, power relations, property arrangements, and dominant knowledge systems. As a result, similar policy interventions may lead to different outcomes across regions, requiring context-sensitive approaches to transformative change (Deliverable 2.4; Policy Brief 5).

The case studies from WP2 indicate that a "one-size-fits-all" approach is insufficient for mainstreaming biodiversity across sectors like food, energy, and health. This section presents necessary region-specific considerations across Europe to design and implement policies that effectively mainstream biodiversity across sectors and enable transformative change. Table 5 presents an outline of the regional considerations, more details are available in Appendix F.

Table 5. Summary of regional considerations

Region (examples of issues in extreme cases)	Considerations
Central and Eastern Europe Post-communist legacies (e,g,, Czechia)	Navigate deep-seated historical and socio-political factors: • Broken bonds to land • Public sentiment and activism • Resortism and governance • Underdeveloped regions • Fragility of institutions and public distrust (Workshop 4, 2026)
Northwestern Europe Spatial scarcity and consensus models (e.g., the Netherlands)	Regulate competition for physical space: • Mindset of scarcity • Poldering governance • Intensive production locks
Northern Europe Productivist industry traditions (e.g., Finland)	Account for administrative and budgetary splits: • The perverse effect of split powers • Inequality in access to green space
Southern Europe Centralisation and local autonomy (e.g., Greece)	Connect central authorities and local realities: • Central bureaucracy • The value of financial autonomy • Community “buy-in” • Fragility of institutions and public distrust (Workshop 4, 2026)
Institutional fragmentation the Belgian example	Shift established industrial paradigms: • Productivist logic in forest • Structural and economic barriers

6.3. Entry points and challenges for Transformative Change in the EU policy-making process

Sixteen existing entry points within EU governance systems have been identified that can support the implementation of transformative change principles (see Appendix A for definitions; IPBES, 2024b). These include established policy processes, governance mechanisms, funding instruments, participatory structures and knowledge systems that can be strengthened to better enable transformative change across policy sectors and governance levels (Figure 9).

Principle 1. Equity and justice

- **Impact Assessments** conducted by the European Commission during policy development provide an important mechanism for embedding equity and justice considerations into policymaking. By evaluating the economic, social and environmental implications of policy options, they can help identify distributional impacts, trade-offs, and potential inequalities. However, economic considerations often take precedence, limiting the integration of fairness and justice concerns. Strengthening the systematic assessment of who bears the costs and benefits of policy interventions, who participates in decision-making, and how impacts are distributed across population groups, regions, future generations and communities beyond the EU would improve transparency, accountability and policy coherence. Equally important is the clear communication of assessment findings to policymakers, stakeholders and the public, enabling more informed debate, strengthening public scrutiny, and increasing trust in decision-making processes.
- **Strategic foresight** offers a valuable entry point for incorporating long-term perspectives into policymaking. By exploring alternative futures, it provides significant potential to assess the long-term implications of policy choices, particularly in relation to systemic risks, social inequalities and intergenerational justice. It can also help challenge assumptions underlying current development pathways and broaden consideration of alternative societal and economic futures that prioritise wellbeing, equity, resilience and sustainability. However, its impact remains constrained by short- and medium-term political cycles and its incomplete integration into policymaking processes. Strengthening the systematic use of foresight through its integration into policy design, impact assessments and strategic planning would support more future-informed, robust and resilient policies (European Union, 2025).
- **Citizen participation and transparency**. Stakeholder consultations, citizens' initiatives, petitions, public campaigns and the Transparency and Better Regulation Agenda contribute to more equitable and accountable decision-making. These mechanisms create opportunities for citizens and stakeholders to influence policy development and strengthen public scrutiny of decisions. However, participation remains uneven and some groups continue to be underrepresented. Improving accessibility, outreach and capacity-building, particularly for marginalised groups, would help strengthen procedural justice and democratic legitimacy, alongside stronger transparency measures to balance stakeholder influence.

Principle 2. Pluralism and inclusion

- **Participatory governance**. Participatory policymaking mechanisms, including public consultations, implementation dialogues, citizens' initiatives and feedback channels, are central to promoting pluralism and inclusion. They enable a wider range of actors and knowledge systems to contribute to decision-making and can improve policy legitimacy and societal acceptance. However, complex procedures and unequal stakeholder influence can limit meaningful participation. Simplifying engagement processes and strengthening support for underrepresented groups can help address these barriers.
- **Science–policy–practice interfaces** provide a critical mechanism for integrating diverse forms of knowledge into policymaking. Expert groups, advisory bodies, EU-funded research projects, emerging mechanisms such as the Horizon Europe-funded BioAgora Science Service for Biodiversity, and interdisciplinary research programmes facilitate collaboration among researchers, policymakers, businesses, practitioners, civil society organisations and local communities. These mechanisms support the co-production of actionable knowledge and help bridge the gap between evidence generation, policy development and implementation. However, challenges remain in translating knowledge into policy and in integrating diverse knowledge systems. Strengthening co-creation approaches, knowledge brokering and interdisciplinary collaboration can help address these gaps.

- **Multi-level governance**. EU governance structures and respect for the principle of subsidiarity provide opportunities for context-specific and locally responsive approaches to transformative change. Flexibility in implementation can improve policy acceptance and effectiveness. However, fragmentation across policy sectors and governance levels remains a significant challenge. Strengthening coordination mechanisms, policy coherence, and cross-sectoral integration and collaboration are key to overcoming these barriers.

Principle 3. Respectful and reciprocal human-nature relationships

- **Biodiversity and nature-related policy frameworks**. Existing EU policy frameworks, including the European Green Deal, the Biodiversity Strategy and the Nature Restoration Regulation, provide strong foundations for embedding nature-positive approaches across policymaking. These frameworks support biodiversity conservation, promote stewardship approaches and strengthen ecological resilience. However, tensions between environmental objectives and economic priorities continue to constrain implementation. Greater policy coherence and alignment of incentives with biodiversity goals are needed to address these challenges.
- **Strategic foresight for nature-positive futures** can help explore pathways towards more sustainable and resilient relationships between people and nature. By examining alternative futures, considering long-term ecological risks, and exploring different models of development, it supports more proactive and anticipatory approaches to environmental governance. Integrating foresight more systematically into sectoral policies and investment decisions could strengthen nature-positive transitions.
- **Sustainable finance** frameworks provide a key entry point for redirecting financial flows towards environmentally sustainable activities. While current approaches often focus on reducing risks and avoiding harm, stronger incentives are needed to actively reward biodiversity conservation, ecosystem restoration and wider environmental benefits. At the same time, growing interest in biodiversity markets and nature-credit mechanisms highlights the need for robust safeguards to prevent greenwashing, ensure environmental integrity and avoid overstating positive outcomes. Robust standards, transparent monitoring and reporting mechanisms, independent verification, and outcome-based incentives are essential to ensure that financial mechanisms deliver measurable and lasting benefits for biodiversity and society.
- **Recognising diverse values of nature**. Strengthening human–nature relationships requires moving beyond narrow economic perspectives and recognising the multiple values that nature provides to society. While economic valuation can help make the benefits of biodiversity and ecosystem services more visible in decision-making, many contributions of nature cannot be fully captured through market-based metrics. Cultural identity, spiritual values, sense of place, wellbeing, social cohesion and ecological resilience are examples of non-financial benefits that are often overlooked. Broadening valuation approaches to incorporate these diverse values would support more holistic and equitable decision-making and help ensure that policies reflect the full range of human–nature relationships.
- **Aligning incentives with sustainability objectives**. Fiscal measures, subsidy reform, sustainable public procurement and regulatory incentives provide important levers for addressing indirect drivers of biodiversity loss and environmental degradation. However, environmentally harmful incentives continue to exist across several sectors, creating inconsistencies between policy objectives and implementation. Improving policy coherence and progressively aligning public and private incentives with biodiversity, climate and sustainability goals would help address systemic pressures and support transformative change.

Principle 4. Adaptive learning and action

- **Monitoring, evaluation and reporting systems** provide essential foundations for adaptive governance. These mechanisms create feedback loops that enable policymakers to assess progress, identify challenges and adjust policies over time. However, differences in monitoring capacity, data availability and coordination across Member States and slow reporting cycles can limit effectiveness and reduce the ability of policymakers to respond quickly to emerging issues. Improving harmonised monitoring systems, accelerating reporting processes and strengthening feedback mechanisms would support more adaptive and responsive policymaking.
- **Knowledge exchange, policy learning and strategic research**. Adaptive learning can be strengthened through science–policy–practice collaborations, research programmes and systematic policy learning. Knowledge generated through implementation, experimentation and research can help identify effective approaches and inform future decisions. In particular, learning from successful legislation and policy initiatives can accelerate replication and scaling of effective practices. Emerging science–policy mechanisms, such as the Horizon Europe-funded BioAgora Science Service for Biodiversity (SSBD), can further support adaptive learning by facilitating the translation of research and implementation evidence into policy-relevant knowledge and strengthening dialogue between researchers, practitioners and policymakers. This could provide an important pathway for BIONEXT outputs to feed into science-policy processes and support transformative change policymaking and implementation.
  However, fragmented knowledge-sharing systems and slow reporting and evaluation cycles can delay the transfer of lessons into policymaking and limit opportunities for timely adaptation. Strengthening mechanisms for knowledge exchange, lesson-sharing and rapid dissemination of evidence would enhance institutional learning and adaptive capacity across policy domains. In parallel, developing long-term strategic research agendas that align research, innovation and policy priorities can help address emerging challenges, identify knowledge gaps and ensure a sustained evidence base for transformative change over time.
- **Experimentation and innovation**. Pilot projects, living labs and other experimental governance approaches provide opportunities to test, refine and scale innovative solutions. These initiatives support learning under conditions of uncertainty and can help identify effective responses to complex challenges. Their impact depends on adequate funding, sustained institutional support and clear pathways for scaling successful initiatives.
- **Funding and capacity-building**. EU funding instruments, including Horizon Europe, the LIFE Programme, and Cohesion Policy, play a central role in supporting innovation, institutional learning and capacity building. These programmes help strengthen adaptability, resilience, and responsiveness, while facilitating the dissemination of good practices. However, access to funding remains uneven. Simplifying procedures and improving support for under-resourced actors and regions would help ensure more equitable participation in transformative change processes.
- **Private-sector leadership and innovation**. The private sector can play an important role in advancing transformative change through innovation, investment and the development of nature-positive solutions. Beyond individual company action, business networks and coalitions can facilitate peer learning, knowledge exchange and collective leadership, helping to build confidence in sustainability transitions and demonstrate the feasibility of nature-positive approaches. Businesses and business associations can also contribute to agenda-setting by advocating for ambitious policies, supporting regulatory certainty and, in some cases, driving action beyond the pace of government initiatives. However, voluntary commitments and sustainability claims do not always translate into measurable outcomes. Robust accountability frameworks, transparent reporting and independent verification are therefore essential to

prevent greenwashing and ensure that emerging biodiversity finance and nature-credit mechanisms deliver genuine environmental and social benefits.

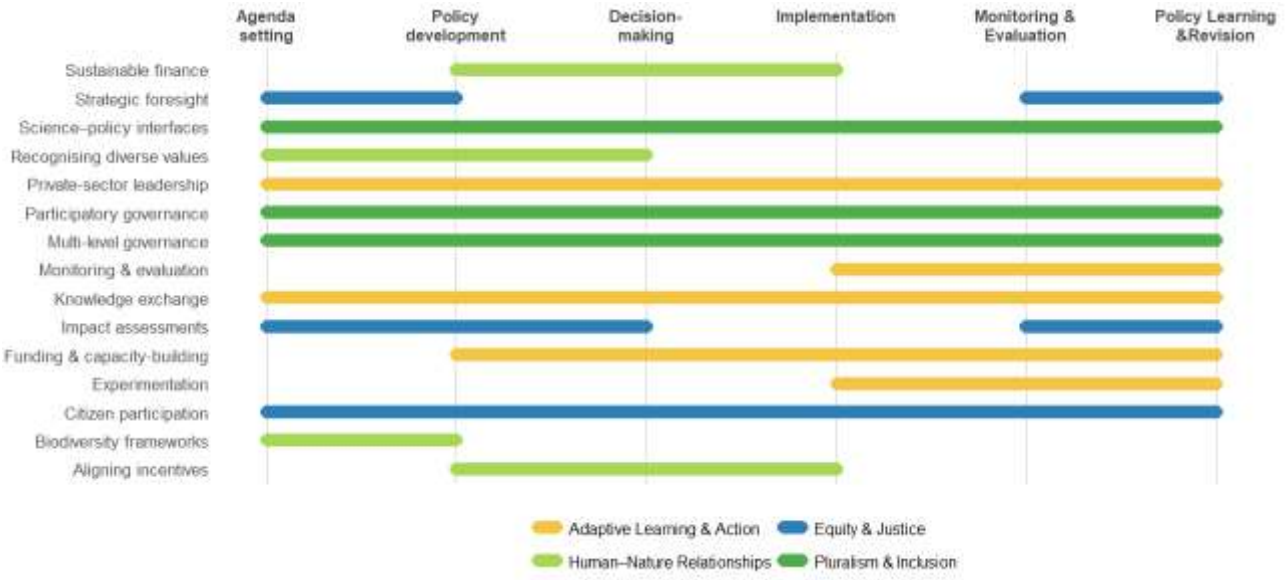


Figure 9. Timeline illustrating where the entry points occur within the EU policymaking process

7. Reflective conclusions and Future work

7.1. Reflections on the complement of the BIONEXT Guidance to the IPBES assessments

The BIONEXT Guidance provides an important bridge between the high-level global assessments of IPBES and the practical realities of European governance. While IPBES provides the foundational conceptual framework and global response options, the Guidance goes beyond by offering an **operational translation** of these insights, specifically tailored to the institutional constraints and political feasibility of the European Union.

By translating transformative change and a nexus approach into practical considerations/actions, and by synthesising sustainability research outcomes into policy options, the Guidance moved beyond the theoretical. Remarkably, both the identification of **synergies and trade-offs** across the nexus and the **BIONEXT Inspiration Tool**, which draws on **648 transformative actions** co-created during the project combined with IPBES nexus and transformative change components, support the development of context-specific policy options beyond the project timeframe. Furthermore, while IPBES identifies global drivers of biodiversity loss, the Guidance complements this work through a granular analysis of **75 EU policy instruments,** identifying implementation challenges and **16 strategic entry points** within the EU policy cycle, where transformative principles could be explicitly embedded.

In essence, if IPBES provides the "what" of global biodiversity needs, BIONEXT and its Guidance provide the European-specific application of the “what”, through the project findings, plus the "how-to" through policy options and strategic considerations for their formulation and implementation pathways. The project’ demonstrates that transformative change is not merely a top-down mandate but a multi-dimensional orientation that requires balancing synergies, trade-offs, and **justice**. By grounding these transitions in bottom-up grassroots initiatives and experiences of nature-positive stewards, BIONEXT highlights pathways through which European governance can move beyond incremental approaches towards more systemic and integrated forms of change.

Looking beyond the immediate scope of the project, the foundations laid by the Guidance may help inform the evolution of future policy instruments and governance approaches. One potential area for further exploration is the development of more **integrated impact assessment approaches** that consider cross-sectoral synergies and trade-offs throughout the policy cycle. Furthermore, future work could examine establishing **Nexus Science-Policy Hubs** within the European Commission that would allow the monitoring of negative impacts and trade-offs beyond Europe in real-time by using AI assistance and nexus modelling. Finally, to ensure these nature-positive policy options are durable, future legal and governance research could focus on **institutionalising exnovation**, providing the robust legal mechanisms necessary to mandate the phase-out of unsustainable legacy industries and align European society with planetary boundaries.

7.2. Reflections on the transformative potential of the policy options

The policy options demonstrate significant transformative potential because they seek change across multiple dimensions of society, including values, structures, and everyday practices. This is a notable strength, as policy interventions often neglect underlying societal views and values. In this case, the emphasis on reshaping human–nature relationships and fostering new values for nature helps address deeper drivers of unsustainability (IPBES, 2024b). The proposed policy options also contain several strong examples of integrated approaches, particularly in the food sector, where changes in dietary practices, producer incentives, consumer behaviour, and financing mechanisms are combined. Such interventions acknowledge that transformation requires action across the entire system rather than isolated measures.

However, these integrated approaches must be applied more consistently across the nexus. For example, while transport policy options focus strongly on infrastructure and regulatory changes, they pay less attention to cultural perceptions and social norms related to mobility. In addition, the strong emphasis on participation is promising, provided that participation is understood not as consensus-seeking but as a process that recognises plurality, includes marginalised perspectives, and creates space for transformative change, including consideration of non-human interests (de Pater, 2025). Moreover, many of the proposals remain embedded within existing governance, financial, and decision-making systems, raising questions about whether incremental reforms are sufficient to address deeply rooted, unsustainable regimes (Temper et al. 2018). Greater attention should therefore be paid to issues of ownership, financing, and decision-making, particularly in proposed initiatives such as energy communities. From a transformative perspective, it is important to assess who owns resources, who benefits, and whether governance arrangements genuinely "challenge, alter, or replace" existing unsustainable structures (Avelino et al. 2019).

The diversity of social, economic, and cultural contexts across European regions needs to be considered. A one-size-fits-all approach is unlikely to be effective, requiring greater sensitivity to regional differences (IPBES, 2024b). This Guidance did an initial attempt in this regard by including regional considerations based on case studies considered in the project, but more detailed and spatial-explicit analyses is necessary to tailor policy options. Therefore, the policy options presented here should be considered as a starting point for context-specific policy options, and the Inspiration Tool is another legacy resource to contribute to in this regard. Finally, the policy options should not be treated as a fixed blueprint for transformation. Instead, they should remain open to learning from bottom-up initiatives and grassroots innovations, supporting and aligning with these dynamics while preserving their transformative and potentially radical character (Valve et al., 2025).

Additional future work could also consider a more extensive range of policy needs relevant for transformative change but that were beyond the BIONEXT scope. For instance, participants of the final workshop highlighted two main points related to contemporary challenges: 1) to explore the implications of geopolitical conflicts and how to restore global peace for nature-positive futures, and 2) to study the impact of AI in transformative change in policy design, including its unethical use for misinformation and its knowledge primarily trained by male perspectives. Finally, follow-up work could also include the identification of pilot cities or regions for the practical implementation of the Guidance.

7.3. Reflections on the policy options from a policy perspective

The proposed policy options provide a valuable starting point for advancing transformative change within existing EU governance frameworks. However, the Guidance was developed within a specific policy context and timeframe, which inevitably constrained the range of instruments and priorities considered. Since the completion of BIONEXT's policy instrument analysis, important developments, including the European Ocean Pact and discussions on the post-2027 Common Agricultural Policy (CAP), have emerged, illustrating the dynamic nature of the European policy landscape. Future work could build on the current Guidance by periodically reviewing and updating the policy options to reflect evolving priorities, governance arrangements, and policy instruments. Such updates should draw on emerging scientific evidence to ensure the Guidance remains relevant, robust, and responsive to new knowledge. In addition, while the Guidance focused specifically on the biodiversity nexus, future iterations could adopt a broader perspective by examining how biodiversity conservation and ecosystem restoration contribute to wider societal objectives that are becoming increasingly prominent in European policy debates, including economic resilience, defence and security, and strategic autonomy.

A second limitation relates to policy implementation. The Guidance focuses primarily on identifying policy options; yet, in many cases, the principal challenge lies not in the absence of commitments or policy instruments, but in shortcomings in implementation, enforcement, and coordination among Member

States and stakeholders. Future work could therefore place greater emphasis on the governance mechanisms, incentives, accountability arrangements, and implementation pathways needed to translate policy ambitions into tangible outcomes. Similarly, although the policy options provide a useful framework at the EU level, further attention is needed to understand how they can be adapted and operationalised within different national and local contexts. This includes considering how implementation can address the distribution of costs and benefits across sectors, regions, and stakeholder groups to support equitable and just outcomes. Some proposals, such as the recognition of the Rights of Nature, would also require more detailed examination of their legal and institutional feasibility within the European context, including the respective roles of the EU and the Council of Europe. Finally, future iterations could draw on emerging evidence from additional IPBES assessments, particularly those addressing business and biodiversity, to better capture the roles, responsibilities, and incentives of private-sector actors and other non-state stakeholders in enabling transformative change.

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APPENDICES

Appendix A. Key definitions and concepts used in the Guidance

All definitions are presented in alphabetical order within the subsections: BIONEXT core definitions and definitions used in the fields and categories of the inspiration tool, which are adapted to refer to the transformative actions.

BIONEXT core definitions

Biodiversity nexus:

The ***biodiversity nexus*** refers to the interconnected and interdependent relationships between people and nature, highlighting how human resource use impacts nature and biodiversity and how changes in biodiversity, in turn, affect human well-being. It encompasses the linkages between biodiversity and key sectors such as water, food, energy, health, climate, and transport, providing a framework for understanding these interactions to support better decision-making on nature and biodiversity.

Policy option:

A ***policy option*** refers to one of the possible, distinct, feasible, and evidence-informed courses of action that policymakers and other relevant decision-making actors can adopt, to address a specific policy problem or achieve a defined and measurable outcome. It typically involves the adoption and use of specific policy instruments selected based on criteria such as institutional competence, costs and benefits, equity, implementation capacity, and expected outcomes.

In the BIONEXT context, a policy option is understood as an evidence-informed course of action that promotes transformative change for biodiversity and ecosystem services in the context of climate change.

Transformative change:

Transformative change is defined as "*fundamental, system-wide shifts in views, structures and practices in ways that address the underlying causes of biodiversity loss and nature's decline*". Transformative change is needed to address the major challenges to nature and humankind, such as biodiversity loss, climate change, and social injustices. Transformative change means that we move beyond just fixing problems and instead fundamentally shift how we interact with the natural world. Generating such fundamental shifts in our mindsets, policies, and practices demands action from all, from citizens to policymakers. A change is only transformative if it shakes up ecological, technological, and socio-economic systems (BIONEXT Glossary).

Transformative policy option:

A ***transformative policy option*** is an evidence-informed course of action designed to drive fundamental, system-level change rather than incremental improvement in existing states, processes, or practices. It moves beyond "business as usual" by challenging prevailing norms and reshaping power structures, behaviours, and institutional arrangements that contribute to unsustainable outcomes.

Such policy options have the potential to:

- Address root causes rather than symptoms, by tackling the underlying drivers of biodiversity loss while also contributing to broader societal objectives.
- Enable systemic and cross-sectoral change, supporting the integration of environmental, social, and economic objectives across multiple sectors and governance levels.
- Reset priorities, narratives, and long-term visions, redefining how societies and sectors interact with, value, and depend upon nature.

- Shift behaviours, values, and perceptions, shaping how individuals, institutions, and communities understand their relationship with the environment.
- Go beyond incremental reform, offering ambitious yet feasible pathways for large-scale and enduring change rather than isolated or short-term improvements.
- Deliver long-term, measurable benefits for biodiversity and society, while supporting socio-economic resilience, equity, and fairness.

In essence, a transformative policy option has the potential to change the context in which decisions are made, creating enabling conditions for durable, feasible and holistic change towards nature-positive and resilient futures.

Definitions used in the fields and categories of the inspiration tool

'Actions' in the inspiration tool – BIONEXT transformative actions:

Transformative actions co-created under the IPBES Nature Futures Framework for three nature-positive futures in Europe by 2050: NaturalAll (Nature for Nature), Dòigh Nàdair (Nature as Culture), and Return to Nature (Nature for Society).

'Actors' in the inspiration tool – Key actors for transformative change:

Slightly adapted from IPBES (2024b).

- **EU policymakers**: The action requires the involvement of EU policymakers to be planned, implemented or monitored.
- **National policymakers**: The action requires the involvement of national European policymakers to be planned, implemented or monitored.
- **Local policymakers**: The action requires the involvement of local European policymakers to be planned, implemented or monitored.
- **Governments**: The action requires the involvement of national, regional or local governments, or international organisations to be planned, implemented or monitored.
- **IPLC**: The action requires the involvement of Indigenous Peoples and local communities (IPLC) to be planned, implemented or monitored. IPLC are individuals and communities who, on the one hand, self-identify as Indigenous and, on the other hand, are members of local communities that maintain inter-generational connection to place and nature through livelihood, cultural identity and worldviews, institutions and ecological knowledge. Indigenous Peoples have recognised and distinct rights, which are not extendable to the broader and encompassing concept of local communities.
- **Financial**: The action requires the involvement of the private sector, financial institutions, donors, foundations, or social entrepreneurs to be planned, implemented or monitored.
- **Civil society**: The action requires the involvement of individuals, citizens, non-governmental organisations, civil society organisations, trade unions, communities, grassroot movements, social movements, activists, youth groups, woman- and gender-focused groups, or faith-based organisations to be planned, implemented or monitored.
- **Academia**: The action requires the involvement of scientists, research communities, or formal scientific institutions to be planned, implemented or monitored.

'BD loss' in the inspiration tool – Underlying causes of biodiversity loss:

Slightly adapted from IPBES (2024b).

- **Disconnection**: The action contributes to addressing the underlying cause of biodiversity loss referred to disconnection from and domination over nature and people. This underlying cause refers to the view that humans are separate from and superior to nature and that nature is comprised of objects for humans to use as resources. This way of framing human-nature relations justifies not

only the exploitation of nature, but also the exploitation of specific people and communities to create the labour force necessary for nature's exploitation. This reinforces their marginalisation and can push some communities into destructive relationships with nature. This underlying cause has deep historical roots and has had widespread impacts through colonialism, slavery, modernism, capitalism and growth-driven economies. It continues to influence social and economic structures that justify the exploitation of nature and of marginalised people and communities. It is inconsistent with the worldviews and values of many Indigenous Peoples and local communities.

- **Concentration**: The action contributes to addressing the underlying cause of biodiversity loss referred to concentration of power and wealth. This underlying cause acknowledges that the activities and interests of a decreasing number of people are disproportionately driving biodiversity loss and nature's decline. Inequalities in power and wealth exist both within and between countries and intersect with other drivers of marginalisation (including, for example, race, class, ability, gender or age). Concentration of power and wealth matter for biodiversity because the wealthy are responsible for a disproportionate use of natural resources, unsustainable levels of consumption and associated environmental impacts. Wealthy actors are currently driving biodiversity loss locally and in other places through their levels of consumption and associated patterns of resource extraction. Furthermore, nature's destruction can become a survival strategy in poorer communities. The concentration of power and wealth also creates differential access to decision-making processes and can be used to block transformative change.
- **Prioritisation**: The action contributes to addressing the underlying cause of biodiversity loss referred to prioritisation of short-term, individual and material gains. This underlying cause emphasises immediate interests and desires over values of community and maintenance of social and ecological integrity over the longer term. It is perpetuated through economic and social systems that measure progress primarily as growth in Gross Domestic Product, frame satisfaction or happiness in terms of accumulation of material possessions, and consider humans as benefit-maximising individuals. Compounding this is the short-term thinking that dominates business reporting and political cycles.

'Nexus actions' in the inspiration tool – Actions or policies to address specific challenges or opportunities across the nexus (also defined as response options):

Slightly adapted from IPBES (2024a).

- **Conserve**: The action is related to conserving ecosystems, involving at least one of the following options: area-based conservation, halt conversion of ecosystems of high ecological integrity, or forest conservation for health.
- **Restore**: The action is related to restoring ecosystems, involving at least one of the following options: forest landscape restoration, restoration of coastal and marine systems, restoration of inland water systems, rewilding, restoration of soil health, mangrove conservation and restoration for health, wetland conservation and restoration, or restoration of coastal and marine ecosystems for carbon sequestration.
- **Manage**: The action is related to managing ecosystems, involving at least one of the following options: agroecology, sustainable inland fisheries, management of invasive alien species, ecological intensification of croplands, ecological intensification of rangelands, ecological intensification of aquatic foods, increase of soil organic carbon, integrated multi-trophic aquaculture, or forest-based practices to address climate change.
- **Consume**: The action is related to consuming sustainably, involving at least one of the following options: efficient water use in agriculture, reduce food loss and waste, sustainable healthy diets, sustainable use of medicinal plants, reduce meat overconsumption, offshore wind power, solar photovoltaics on land, or sustainable bioeconomy.

- **Reduce**: The action is related to reducing pollution, involving at least one of the following options: manage wastewater, reduce nutrient pollution, reduce pesticide pollution, reduce plastic pollution, pollution prevention, sustainable intensification, or reduce short-lived climate pollutants.
- **Integrate**: The action is related to integrating planning and governance, involving at least one of the following options: integrated landscape and seascape approaches, land and sea planning, integrated water infrastructure, transboundary water cooperation, groundwater governance, water-sensitive urban infrastructure, community water management, city region food systems, or integrated watershed-health interventions.
- **Risk**: The action is related to managing risk, involving at least one of the following options: urban nature-based solutions, ecosystem-based adaptation in rural landscapes, dam operation, net-zero sustainable healthcare, urban green infrastructure, biodiversity management for zoonoses, health impact assessments, the One Health approach, or multi-hazard early warning systems.
- **Rights**: The action is related to ensuring rights and equity, involving at least one of the following options: right-based approaches, inclusive water education, inclusive water management, rights of nature, address gendered burdens of water collection, foster gender transformative approaches, indigenous food systems, access to natural resources and land, universal health coverage, or intercultural health services.
- **Financing**: The action is related to aligning financing, involving at least one of the following options: natural capital accounting, finance for water infrastructure, reform public spending, or global cooperation for finance and technology.
- **Diverse**: The action is related to diverse aspects but involves at least one of the following options: multilateral environmental agreements, reconnecting people with nature, nature on prescription, or integrated health education.

'Nexus governance' in the inspiration tool – Components of nexus governance:

Nexus governance refers to the systematic coordinating structures and processes that enhance the engagement of multiple actors through horizontal (e.g., across various nexus elements at one scale) and vertical (e.g., cross-scale connectivity or multilevel governance) channels to address nexus challenges, identify policy and sociopolitical options, and manage their implementation towards just sustainable futures (IPBES 2024a).

Nexus governance aims to achieve policy coherence to meet international and domestic goals and objectives with appropriate response options that manage and minimize trade-offs, while promoting synergies and co-benefits across scales and time, such as through recognizing and supporting the actions of societal actors through arenas of engagement (e.g., the many different settings, places, spaces and contexts within which governance actors interact to shape nexus approaches and initiatives (Schipper et al., 2022)). Nexus governance is thus broader than integrated governance and other related approaches.

IPBES identifies five key components as important for nexus governance:

- **Integrative**: The action represents an opportunity to apply integrative, holistic and transdisciplinary framings of problems and solutions, across sectors and actors.
- **Inclusive**: The action represents an opportunity to apply inclusive approaches that bring about enhanced opportunities for diverse actor engagement across sectors.
- **Equitable**: The action represents an opportunity to apply considerations of equity and justice, alongside accountability, across sectors and actors.
- **Collaborative**: The action represents an opportunity to apply enhanced mechanisms and processes for collaboration and coordination across scales, sectors, and actors.
- **Adaptive**: The action represents an opportunity to apply adaptive, reflexive and experimental approaches to learn from successes and to scale these solutions across sectors and actors.

‘Policy instrument’ in the inspiration tool – Types of policy instruments:

Policy instruments are the different interventions (including formal rules, laws, social norms and processes, among others) made by decision-makers (ranging from governments and public authorities, intergovernmental organisations, companies, to other actors) to ensure that (public) policy objectives are supported and achieved by influencing the behaviour and actions of others (IPBES, 2022a; 2024a).

Policy instruments are generally used in combination, as a policy mix, which “has evolved to influence the quantity and quality of biodiversity conservation and ecosystem service provision in public and private sectors” (Ring & Schröter-Schlaack, 2011; IPBES, 2020).

Within the IPBES context, the following four categories of policy instruments are identified:

- **Regulatory:** The action could primarily be implemented through legal and regulatory instruments, which comprise interventions that formally influence social and economic action through formal rules and regulations that legally regulate (prohibit, sanction or inhibit) certain activities. Legal and regulatory-based instruments include agreements, legislation, regulations, rules, standards, and planning, and are developed and applied at international, regional, national, and local scales. Examples include Multilateral environmental agreements, Marine and terrestrial protected areas / no-take zones, Social and environmental standards and National Biodiversity Strategic Action Plans (IPBES, 2016; 2022b; 2024a).
- **Economic**: The action could primarily be implemented through economic and financial instruments, including regulations that financially incentivise or constrain specific activities by handing out or taking away economic resources, including, for example, subsidies, taxes, charges and fiscal transfers. Examples include natural capital or ecosystem accounting, socially responsible investments, water funds, debt for nature swaps, green bonds, Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+) (IPBES, 2016; 2024a).
- **Right-based**: The action could primarily be implemented through rights-based instruments and customary norms, including formal and informal means of intervention that influence social and economic action through locally defined norms, customs, and tradition. They aim to strengthen collective rights and customary institutions of Indigenous Peoples and local communities (IPLC) that promote an equitable and fair management of natural resources (IPBES, 2016). Customary and rights-based approaches are often considered and conceived at local scales, however international agreements and guidelines, often developed through extensive consultation with rights holders, exist to guide new and support existing rights-based approaches. Rights-based and customary instruments at an international scale include treaties and guidelines, whereas at local and national scales they include customary laws, norms, and tenure, human rights-based approaches, and systems of traditional knowledge (IPBES, 2022b; 2024a). Examples of these approaches include official government institutions that acknowledge IPLC' rights to govern their lands, territories and resources, and international and national human rights instruments.
- **Cultural**: The action could primarily be implemented through social and cultural policy instruments, including information-based instruments and voluntary or collective actions with an emphasis on the intertwined relationships between ecosystems and sociocultural dynamics. Awareness based voluntary interventions may include for example (i) information-related instruments like environmental education, eco-labelling, pollutant release and transfer registers, biodiversity registers, awareness raising (including award schemes), information dissemination and community right to know; (ii) self-regulation, voluntary agreements, corporate social responsibility, buyer-supplier relations; (iii) participation (social pressure, worshipping etc.); and (iv) enhancement of collective action of IPLC and local resource users, etc. (IPBES, 2016; 2024a). Other examples include voluntary certification, co-management of land and seas with IPLC, scientific and

technological policy instruments, behaviour nudges for reduced consumption, Indigenous and community conserved areas, other effective area-based conservation measures, sacred sites and landscapes, and indigenous institutions that govern management of resources.

'TC approaches' in the inspiration tool – Transformative change approaches:

Slightly adapted from IPBES (2024b).

- Systems: The action alters the relationships and feedback that can block or can help accelerate systemic change, including changes to the structure, rules and networks in a system, vision, objectives and the overall goals or underlying intent of the system.
- Structural: The action alters economic, social, political and cultural rules in ways that promote sustainability, either through governance interventions or through communities reforming predominant rules.
- Inner transformation: The action involves relational activities that nurture human-other-than-human relationships; intra- and inter-generational relationships; self-other relationships and relationships with oneself leading to shifting inner beliefs, views and practices.
- Empowerment: The action involves asserting agency and power to currently marginalised groups, fostering social movements and building grassroots networks, envisioning alternative pathways using critical tools, self-reflection and historically denied agency to gain recognition, representation, and rights in legal structures and other key arenas of power for the benefit of equity and sustainability.
- Knowledge co-creation: The action implies collaborative research-action interventions that build individual and collective capacities to promote desirable futures through visioning, dialogues, reflection and feedback sessions, including sharing knowledge in accessible ways. This considers knowledge co-creation processes between a variety of actors (such as civil society, Indigenous Peoples and local communities, or scientific actors) working together.
- Science and technology: The action considers the use of new technologies, perspectives, solutions and innovations taken up by society and brought to scale, in conjunction with inclusive innovation processes; increased funding for research, education, outreach and science-policy interface.

'TC challenges' in the inspiration tool – Overarching societal challenges to transformative change:

Slightly adapted from IPBES (2024b).

- Colonialism: The implementation of the action could be challenged by relations of domination over nature and people, especially those that emerged and were propagated in colonial eras and that persist over time. This can be interconnected to a wide range of barriers, such as a) dominant categorisations and rankings of people and biodiversity obscure alternative understandings and worldviews; b) dominant forms of measurement, simplification, and management reduce nature to a narrow set of values, limiting options for management and understanding; and c) persistent relations of domination, reinforced by systems of measurement and associated categorisations, rankings, and management, justify taking resources.
- Inequalities: The implementation of the action could be challenged by economic and political inequalities. This can be interconnected to a wide range of barriers, such as a) uneven access to and influence in processes that formulate policy and regulation and limit exposure to ideas and experiences that could change the status quo; b) the dependence of countries on foreign investment creates competitive environments incentivised to minimise regulation; c) shareholder primacy doctrines drive investment decisions toward shareholder interest and profit rather than public interest; and d) the beneficiaries of the status quo are concerned with losing privileges, while the vulnerable fear potential precarity created by transformation.

- **Weak policies**: The implementation of the action could be challenged by inadequate policies and unfit institutions. This can be interconnected to a wide range of barriers, such as a) administrative boundaries do not match the geographies of biodiversity loss and environmental degradation, reducing the efficacy of plans and policies; b) policies across sectors may conflict with each other, such as when a climate policy does not lessen biodiversity loss; c) time gaps between policy implementation and ecological dynamics, e.g., when measures are implemented too slowly to respond to abrupt environmental changes; and d) policy effectiveness is difficult to measure, challenging the alignment of policy and environmental needs.
- **Unsustainability**: The implementation of the action could be challenged by unsustainable consumption and production patterns, including individual habits and practices. This can be interconnected to a wide range of barriers, such as a) the societal emphasis on economic growth reinforces consumerism, which underlies market and policy arguments for protecting current unsustainable practices; b) the socio-economic disparities that mark global production and consumption are often hidden by narratives blaming degradation and overpopulation; c) unseen practices and structures in one social-ecological system that impact ecosystems, biodiversity and societies across great distances; and d) habitual behaviours conform and confirm social practices and structures (including values, norms and institutions), making them stable and difficult to change.
- **Tech access**: The implementation of the action could be challenged by limited access to clean technologies and uncoordinated knowledge and innovation systems. This can be interconnected to a wide range of barriers, such as a) structural, strategic, operational, procedural and behavioural barriers to the generation, development and adoption of sustainable technologies; b) knowledge and innovation systems on biodiversity management are not sufficiently coordinated and integrated among different stakeholders; c) the limited and uneven attention to and investment in sustainability and biodiversity management knowledge and innovations across different sectors; d) poor regulation and a lack of oversight on the application and potential negative impacts of emerging technologies; and e) Indigenous and Local Knowledge on biodiversity-friendly actions and innovations is unrecognised, marginalised, disintegrated and not adequately supported.

'TC direction' in the inspiration tool – Direction of transformative change intervention:

Slightly adapted from IPBES (2024b).

- **Bottom-up**: The action is to be implemented primarily by a bottom-up approach, in which decisions and system elements are driven by basic or lower- order processes.
- **Top-down**: The action is to be implemented primarily by a top-down approach, in which decisions and system elements are driven by top-level or higher- order processes.

'TC interventions' in the inspiration tool – Interventions for transformative change:

Slightly adapted from Mustajoki et al. (in prep.), derived from Work Package 2.

- **Economic**: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Allocating and mobilising capital and resources*: Ensuring that financial investments, skilled labour, and materials are available where they are needed most. Examples include redirecting funds toward sustainable industries or training programs to equip workers with future-proof skills.
  - *Developing new business models and innovations to drive sustainable change*: New ways of creating and delivering value that challenge market structures. Examples include circular economy models that minimise waste or regenerative businesses that restore ecosystems while generating profit.

- *Implementing market interventions such as economic or financial policy instruments*: Tools like subsidies, taxes, or investment incentives that influence economic activity. Examples include carbon pricing to encourage lower emissions or grants for green energy development.
- *Shifting focus from short-term to long-term economic interests*: Encouraging investment and decision-making that considers future benefits rather than immediate gains. Examples include sustainable pension funds or corporate strategies that prioritise long-term stability over quarterly profits.

- Social: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Dismantling outdated socio-economic pathways that hinder progress*: Challenging entrenched ways of working, governing, or producing that are no longer effective. Examples include shifting away from extractive land use, industrial monocultures, or policies that prioritise short-term economic gains over ecosystem health.
  - *Encouraging behavioural change in citizens and consumers*: Helping individuals and communities adopt habits that support biodiversity and strengthen human-nature connections. Examples include restoring native habitats, reducing resource overuse, or embracing nature-friendly lifestyles.
  - *Ensuring inclusion and participation of stakeholders in decision-making*: Creating opportunities for different groups—such as businesses, communities, policymakers—to contribute to discussions and policies that affect them. Examples include policy consultations or citizen assemblies.
  - *Promoting positive narratives and visions that inspire transformative change*: Using storytelling, media, and leadership to inspire action towards transforming human-nature relationships. Examples include indigenous future narratives that emphasize harmony with the environment or campaigns that highlight the value of biodiversity for future generations.
  - *Strengthening social resilience and empowering people through community-driven initiatives*: Building the capacity of communities and individuals to adapt to change and take initiative. Examples include local cooperatives, skills development programs, or social safety nets.
- Governance: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Adopting alternative governance models*: Exploring new ways of governing that prioritise flexibility, shared decision-making, or iterative learning. Examples include participatory democracy or adaptive policymaking.
  - *Engaging in inclusive planning processes that consider political and power dynamics*: Designing policies and projects in a way that acknowledges different interests and ensures fair representation. Examples include urban planning that includes marginalised communities in decision-making.
  - *Enhancing transparency and accountability in decision-making processes*: Ensuring that governance actions are visible and justifiable, so the public can trust institutions. Examples include open data policies, public audits, or anti-corruption laws.
  - *Ensuring fair governance that accounts for power dynamics*: Developing systems that recognise and balance different levels of influence among stakeholders and ensure accountability, preventing any one group from dominating decision-making. Examples include conflict mediation mechanisms in resource management.
  - *Ensuring fair governance that accounts for power dynamics*: Developing systems that recognise and balance different levels of influence among stakeholders and ensure accountability, preventing any one group from dominating decision-making. Examples include conflict mediation mechanisms in resource management.

- *Establishing effective policy and governance structures for long-term change*: Creating legal, administrative, or institutional frameworks that support stability and continuous improvement. Examples include independent regulatory agencies or long-term climate action plans.
- *Fostering cross-sectoral collaboration to integrate diverse expertise*: Encouraging cooperation between government, businesses, civil society, and academia to tackle complex biodiversity challenges. Examples include partnerships where businesses integrate biodiversity considerations into their supply chains or operations, such as using sustainable sourcing practices or reducing habitat destruction.

- **Legislative**: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Creating and updating existing legislation to reflect evolving challenges*: Ensuring that laws remain relevant as society changes. Examples include updating national forest management laws to include provisions for climate change adaptation and biodiversity conservation.
  - *Developing and enforcing new regulations and regulatory instruments*: Introducing rules and tools that guide behaviour toward desired outcomes. Examples include stricter regulations on fishing practices to prevent overfishing and to protect marine biodiversity.
- **Technological**: The action is related to the following subcategory of transformative change interventions:
  - *Developing technological innovations that enable systemic change*: Developing and applying new technologies that reshape industries or societies. Examples include using drones and satellite technology to monitor deforestation or using genetic tools to help protect endangered species.
- **Environmental**: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Enhancing spatial planning and resource management to optimise land use and efficiency*: Ensuring land, water, and resources are allocated wisely to meet future needs. Examples include smart urban planning, precision agriculture, or the creation of wildlife corridors to link protected areas.
  - *Restructuring physical infrastructures for sustainability and resilience*: Updating physical and digital systems to withstand future challenges and support sustainability. Examples include redesigning urban areas with green roofs that also provide habitats for wildlife or decentralised water management systems.
- **Value**: The action is related to the following subcategory of transformative change interventions:
- *Addressing deep-rooted (human-centred) values and vested interests that shape societal norms*: Recognising and challenging beliefs or power structures that maintain the status quo. Examples include discussions on economic growth models or shifting social norms around consumption.
- **Knowledge**: The action is related to at least one of the following subcategories of transformative change interventions:
  - *Advancing fundamental scientific research to inform evidence-based solutions*: Conducting in-depth investigations that provide the foundation for future innovations. Examples include climate modelling research or genetic studies for disease prevention.
  - *Co-producing knowledge through collaboration between researchers, policymakers and stakeholders*: Developing knowledge collectively to ensure it is relevant and applicable. Examples include citizen science projects or transdisciplinary research initiatives.
  - *Experimenting with and scaling successful initiatives to accelerate impact*: Testing new ideas in controlled settings and expanding them if they prove effective. Examples include pilot programs for urban mobility solutions or small-scale regenerative agriculture projects.
  - *Facilitating information sharing between diverse actors*: Creating platforms or networks that allow businesses, researchers, and policymakers to exchange knowledge effectively. Examples include open-access databases or public-private partnerships.

- *Innovating research approaches to explore new ways of understanding complex problems*: Developing novel methods to study and address challenges more effectively. Examples include integrating indigenous knowledge into climate science or using AI for policy simulations.
- *Tackling the root causes of unsustainability and biodiversity challenges*: Addressing the fundamental drivers of environmental degradation and biodiversity loss, rather than only responding to the symptoms. Examples include policies that reduce deforestation, promote sustainable land use, or shift economic practices to ones that prioritise long-term environmental health.

'TC policy' in the inspiration tool – Type of transformative policy:

- **Evolutionary**: The action could imply an evolutionary, transformative change approach, in which existing EU policies need to be adapted and strengthened.
- **Revolutionary**: The action can imply a revolutionary, transformative change approach, in which new types of EU policies need to be created.

'TC principles' in the inspiration tool – Key principles of transformative change:

Four principles address the underlying causes of biodiversity loss and nature's decline and guide transformative change towards global sustainability. These are (slightly adapted from IPBES, 2024b):

- **Equity and justice**: The action's foundational values are aligned with the principle of equity and justice. This principle ensures that interventions for transformative change are designed in a fair manner. The literature related to this principle highlights the critical importance of equitable and just procedures and equitable and just outcomes for humans (including both present and future generations) and other species.
- **Pluralism**: The action's foundational values are aligned with the principle of pluralism and inclusion. This principle ensures that differences in perspectives, voices and experiences are recognised and honoured through the development of context-specific strategies and actions for transformative change. Actions that are aligned with this principle engage diverse actors, visions and worldviews and remain open to ongoing contestation, renegotiation and change.
- **Respect**: The action's foundational values are aligned with the principle of respectful and reciprocal human-nature relationships. This principle acknowledges relational values and responsibilities based on human-nature connectedness. It represents a move from instrumental relationships of extraction, exploitation, domination and control towards fostering values of care, respect, solidarity, responsibility and stewardship.
- **Adaptive**: The action's foundational values are aligned with the principle of adaptive learning and action. This principle recognises that transformative change is a dynamic and emergent process with unfolding impacts and unintended consequences that need to be continuously addressed.

Principles[2] refer to normative or procedural guidelines that govern behaviour, decision-making or actions. Principles are crucial to addressing the underlying causes of biodiversity loss and are fundamental to shifting views, structures and practices for a just and sustainable world.

'TC strategies' in the inspiration tool – Strategies and actions for transformative change:

Five key strategies and associated actions have complementary and synergistic effects and substantial potential to advance deliberate transformative change for global sustainability. An integrated set of

[2] The term "principles", as used here, refers to a framework for understanding, reasoning and making judgments, and does not refer to principles of law. Principles often represent values or beliefs that guide decisions and behaviours.

actions for each strategy shifts entrenched views, structures and practices in an adaptive way. The strategies are (slightly adapted from IPBES, 2024b).

- **Conservation**: The action contributes to conserving and regenerating places of value to nature and people. Examples of these actions include a) conserving vital biocultural heritages, b) enhancing legal protection for biodiversity, c) basing conservation on diverse values, d) shifting towards regenerative systems, e) advancing integrated spatial planning.
- **Sectors**: The action contributes to driving systemic change in the sectors most responsible for biodiversity loss and nature's decline. Examples of these actions include a) regulating direct exploitation, b) embedding technology in transformative frameworks, c) financing global sustainability, d) supporting civil society initiatives.
- **Economy**: The action contributes to transforming economic systems for nature and equity. Examples of these actions include a) mainstreaming innovative economic tools, b) supporting just transitions to wellbeing economies, c) transforming financial systems, d) adopting new metrics of success.
- **Governance**: The action contributes to transforming governance systems to be integrated, inclusive, accountable and adaptive. Examples of these actions include a) promoting integrated governance, b) engaging in inclusive governance, c) securing multi-lateral action, d) strengthening learning through adaptive.
- **People**: The action contributes to shifting individual and societal views and values to recognise and prioritise fundamental interconnections between humans and nature. Examples of these actions include a) promoting nature connectedness, b) shifting cultural narratives, c) changing social norms, d) facilitating transformative learning, e) co-creating knowledge.

'TC visions' in the inspiration tool – Transformative change visions:

Slightly adapted from IPBES (2024b).

- **Good economy**: The action contributes to realising a regenerative and circular economy.
- **Empowerment**: The action contributes to realising community rights and empowerment.
- **Healthy ecosystems**: The action contributes to realising biodiversity and ecosystem health.
- **Reconnection**: The action envisions spiritual reconnection (between humans and nature) and behavioural change.
- **Innovation**: The action envisions business and technology.

'Ways of' in the inspiration tool – Ways of shifting:

Slightly adapted from IPBES (2024b).

- **Views**: The action integrates new ways of thinking, knowing and seeing through shifting views.
- **Structures**: The action integrates new ways of organising, regulating and governing through shifting structures.
- **Practices**: The action integrates new ways of doing, behaving and relating through shifting practices.

Appendix B. Survey outline

Section 1. Participant profile

1. Please state your current role *[Multiple choice]* *(select all that apply)*

    a. BIONEXT stakeholder (involved in past BIONEXT workshops and/or engaged in the development of the transformative pathways)
    b. CBD National Focal Point
    c. EU policymaker
    d. National policymaker
    e. Local policymaker
    f. IPBES National Focal Point
    g. Horizon Europe Transformative Change Cluster project participant
    h. Other: *[free text]*

2. What is your gender? *[Multiple choice]*

    a. Woman
    b. Man
    c. Non-binary
    d. Prefer not to say
    e. Other: *[free text]*

3. What is your age group? *[Multiple choice]*

    a. Under 25
    b. 25 – 34
    c. 35 – 44
    d. 45 – 54
    e. 55 – 64
    f. 65 or over
    g. Prefer not to say

4. Which country do you work in and/or are a focal point for? *[Drop down list – EU27 + Norway, Switzerland and UK]*

5. Please state which sector(s) best encompass your line of work. *[Multiple choice]* *(select all that apply)*

    a. Activist
    b. Business
    c. Citizen group
    d. Grassroots and public awareness
    e. Government
    f. Intergovernmental organisation (IGO)
    g. Non-governmental organisation (NGO)
    h. Research
    i. Youth
    j. Other: *[free text]*

6. Please identify which nexus element(s) are included in your expertise. *[Multiple choice]* *(select all that apply)*

    a. Biodiversity
    b. Food
    c. Water
    d. Health
    e. Climate
    f. Transport
    g. Energy

h. Other: [*free text*]

Section 2. Policy Option

7. Briefly, to your knowledge, how is the term 'policy option' understood in your sector? [*Free short text*]
8. Thinking about transformative change for biodiversity and ecosystem services in the context of climate change, how well does the following definition of 'policy option' align with your sector's understanding?

   "*a possible course of action or strategy that decision-makers and other actors can adopt to promote transformative change for biodiversity and ecosystem services in the context of climate change*"

   [scale from 1 (not at all) to 10 (very well)]

9. If you scored 6 or lower, what changes would you suggest to improve this definition in the context of biodiversity and ecosystem services? *[Free text]*

Section 3. Transformative change

10. To your knowledge, how is the term 'transformative change' understood in your sector? *[Multiple choice]* *(select all that apply)*

    a. Significant changes in policies, governance and institutional structures
    b. Shifts in societal norms, values or behaviours
    c. Adoption of new technologies or practices
    d. Systemic change across multiple sectors
    e. Economic or financial transformation
    f. Changes in the environment or ecosystems
    g. Inclusion and participation of diverse actors
    h. Other: *[free text]*

11. Briefly, in your view, what makes a policy option transformative? *[Free short text]*
12. How should policy options be used to facilitate transformative change in Europe?

    a. Evolutionary approach: adapting and strengthening existing EU policies
    b. Revolutionary approach: creating new types of EU policies
    c. Mixed approach: a combination of evolutionary and revolutionary approaches
    d. Other: *[free text]*

13. Please explain your answer in question 12 *(optional)* [*Free text*]
14. In your opinion, which existing EU environmental policy frameworks, policy implementation processes, or policies addressing the biodiversity-related nexus elements (e.g., biodiversity, water, food, energy, transport, climate, health, others) require urgent transformative change? Please explain. *[Free text]*

Section 4. The Guidance

15. To support transformative change, what type of scientific guidance is needed most in your sector? *(select all that apply)*

    a. Synthesised and accessible data or evidence
    b. Guidance in simplified language
    c. Future scenarios or foresight analysis
    d. Science-policy co-creation tools or frameworks
    e. Case studies or practical examples
    f. Decision support tools
    g. Other: *[free text]*

16. What are your main expectations for the BIONEXT Guidance in your sector? *[free text]*

17. Would you like to take part in the co-creation of the Guidance? This includes participating in another survey or webinar in April and joining the policy day of the BIONEXT Workshop 4 in Antwerp, Belgium, on 19 May 2026. *[Multiple choice]*

18. Is there anything else you would like to share about your sector's needs and expectations? *(optional) [free text]*

Appendix C. List of BIONEXT outcomes used in the Guidance

Responsible Work Package	BIONEXT outcome (citation)	Title	doi or public link
WP1	Kim et al. (2024)	Understanding the role of biodiversity in the climate, food, water, energy, transport and health nexus in Europe	https://doi.org/10.1016/j.scitotenv.2024.171692
WP1	Kim et al., (2024) SM	Supplementary material of Kim et al. (2024)	https://ars.els-cdn.com/content/image/1-s2.0-S0048969724018345-mmc1.docx
WP1	Deliverable 1.3	Report describing the application of the nexus modelling framework	Not yet public
WP1	Lazurko et al. (2025b)	Enriching the European Shared Socio-economic Pathways with considerations of biodiversity and nature using a nexus approach	https://doi.org/10.1016/j.crm.2025.100741
WP1	Raymond et al. (2025)	Pathway narratives towards a nature-positive European Union land system: operationalising the Nature Futures Framework for policy objectives	https://doi.org/10.1007/s11625-025-01737-0
WP1	Ioannou et al. (2026)*	JUNIPER: Joint Use of Nexus Indicators for Policy and Environmental Resilience - Case Study of Greece [Preprint].	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6863181
WP1	JUNIPER EU-level baseline (2020)*	Model results template - WS4 Iteration 2 (with justifications). Baseline column used for current-state values only.	Not public
WP1	Kim et al., (in prep.)*	Beyond silos: Evidence for cross-sectoral policy coherence from biodiversity nexus mechanisms in Europe	Not yet public
WP2	Deliverable 2.1	Constructing a conceptual understanding of transformative change in the biodiversity nexus	https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e500b10b61&appId=PPGMS
WP2	Deliverable 2.3	Co-created transition pathways in the biodiversity nexus	https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e51e9ccbe3&appId=PPGMS
WP2	Deliverable 2.4	Enabling justice in nature-positive transformations: insights from transitions in agriculture, forestry, and health	https://drift.eur.nl/en/publications/composting-conflict-bionext-zine-and-case-studies/
WP2	Milestone 2.4	Analysis of (in)justices in the co-created transformative pathways as input for workshop 3	Not public
WP2	Hebinck et al. (2026)	From science-policy to science-policy-society: enabling transformative change in practice	Not yet public
WP2	Lazurko et al. (2025a)	Envisioning nature-positive futures for Europe: inspiring transformative change at the biodiversity nexus	https://doi.org/10.1080/26395916.2025.2561107
WP2	de Pater (2025)	Functions and dimensions of pluralism in transformative governance for biodiversity: a review	https://doi.org/10.1080/26395916.2025.2587965
WP2	de Pater et al. (2025)	Plurality in transformative change: three pathways toward nature-positive Europe(s) [preprint]	https://doi.org/10.31235/osf.io/v4rfh_v2
WP2	Valve et al. (2025) (Deliverable 2.2)	Transformative change from below? Linking biodiversity governance with the diversity of bottom-up action	https://doi.org/10.1016/j.envsci.2025.104000
WP2	Valve et al. (2025) SM	Supplementary material of Valve et al. (2025)	https://ars.els-cdn.com/content/image/1-s2.0-S1462901125000164-mmc1.docx
WP2	Context Czechia	Case study Task 2.2 – Context Czechia	Not public
WP2	Focus group Czechia	Case study Task 2.2 – Summary focus group Czechia	Not public
WP2	Interviews Czechia	Case study Task 2.2 – Summary interviews Czechia	Not public
WP2	Interviews Greece	Case study Task 2.2 – Summary interviews Greece	Not public
WP2	Focus group Netherlands	Case study Task 2.2 – Summary focus group Netherlands	Not public
WP2	Interviews Netherlands	Case study Task 2.2 – Summary interviews Netherlands	Not public
WP2	Interviews UK	Case study Task 2.2 – Summary interviews UK	Not public
WP2	Interviews Belgium	Case study Task 2.2 – Summary interviews Belgium	Not public
WP2	Narrative Finland	Case study Task 2.4 – Transition narrative Finland	Not public

Responsible Work Package	BIONEXT outcome (citation)	Title	doi or public link
WP2	Background Finland	Case study Task 2.4 – Background Finland	Not public
WP2	Narrative Netherlands	Case study Task 2.4 – Transition narrative Netherlands	Not public
WP2	Narrative Belgium	Case study Task 2.4 – Transition narrative Belgium	Not public
WP3	Deliverable 3.2	Coded database of transformational elements (spreadsheet converted to csv)	Not public
WP3	Deliverable 3.2 SD	Coded database of transformational elements (supporting document)	Not public
WP3	Vaňo, Jungwirth Březovská, Viesca-Ramirez, et al., (2026)*	Transformative change mechanisms in European biodiversity nexus cases: An empirical archetype analysis	https://doi.org/10.5281/zenodo.21700167
WP4	UNEP-WCMC (2025)*	BIONEXT Information Note for WP4: Nexus synergies in EU legislative and policy instruments (Summary Report, binding instruments spreadsheet, non-binding instrument spreadsheet)	Not public
WP4	Workshop 4 (2026)*	From research to policy: co-designing and fine-tuning the BIONEXT Guidance for transformative change	N/A (notes not public)
WP5	Mustajoki et al. (in prep.)*	An approach for assessing the significance of actions in driving transformative change for biodiversity – Application to EU biodiversity targets	Not yet public
WP5	Keune et al. (in review)*	Of course we do One Health: interdisciplinary exploration of the One Health Nexus	Not yet public
WP6	Policy Brief 1	Exploring transformative solutions for biodiversity and sustainability	https://doi.org/10.58013/m37v-x853
WP6	Policy Brief 2	What policymakers need to learn from bottom-up biodiversity action	https://doi.org/10.58013/t276-dq53
WP6	Policy Brief 3	Interlinkages between biodiversity, climate, food, water, energy, transport and health: A concentrated dose for policymakers	https://www.bionext-project.eu/policy-brief-3
WP6	Policy Brief 5*	Why policies relevant to biodiversity risk overlooking justice – and how to address it	https://www.bionext-project.eu/policy-brief-5

*: considered manually, not as part of the AI-supported synthesis due to their timeline or accuracy issues in the automated retrieval.

Appendix D. Cases of co-created policy options

<table>
<tr><th colspan="4">Case: Derrinlough Wind Farm (Ireland)</th></tr>
<tr><td colspan="4">Summary.
This case examined Derrinlough Wind Farm in Ireland, reflecting broader challenges across Europe. The wind farm, developed on cutaway peatlands, raised concerns given these areas' strong potential for ecological restoration. The case highlights how wind farm development – and renewable energy expansion more widely – can result in habitat loss, biodiversity decline, and landscape and visual impacts. It underscores tensions between biodiversity protection and the rapid scaling of renewables, questioning whether site selection and planning decisions are consistently based on robust scientific evidence.

Driven by rising energy demand and supported by policies such as the EU Renewable Energy Directive, the case illustrates the trade-offs between climate mitigation goals and biodiversity protection. It also highlights a pattern in which power dynamics and public acceptance pressures often place greater weight on energy generation than on ecological and community considerations, sometimes resulting in local social impacts, and in other cases shifting developments towards marginal or ecologically inappropriate sites.</td></tr>
<tr><td colspan="4">Policy issues affecting biodiversity:
• Siloed and incoherent governance: Biodiversity objectives are often treated as secondary to energy priorities, with inconsistencies between policy areas – for example, between the rapid expansion of renewable energy and the protection of habitats under frameworks such as Natura 2000.
• Lack of mainstreaming: Biodiversity considerations are not systematically integrated into energy policy or site selection processes, limiting their influence on planning and decision-making.
• Knowledge gap: There is a disconnect between scientific knowledge and policy development, with biodiversity risks often underestimated or insufficiently reflected in planning. As evidence moves through decision-making processes, its influence can be diluted by economic, financial, and political considerations, while policies are still often assumed to be fully evidence-based.</td></tr>
<tr><td colspan="4">Visible impacts on biodiversity: Land use change and habitat loss, wildlife mortality (e.g. bats), and disturbance or displacement of species (e.g. seabirds).</td></tr>
<tr><th colspan="2">Input for the inspiration tool</th><th colspan="2">Output from the inspiration tool</th></tr>
<tr><td>Underlying causes of biodiversity loss</td><td>concentration of power and wealth; prioritisation of short-term, individual and material gains</td><td>Related transformative interventions</td><td>Legislative; Governance; Environmental; Economic</td></tr>
<tr><td>Transformative vision by 2050</td><td>a regenerative and circular economy; community rights and empowerment; biodiversity and ecosystem health; business and technology</td><td>Associated policy instruments</td><td>Regulatory; Rights-based; Environmental; Economic</td></tr>
<tr><td>Challenges for transformative change</td><td>economic and political inequalities; inadequate policies and unfit institutions; unsustainable consumption and production patterns, including individual habits and practices; limited access to clean technologies and uncoordinated knowledge and innovation systems</td><td>Related nexus governance</td><td>Equitable; Integrative</td></tr>
<tr><td>Nexus element(s)</td><td>biodiversity; food/agriculture; water; human health; climate change; energy; transport</td><td>Related nexus actions</td><td>Rights; Integrate; Conserve; Manage; Financing</td></tr>
<tr><td>Others</td><td>finance</td><td></td><td></td></tr>
<tr><td colspan="4">Related BIONEXT transformative actions:
• Establish favourable legislative environment for energy communities (i.e., local, decentralised groups of citizens, businesses and authorities who together produce, manage and share renewable energy).
• Prevent land exploitation from renewable energy products.
• Develop progressive taxation of energy consumption.</td></tr>
<tr><td colspan="4">Policy option co-creation process: The group used the provided actions as a starting point for discussion and reflection. Initial discussion focused on progressive taxation, which was considered a promising yet complex approach, particularly given that existing systems often subsidise high-energy users. The discussion then shifted towards preventing land exploitation linked to renewable energy, which became the central theme due to its direct relevance to the case.

Participants explored how this issue could be addressed within a policy landscape that prioritises rapid decarbonisation. A range of potential policy options was proposed and discussed; however, the group did not reach a consensus on a preferred course of action. Overall, participants found the inspiration tool valuable in facilitating structured, cross-disciplinary dialogue and supporting collaborative development of policy options.</td></tr>
<tr><td colspan="4">Policy option(s):
• Reform energy taxation and pricing: Fundamentally rethink energy pricing and taxation systems to better reflect environmental and social costs, moving away from models that implicitly subsidise high consumption towards more equitable and nature-positive frameworks.
• Strengthen evidence-based land-use decisions: Enable renewable energy development while ensuring land-use decisions are guided by robust, transparent impact assessments that capture cumulative environmental and biodiversity impacts and incorporate diverse stakeholder perspectives.
• Improve EU impact assessment processes: Enhance the transparency, accessibility, and communication of EU impact assessments, ensuring they are firmly grounded in robust scientific evidence. Assessments should clearly articulate both benefits and trade-offs, be effectively communicated to the public, and be meaningfully integrated into policymaking, particularly within the EU legislative process.
• Adopt comparative, multi-criteria site selection: Require systematic assessment of alternative locations, comparing environmental, social, and economic impacts to prioritise sites that minimise harm to biodiversity while supporting societal and economic objectives.
• Operationalise the mitigation hierarchy: Strengthen the practical application of avoidance, minimisation, restoration, and offsetting measures by drawing on existing industry evidence and best practices.</td></tr>
</table>

Case: Derrinlough Wind Farm (Ireland)

- **Build capacity for EIAs and permitting:** Increase resources, technical expertise, and institutional capacity for Environmental Impact Assessment (EIA) and permitting processes to ensure that accelerated renewable energy deployment does not compromise the quality of ecological assessments, particularly regarding biodiversity impacts.
- **Enhance enforcement and close regulatory gaps**: Strengthen implementation of existing legislation (e.g. EIA, SEA) at EU and national levels, address loopholes, and ensure consistent application across sectors, including emerging or transitional activities, so that all relevant developments are subject to appropriate environmental assessment.
- **Strengthen compliance and deterrence mechanisms**: Ensure penalties for non-compliance with environmental legislation (e.g. EIA and SEA requirements, as well as habitat protection frameworks) are proportionate and effective, so that compliance is not outweighed by the economic benefits of non-compliance.
- **Promote cross-sectoral governance and coordination**: Improve alignment across policy domains and ministries to reduce siloed decision-making and better integrate biodiversity, energy, and land-use objectives.
- **Leverage financial sector influence:** Engage investors and financial institutions in reinforcing environmental compliance through clear regulatory expectations, KPIs, and robust due diligence standards, including the potential withdrawal of financing for non-compliant activities.
- **Increase transparency and public participation:** Ensure consultation processes are genuinely accessible and influential, enabling meaningful public input, addressing power imbalances, and strengthening accountability in decision-making.
- **Develop credible market-based mechanisms**: Explore biodiversity and environmental credit systems to support transformative change, ensuring robust standards to prevent greenwashing and prioritising local environmental benefits. Emerging examples, such as regenerative agriculture in the United States and water credit systems in Washington, highlight the potential of these approaches. While market mechanisms can help address gaps in government action, strong safeguards are needed to ensure credibility and maximise local ecological and social co-benefits.
- **Improve data, monitoring, and accountability:** Strengthen data collection on localised and value-chain biodiversity impacts to support more informed decision-making and the development of credible market-based mechanisms. Enhance monitoring, reporting, and feedback systems to ensure environmental outcomes – particularly for biodiversity credits – are measurable, verifiable, and enforceable. This is especially important given current limitations in tracking nature-related risks across complex supply chains and the lack of granular, location-specific data.
- **Clarify 'overriding public interest':** Provide clearer criteria and guidance on how "overriding public interest" is defined and applied in planning processes, ensuring it is used consistently and only where truly justified. This would support more balanced decisions between energy development, biodiversity protection, and wider societal interests, and help prevent its overuse to justify environmentally harmful projects.

Case: Financing nature-conscious health-promoting agriculture in the EU

Summary.
This case focused on livestock-intensive agricultural systems in the EU, whose biodiversity impacts include land-use change, nutrient pollution, air and water contamination, and disease transmission affecting both wildlife and humans. Stakeholders selected this case because they considered biodiversity loss to be driven by multiple interconnected policy-implementation challenges, including siloed governance, inadequate integration of biodiversity into agricultural and financial policies, and a focus on addressing impacts rather than underlying drivers.

Participants discussed how harmful subsidies and investment flows seem to continue to support industrialised food production, while biodiversity considerations remain insufficiently embedded in sustainable finance frameworks and agricultural policy. The case was seen as reflecting broader indirect drivers such as short-term economic incentives, disconnection from nature, and unsustainable food systems.

Stakeholders considered it a strong example of the need for more integrated approaches linking biodiversity, health, agriculture, climate, and finance, while addressing the root causes of biodiversity loss rather than only its consequences.

Policy issues affecting biodiversity: siloed and incoherent governance, neglect of indirect drivers of biodiversity loss, lack of mainstreaming of biodiversity across agricultural, health, and finance policies.

Visible impacts on biodiversity: Habitat loss from land-use change, air and water pollution, nutrient runoff, wildlife mortality from disease transmission and declining populations of wild bird (e.g. European crane) and other wildlife species.

Input for the inspiration tool		Output from the inspiration tool	
Underlying causes of biodiversity loss	prioritisation of short-term, individual and material gains	**Related transformative interventions**	Economic; Legislative
Transformative vision by 2050	biodiversity and ecosystem health; a regenerative and circular economy; spiritual reconnection (between humans and nature) and behavioural change	**Associated policy instruments**	Economic; Regulatory
Challenges for transformative change	relations of domination over nature and people, especially those that emerged and were propagated in colonial eras and that persist over time; unsustainable consumption and production patterns, including individual habits and practices;	**Related nexus governance**	Integrative
Nexus element(s)	biodiversity; food; health	**Related nexus actions**	Consume; Reduce
Others	none		

Related BIONEXT transformative actions:
- Regulate and tax meat and unhealthy foods differently than other foods;

Case: Financing nature-conscious health-promoting agriculture in the EU
• Implement restrictive policies, incentives and subsidies, including related to food prices
Policy option co-creation process: The policy options generated by the inspiration tool served as a starting point for discussion. Participants reflected on the feasibility, effectiveness, and political acceptability of the proposed actions. While many agreed with the objectives, discussions highlighted significant implementation challenges. This led the group to broaden the focus beyond regulatory measures alone to also consider financial incentives, sustainable finance reforms, and engagement with private-sector actors, and health-oriented policy framing. Particular emphasis was placed on communicating the economic, health, and supply-chain risks associated with unsustainable livestock production, as well as the need to support farmers and producers through a positive, solution-oriented transition narrative. The discussion refined the initial policy options into a set of approaches combining regulatory change, financial incentives, stakeholder engagement, and improved mainstreaming of biodiversity across food, climate, health and finance policies, with a clear insight that food systems are often at the heart of several nexus elements.
Policy option(s): • Support participatory and consultative governance processes (e.g. citizen initiatives) to facilitate the implementation of food-system transitions.

Case: Renewable energy projects based on wind and solar within the EU			
Summary. The case explores the impacts of renewable energy projects (wind and solar) on biodiversity in the EU. It envisages a generic case that is located within a rural area with potential conflicts with tourism, Protected Areas for nature conservation and other land uses. It explores the issues of greenwashing through public consultation that is ineffective in terms of not taking full account of local societal concerns and is more about box ticking. The case also explores the need to extend current environmental impact assessments to include socio-cultural aspects that are largely overlooked in current procedures.			
Policy issues affecting biodiversity: A lack of mainstreaming, siloed approaches, and knowledge gaps arising from a lack of understanding of biodiversity impacts. Communication is also a problem in terms of the implementation gap between public acceptance and the lack of communication and proper consultation, Environmental Impact Assessment (EIA) legislation is ineffective.			
Visible impacts on biodiversity: Negative impacts on migratory birds (bird mortality), soil biota, livestock, and human health. There are also impacts of the infrastructure (e.g. roads) that is needed to service the energy projects and offsite effects of mining rare earths for batteries.			
Input for the inspiration tool		**Output from the inspiration tool**	
Underlying causes of biodiversity loss	Concentration of power and wealth, due to a lack of consultation	**Related transformative interventions**	Legislative; Governance; Regulatory; Rights-based
Transformative vision by 2050	Good Economy (local benefits, reduced energy demand); Empowerment (through consultation); Innovation (private sector involvement, better technology, e.g. agrivoltaics)	**Associated policy instruments**	Legislative; Governance; Environmental; Economic More effective consultation; better Environmental Impact Assessment that also incorporates socio-cultural aspects (that are currently lacking)
Challenges for transformative change	Inequalities (community engagement, energy prices, non-economic valuation); Unsustainability (reduced energy demand); Tech access (need for other energy sources, storage)	**Related nexus governance**	Legislative; Governance; Regulatory; Rights-based Better EIA incorporating socio-cultural aspects; Investment in sustainable infrastructure; more research to close knowledge gaps. a) new ways of thinking, knowing and seeing through shifting views; b) new ways of organising, regulating and governing through shifting structures; c) new ways of doing, behaving and relating through shifting practices
Nexus element(s)	biodiversity; food/agriculture; water; human health; climate change; energy; transport	**Related nexus actions**	Environmental, Regulatory, Rights-based; Governance Cross nexus thinking to support policy interventions
Others	none		
Related BIONEXT transformative actions: • Reallocate energy supply, prioritised based on social vulnerability • Pursue a just energy transition • Prioritise energy production based on social vulnerability			
Policy option co-creation process: An open discussion based on personal experience of the issues. Consensus reached through discussion and agreement.			
Policy option(s): • More regulation on the community engagement and consultation process • Mandates incorporation of socio-cultural aspects in existing Environmental Impact Assessment legislation			

Case: Logic of the water crisis in the Mediterranean

Summary.
Water depletion across the Mediterranean is increasing due to a combination of e.g. intensive agriculture, irrigation, climate change, groundwater over-abstraction, and tourism-related demand. Historically, agricultural policies, including the Common Agricultural Policy support mechanisms, have contributed to agricultural intensification trends in some regions, which may increase pressure on water resources where irrigation-dependent systems are expanded. In some Mediterranean areas, insufficient control of groundwater abstraction contributes to pressure on already vulnerable aquifers. The expansion of high-value, water-intensive crops like kiwi and avocado has raised concerns about increasing competition for water resources and impacts on traditional agricultural systems. Market incentives and changing consumption patterns may further influence land-use decisions and intensify pressure on local water availability. Furthermore, water allocation priorities favour tourism for economic revenue, harming local communities. Emerging infrastructure demands, including data centres requiring water for cooling, may create additional pressures in areas already experiencing water scarcity, although impacts seem to remain location-dependent.

Policy responses have increasingly shifted towards improving water efficiency, reuse, and demand management, although challenges remain in reducing overall water demand and addressing competing uses. Unsustainable irrigation practices can contribute to soil degradation and may affect traditional agricultural practices and cultural landscapes. Crucially, unique Mediterranean wetlands are particularly vulnerable to reduced water availability, with declining groundwater levels posing risks to wetland functioning and species that depend on these habitats.

Policy issues affecting biodiversity: Siloed (biodiversity policy efforts not connected to other domains); Dominance of instrumental value (nature is seen as a product); Neglecting indirect drivers (not considering indirect drivers like consumption patterns)

Visible impacts on biodiversity: Degradation of wetlands and soil.

Input for the inspiration tool		Output from the inspiration tool	
Underlying causes of biodiversity loss	Concentration of power and wealth	**Related transformative interventions**	Social; Value
Transformative vision by 2050	Community rights and empowerment; Spiritual reconnection and behavioural change	**Associated policy instruments**	Cultural
Challenges for transformative change	Economic and political inequalities; Unsustainable consumption and production patterns	**Related nexus governance**	Inclusive
Nexus element(s)	Biodiversity, Food, Water	**Related nexus actions**	Consume; Reduce
Others	Climate, Economy		

Related BIONEXT transformative actions:
- Use water footprint labelling for goods and services to inform consumers;
- Change water consumption patterns in various areas, including textile production, lifestyles, food waste and information technology

Policy option co-creation process: Participants were provided with outputs from the BIONEXT Inspiration Tool, particularly the transformative actions and associated policy instruments. Although cultural interventions such as education, participation, and awareness-raising were recognised as important enabling factors, participants considered that these should be complemented by, rather than precede, structural interventions. Participants highlighted that relying primarily on cultural measures risks placing responsibility on farmers and consumers, while key barriers were perceived to relate to economic incentives and regulatory frameworks. Instead, participants proposed a sequenced package of interventions beginning with economic incentives, such as subsidies for water-efficient farming practices, alongside regulatory measures, including water licensing and strengthened rights and participation of smallholder farmers. These measures would be complemented by community-based capacity building and co-creation processes, followed by cultural interventions aimed at promoting alternative farming practices, strengthening farmers' role as landscape stewards, and enhancing recognition of their contribution to sustainable land management.

Policy option(s):
- **Policy Package 1** - Economic subsidies & regulatory controls: Phase 1 to shift public funds away from industrial agriculture toward landscape management and sustainable practices.
  - **Agro-environmental subsidies**: Shift taxpayer money from free-market support to targeted agro-environmental schemes, paying farmers directly for land management and ecological services rather than just crop yield.
  - **Water licensing & rights**: Establish strict groundwater licensing and regulation frameworks to manage abstraction. Align these policies to protect and elevate the water rights of smallholder farmers.
  - **Agro-industrial reform**: Implement targeted actions to restrict or reform the power of the agricultural lobby and large industrial players who might otherwise oppose the transition to sustainable farming.
- **Policy Package 2** - Capacity building & community creation: Financial incentives are insufficient on their own; they must be accompanied by educational, cultural, and community-building efforts to guide farmers into their new roles.
  - **Stewardship guidance**: Provide practical training and guidance to help farmers transition from basic crop producers to land and water stewards.
  - **Farmer communities**: Foster a supportive, collaborative community of farmers focused on regenerating the landscape and reducing water consumption.
  - **Cultural & educational instruments**: Launch public policy campaigns to educate society on the true value of farming to the Maltese landscape and nature.
- **Policy Package 3**: Elevating farmer status & pride
  - **Social elevation**: Actively counter the local perception of farmers as "lower working-class."
  - **Recognition**: Implement public relations or award initiatives that instil respect and pride in the hard work of land management and local food production.

Appendix E. Descriptions of real-world cases

E.1. Cases 1 to 5 as examples of 5 transformative actions

(1) Nature on Prescription (Belgium): This initiative reframes everyday contact with nature as a legitimate health intervention rather than a lifestyle "add-on" (narrative Belgium, T2.4). It works by connecting patients to biodiversity-rich environments through care providers, bridging the gap between the health and environmental sectors (narrative Belgium, T2.4).

(2) Continuous Cover Forestry (Finland): This represents a shift from traditional "rotation forestry" (clear-cutting) to a management regime that maintains forest canopy to protect biodiversity and recreational and landscape values (background Finland, T2.4). It is particularly effective in peatlands where it maintains water tables and thereby reduces carbon emissions. (narrative Finland, T2.4).

(3) Herenboeren Cooperative (Netherlands): This is highlighted as a "hopeful example" of a cooperative model where farmers and consumers collaborate to recognise the necessity of biodiversity restoration for sustainable food production (focus group Netherlands, T2.2).

(4) Marine Park Management (Greece - Alonissos): In this case, transformative change occurred through a shift in local perception. Permanent residents who initially viewed the protected park as a limitation became its "protectors" through active engagement and education (interviews Greece, T2.2).

(5) Sustainable Infrastructure Management (UK): One major UK railway operator successfully shifted its mindset from viewing trees on the line as a "problem" (to be solved by cutting them down) to treating biodiversity as a valuable asset (interviews UK, T2.2). This was supported by senior leadership and legislative requirements like the Biodiversity Net Gain policy (interviews UK, T2.2).

E.2. Cases 6 to 14 as examples of 8 transformative change and its different types of interventions

(6) Stiemer Vallei, Genk (Belgium) - Economic interventions

This case is exemplary because it explicitly used formal policy shifts to restructure municipal finances and create novel economic partnerships, besides stimulating entrepreneurship and cross-societal involvement in the management of resources.

- Allocating and mobilising capital and resources: The project achieved a breakthrough through city financing innovation by pooling regular resources from various sectors (e.g., roads investments, nature management, and water-related investments). It successfully opened up a traditional funding mechanism for sewage infrastructure to support nature-based solutions (NBS). Through public-private cooperations, the city managed to increase the resources being invested in the programme.
- Developing new business models and innovations: It implemented the Stiemer Deals, an innovative co-production approach that established a collaborative governance model by involving voluntary agreements between different partners (the city services, citizens, companies, NGOs) to co-govern and co-finance the valley. This has catalysed economic development and nature-based enterprises, such as the production of Stiemer beer and Stiemer ice cream.

Policy option connection: These actions were integrated into the city's 2020 Policy Cycle, making sustainability a horizontal topic on delivery agendas across the city authority. Through the Connecting Nature exemplar, the city has been using the Connecting Nature Framework to develop and mainstream this vision through a nature-based solution lens, then to implement it in legislation and action.

(7) Landscape and Recreation Value Trade (Finland) – Economic interventions

This case is a primary example of using financial policy instruments to reorient a municipality's economy, based on tourism and timber industry, toward payments for ecosystem services.

- **Allocating and mobilising capital and resources**: The project aims to collect and distribute funds from voluntary donations (from recreational users and others) to compensate forest owners for the opportunity costs related to forest conservation.
- **Implementing market interventions**: The project piloted a Payment for Ecosystem Services (PES) scheme, a financial policy instrument where forest owners are financially compensated for voluntarily enhancing landscape and recreational values.
- **Developing new business models and innovations**: This model incentivises forest owners to offer ecosystem services rather than raw wood, creating a new source of income that supports biodiversity protection while integrating tourism and commercial forestry needs. It directly addresses the lack of sustainable funding for the opportunity costs of delaying clear-felling.
- **Shifting focus from short-term to long-term economic interests**: the PES inherently implies a shift in the economic interests, focusing on the long-term conservation of natural areas for a long-term provision of ecosystem services.

Policy option connection: Upscaling this mechanism within the EU is identified as requiring either EU support or national legislation, as well as credible and reliable organisations considered fit to run this kind of FES scheme.

(8) **Supporting urban greening and social justice in Barcelona (Spain) – Social interventions**

This case is notable for addressing nearly all categories of social transformative interventions, particularly dismantling outdated pathways and ensuring inclusion.

- **Dismantling outdated socio-economic pathways**: The city uses policy instruments to actively counteract gentrification and green gentrification—the trend where increasing housing prices and city improvement, including urban greening, excludes low-income residents.
- **Encouraging behavioural change in citizens and consumers:** This is done by involving citizens in the design and implementation of environmental-climate policies; and building citizen awareness about the value of urban greening and its benefits.
- **Ensuring inclusion and participation**: An inclusive and participatory approach is at the core of the city's greening strategy, involving residents, social groups and several organisations and stakeholders in co-designing climate solutions, in the protection and improvement of green areas. Fairness, gender perspective, accessibility and connectivity are key criteria in the greening model.

Policy option connection: Some of these actions are part of the Barcelona Tree Master Plan 2017-2037. The plan is aligned with the goal of the Barcelona Green Infrastructure and Biodiversity Plan 2020 (GIBP, adopted in 2013), recently updated with the Barcelona Nature Plan 2030; and further supported by the Stimulus Programme for promoting Green Infrastructure (Ajuntament de Barcelona, 2017), and the Tree Master Plan adopted in 2017.

(6) **Stiemer Vallei, Genk (Belgium) – Social interventions**

This project is a primary example of strengthening social resilience and inclusion through novel partnership models.

- **Ensuring inclusion and participation**: It implemented the Stiemer Deals, an innovative co-production approach that established a collaborative governance model by involving voluntary agreements between different partners (the city services, citizens, companies, NGOs) to co-govern and co-finance the valley.
- **Strengthening social resilience and empowerment**: The project features a strong co-creative approach that contributes to build social cohesion, a sense of belonging and pride, and social resilience, including diverse interventions, such as the Friends of the Stiemer programme that includes citizens and experts in soundboard meetings; a Junior Team of local schoolchildren acting

as ambassadors; fostering co-produced entrepreneurship; implementing a citizen-science-based Stiemerlab project for monitoring the water quality of the Stiemer waterway.

- **Promoting positive narratives**: The communication strategy focuses on creating visibility and pride, using education and co-creation to promote engagement and drive active participation.

Policy option connection: These interventions were integrated into the city's 2020 Policy Cycle, making sustainability and social co-creation horizontal topics across all municipal agendas.

(6) **Stiemer Vallei, Genk (Belgium) – Governance interventions**

This case explicitly transitioned from project-based management to a program-based co-governance model integrated into municipal policy.

- **Adopting alternative governance models**: The project shifted to an integrated governance model characterised by a horizontal, co-creative approach. It implemented the Stiemer Deals, an innovative co-production approach that established a collaborative governance model by involving voluntary agreements between different partners (the city services, citizens, companies, NGOs) to co-govern and co-finance the valley.
- **Establishing effective policy and governance structures for long-term change**: Sustainability and social co-creation were embedded as a horizontal topic across all delivery agendas through the 2020 Policy Cycle. It also utilised reflexive monitoring, integrating the learning process into the overall governance and implementation strategy, which has since been transferred to other major city programs. The project made faults in the work organisation within the City administration visible, and the City managed to adapt to the organisational needs of the project by restructuring working groups. The collaborative governance model was mainstreamed across other major city programmes.
- **Fostering cross-sectoral collaboration**: The project bridged multidisciplinary bodies within the municipal administration, but also managed to involve, in a horizontal and co-creative approach, authorities, citizens, NGOs, businesses and other agencies. It implemented the Stiemer Deals, an innovative co-production approach that established a collaborative governance model by involving voluntary agreements between different partners (the city services, citizens, companies, NGOs) to co-govern and co-finance the valley.

Policy option connection: These interventions were integrated into the city's 2020 Policy Cycle, making sustainability and social co-creation horizontal topics across all municipal agendas.

(9) **Wetland adaptation in Attica Region (Greece) – Legislative interventions**

This case demonstrates the successful evolution of national legislation to address the evolving challenge of wetland degradation and climate-driven droughts.

- **Creating and updating existing legislation**: A primary success factor was the evolution of the national legislation, with the law 4559 (August 2018), which officially delineates boundaries for 15 wetlands to ensure their legal protection, covering over 460 hectares of wetlands, and bans activities that might degrade the ecological status of the wetlands. This law explicitly bans any building permits, drainage or other activities that might degrade the ecological status of wetlands. Additionally, the Vourkari wetland was formally designated as a Regional Park by a Presidential Decree in 2017.
- **Developing and enforcing new regulations:** The success of the Attica Wetland Action Plan was proven by the fact that it has been used as a baseline document for the new regional programming period of the Attica Region. As a result, specific measures have been integrated in the Attica RePACC and in the regional operational Program of Attica Region 2021-2027.

Policy option connection: The Attica Wetland Action Plan integrated priority actions that were foreseen by existing legislation and fall under existing national strategic, policy and programming frameworks.

(10) **Waterevolution (Italy) – Technological interventions**

This case applies a sophisticated technological model to reshape the global maritime industry.

- **Technological Innovation**: The project pioneered a "computational sustainability" tool to evaluate sustainability elements at every stage of the production cycle. This includes a "cradle to cradle" approach to assess the whole ship life cycle -- from construction to dismantling -- to reduce environmental and energy footprints. Also, yacht designers receive support with mathematical modelling to define, compare, and assess alternative solutions along all steps of the yacht design and production.
- **Systemic Change**: It encourages shipbuilding companies to recondition their core business to embrace energy and resource efficiency, moving the industry toward ocean responsibility.

Policy option connection: The technological model was used as an evidence-based course of action to develop a cross-sectoral communication platform to facilitate discussion and build awareness about ocean issues while highlighting solutions achievable through collective effort.

(11) **Lisbon Masterplan Vale de Alcântara (Portugal) – Environmental interventions**

This case is notable for enhancing spatial planning for sustainability, as it fundamentally changed the rules of the system for urban development.

- **Enhancing spatial planning and resource management to optimise land use and efficiency:** In 2012, the city's new Master Development Plan adopted the ecological structure as the overarching guiding principle for urban land use, henceforth ensuring urban regeneration, a healthy environment and increasing the provision of ecosystem services. The project created 108 hectares of new green areas and six green corridors to improve ecological flows and landscape functions. Agriculture allotments were also integrated into the municipal ecological structure.
- **Restructuring physical infrastructures for sustainability and resilience:** The city widely increased green spaces, enhanced green infrastructure to promote active mobility, regenerated the riverfront, promoted and enhanced urban agriculture.

Policy option connection: Some of the key policies enabling change were the city's new (2012) Master Development Plan, Biodiversity Action Plan in 2016, the Biodiversity 2020 Strategy. Also, a participatory budget process was adopted to involve its inhabitants in drawing up and ranking the proposals to be included in a predetermined proportion of the city council's budget.

(12) **The Tullstorp Stream Project (Sweden) – Environmental interventions**

This case is notable for restoring an ecosystem impacted by climate change, while maintaining positive outcomes for the agricultural sector.

- **Improving the present conditions of biodiversity and establishing mechanisms for its protection, conservation, restoration, and/or sustainable use and management:** Over 50 wetlands were created or restored, and 25km of the stream were restored. Water management was improved by reducing nutrient loads to reduce eutrophication, as well as by creating multifunctional water reservoirs to store excess water and adjusting the drainage system to optimise resource use. This allows landowners and producers to grow crops more sustainably and enhances their resilience to climate changes and extreme weather events.

Policy option connection: The EU Water Framework Directive (2000/60/EC) classified the Tullstorp Stream as being in a poor ecological state and requiring significant restoration work. This enabled the Tullstorp Stream Economic Association of landowners, to initiate action and secure the approval and funding of the County Administrative Board of Skåne for it, a major funder of the project.

(13) **Autonomous adaptation in Alentejo (Portugal) – Value interventions**

This farm-based case shifts social norms around land stewardship and the ethics of food production.

- **Deep-Rooted Values**: The project is guided by the ethics of agroecology, while implementing the concepts of agroforestry, agroecology, regenerative agriculture, holistic management, permaculture and food sovereignty. The project seeks the realisation of a community that harmoniously integrates the ecosystem to which it belongs, implementing a food production model based on the respect for nature, aligned with the objectives of sustainable development and able to protect water resources in a drought-prone area.
- **Challenging Norms and mindset shift**: The goal of the various initiatives performed by the agricultural company is to improve the relationship between human actions and resources: water, soil, biodiversity, energy, science and culture, moving away from the conventional extractive agricultural status quo. Consumers are directly involved in the farm life and are considered co-producers when joining the Community Supported Agriculture scheme. While creating landscape mosaics with associated benefits for biodiversity preservation, the initiative enabled the development of sustainable tourism initiatives and is devoted to raise awareness and knowledge on permaculture, agro-ecological farming, and ecological landscape design. The farm challenges traditional land-use norms by providing free 50-year lease agreements to young farmers initiating organic projects, prioritising long-term stewardship over immediate profit.

Policy option connection: Montado is a habitat classified and protected by the European Union's Habitats Directive, it has also been recognised as a Private Protected Area, belonging to the Portuguese Network of Protected Areas.

(8) **Supporting urban greening and social justice in Barcelona (Spain) – Knowledge interventions**

This case addresses nearly all transformative change categories associated with knowledge, particularly innovating research and co-production.

- **Innovating research approaches**: The city has collaborated in several EU-funded projects to develop the Fair Urban Greening index, a novel method to assess the racial and social impact of urban greening and compare cities' performance over time and with each other.
- **Co-producing knowledge**: An inclusive and participatory approach is at the core of the city's greening strategy, involving residents, social groups and several organisations and stakeholders in co-designing climate solutions.
- **Advancing fundamental research**: Collaboration with the Barcelona Lab for Urban Environmental Justice and Sustainability to analyse the green gentrification trend.
- **Experimenting and scaling**: The project used pilots in the Barcelona Superblock program to test ideas that were then upscaled city-wide through the "Superilla Barcelona project". Close and long-term collaboration with researchers has brought science-based evidence and external funding, and expertise to implement, pilot and test different adaptation and greening measures.
- **Facilitating information sharing between diverse actors:** The participatory processes usually have information sessions and workshops open to residents, city authorities and all interested parties. Furthermore, there is a steering group in each area formed by representatives of city authorities and the City Council, which acts as permanent promoters. The municipality closely collaborates with other cities to develop appropriate policy measures to avoid gentrification and to support affordable

housing. The City Council of Barcelona is a member of several sustainability-related city networks such as C40 and Eurocities.

Policy option connection: Some of these actions are part of the Barcelona Tree Master Plan 2017-2037. The plan is aligned with the goal of the Barcelona Green Infrastructure and Biodiversity Plan 2020 (GIBP, adopted in 2013), recently updated with the Barcelona Nature Plan 2030; and further supported by the Stimulus Programme for promoting Green Infrastructure (Ajuntament de Barcelona, 2017), and the Tree Master Plan adopted in 2017.

(14) **Preventing lionfish invasion in Cyprus (Cyprus) – Knowledge interventions**

This case illustrates the powerful use of citizen science and digital tools to enable a systemic response to ecological threats.

- **Advancing fundamental scientific research to inform evidence-based solutions**: The implemented actions included the analyses of lionfish biology and distribution patterns; the formulation of a risk assessment analysis of lionfish to include this species in the list of Invasive Alien Species of Union concern (the Union list -EU Regulation 1143/2014); the development of an early detection system for lionfish with an online dedicated portal and a phone application.
- **Co-producing knowledge**: The project relies heavily on academia, but also on citizen scientists (divers, fishers, and sea users) to report sightings, which increased substantially over the project duration.
- **Facilitating information sharing**: It established a surveillance and early detection system (citizen-based monitoring) including a web GIS tracking interactive platform (Lionfish portal) and a mobile application to record sightings across the Mediterranean. This tool allows continuously updating the knowledge of the distribution of lionfish across the Mediterranean Sea, roughly estimate their abundance and ultimately give information to managers and other stakeholders to take the appropriate actions.
- **Experimenting and scaling**: It developed an Integrated Lionfish Management Guide for policy makers to set the baseline for future coordinated, multi-national efforts.
- **Innovating research approaches**: Citizen science is a key component of the initiative, based on the education and training of the community so that they can in turn contribute to building the on-site knowledge, action and reporting lionfish sightings.

Policy option connection: The project's scientific outcomes triggered changes in policies and permits to effectively remove lionfish and informed the update of EU Regulation 1143/2014.

Appendix F. Description of regional considerations

1. Central and Eastern Europe: Post-communist legacies

In regions such as **Czechia**, policy design must navigate deep-seated historical and socio-political factors:

- **Broken bonds to land**: The legacy of communist-era land reforms and collectivisation interrupted centuries-old relationships between farmers and their land (context Czechia, T2.2). Even with the re-establishment of private property, legal barriers continue to complicate sustainable land management, particularly for small farmers (context Czechia, T2.2).
- **Public sentiment and "activism"**: There is often an ingrained ideological opposition to environmental "activism" rooted in the communist past, where being too active in nature protection was viewed with suspicion (interviews Czechia, T2.2).
- **"Resortism" and governance**: A profound "resortism" (siloed thinking) among ministries and a lack of debating skills in the public sphere hinder holistic energy and biodiversity policy (interviews Czechia, T2.2; focus groups Czechia, T2.2).
- **Underdeveloped regions**: Specific areas, such as those containing former Sudeten villages, face unique developmental challenges and a lack of ownership over public affairs, requiring more localised and inclusive participation strategies (interviews Czechia, T2.2).

2. Northwestern Europe: Spatial scarcity and consensus models

In densely populated countries like the **Netherlands**, policies are shaped by high competition for physical space:

- **Mindset of scarcity**: A national identity rooted in the "battle against water" and a mindset of controlling nature through engineering often leads to a preference for technological rather than ecological solutions (narrative Netherlands, T2.4).
- **"Poldering" governance**: While consensus-based "poldering" helps bring stakeholders together, it can have a **depoliticising effect** that downplays conflict and relies too heavily on technocratic changes rather than challenging underlying power dynamics (narrative Netherlands, T2.4).
- **Intensive production "locks"**: The high intensity of the agri-food sector has led to legal "nitrogen locks" and expected "water locks," where exceeding EU environmental limits halts further development across other sectors like housing and transport (narrative Netherlands, T2.4).

3. Institutional Fragmentation: The Belgian Example

Policy implementation in federalised states like **Belgium** must account for administrative and budgetary splits:

- **The "perverse effect" of split powers**: In the health sector, preventive care is managed at the community/regional level, while curative care is a federal responsibility (narrative Belgium, T2.4). This creates a disincentive for regional governments to invest in nature-based prevention (e.g., "Nature on Prescription"), as the resulting financial savings in curative care accrue to a different level of government (narrative Belgium, T2.4).
- **Inequality in access**: Urban policies must address the fact that **access to high-quality green space** is often unequally distributed, with wealthier populations generally having better access than vulnerable groups (narrative Belgium, T2.4).

4. Northern Europe: Productivist Industry Traditions

In regions like **Finland**, the primary challenge is shifting established industrial paradigms:

- **Productivist logic in forestry**: Finnish forest policy has traditionally been geared toward maximising wood production through "rotation forestry" (clear-cutting), which is deeply embedded in professional practice, forestry education and advisory services, and mechanised infrastructure (background Finland, T2.4; narrative Finland, T2.4).
- **Structural and economic barriers**: Transitioning to continuous cover forestry—especially on peatlands—requires recalibrating harvesting machinery and reskilling workers who have been trained in clear-cut methods for decades (narrative Finland, T2.4). Furthermore, conventional rotation forestry is often financially more profitable in other than mature spruce-dominated peatland forests, and current subsidy regimes favour practices associated with rotation forestry.

5. Southern Europe: Centralisation and Local Autonomy

In countries like **Greece**, the disconnect between central authorities and local realities is a significant hurdle:

- **Central bureaucracy**: Administrative inefficiencies and delayed responses from central authorities in Athens can stall local transformative projects (interviews Greece, T2.2).
- **The value of financial autonomy**: Success in local conservation (e.g., Alonissos Marine Park) has been achieved through **self-financing mechanisms** like souvenirs and entry tickets, which provide the stability needed to maintain operations despite limited state funding (interviews Greece, T2.2).
- **Community "buy-in"**: Transforming local residents from critics of protected areas into their "protectors" requires intensive education and active representation on governance boards (interviews Greece, T2.2).