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## Executive Summary

Transformative adaptation is understood as a process that goes beyond incremental improvements and entails deeper shifts in economic, governance, and value systems that shape climate and biodiversity risks. Nature-based solutions (NbS) are considered a key component of transformative adaptation because they can simultaneously reduce disaster risk, enhance climate resilience, contribute to mitigation, and deliver co-benefits for biodiversity and social equity. Despite this potential, NbS remain underutilised and are often implemented as isolated projects rather than embedded within broader financial, regulatory, and governance frameworks. Existing evidence indicates that transformational adaptation remains limited across regions and sectors, constrained by entrenched power relations, misaligned policies, structural inequalities, and limited access to finance, knowledge, and enabling institutions.

This deliverable examines transformative policy directions and governance reforms that support climate adaptation, with a focus on the role of Nature-based Solutions (NbS) in insurance and finance. It examines whether combining insurance mechanisms with nature restoration and protection represents a shift away from approaches focused primarily on post-disaster compensation towards models that finance risk reduction and embed ecological resilience within financial systems. The report also assesses whether these solutions have the potential to scale beyond niche applications and contribute to broader changes in how societies understand, manage, and govern climate and nature-related risks.

The report is structured in two main parts. Section 1 provides a stocktaking of current policies, initiatives, and frameworks relevant to NbS in insurance and finance, with a primary focus on the European context. It reviews major reference points, including the Principles for Sustainable Insurance of the UN Environment Programme Finance Initiative, corporate social responsibility-oriented business coalitions, guidance from the European Insurance and Occupational Pensions Authority, climate- and nature-related disclosure frameworks, public involvement in hazard insurance, the IUCN Global Standard for NbS, green bond standards, the EU Taxonomy, emerging approaches such as nature credits, and the European Water Resilience Strategy. This stocktaking highlights growing recognition of NbS as instruments for risk reduction and resilience, while also revealing persistent gaps in regulatory alignment, incentives, and implementation capacity.

Section 2 presents the results of a horizon-scanning exercise that identifies three emerging trends relevant to the uptake and scaling of nature-based insurance and investment solutions. The first trend concerns the growing recognition of financial protection against climate- and disaster-related losses as a public resilience goal, driven by widening protection gaps and increasing constraints on insurability. The second trend examines the conditions under which nature is increasingly framed as a bankable and potentially insurable asset, including the internalisation of nature-related risks in financial decision-making and the convergence of metrics, verification methods, and contractual tools. The third trend relates to the expanding role of subnational actors in designing and governing place-based adaptation and risk-reduction strategies, enabled by the democratisation of climate risk intelligence and the growth of specialised climate and resilience services.



Overall, the report finds that while momentum is increasing around the integration of NbS into insurance and finance, many of the governance conditions required for transformative change remain only partially developed. Advancing NbS as a core pillar of climate adaptation will require coordinated reforms that align financial and regulatory frameworks with long-term risk reduction objectives, recognise nature as a critical asset for resilience, and ensure that benefits and responsibilities are distributed in a fair and inclusive manner. By identifying existing entry points as well as remaining barriers, this deliverable aims to support policymakers, insurers, investors, and practitioners in strengthening the role of NbS within climate adaptation strategies.



## Introduction

The history of climate action is characterized by meaningful progress repeatedly tempered by setbacks, yet over time the essential regulatory and political frameworks for both mitigation and adaptation have slowly taken shape. The global fight against climate change gained broad recognition in 1997 with the Kyoto Protocol setting a global legal precedent (United Nations Framework Convention on Climate Change (UNFCCC), 2025). Although 84 countries signed it, the U.S. withdrawal in 2001 significantly weakened trust and slowed progress (Coon, 2001). That same year, however, the Marrakech Accords established the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), marking the first dedicated financing mechanisms for adaptation (Global Environment Facility, 2010). This was followed in 2005 by the launch of the National Adaptation Programmes of Action (NAPAs), enabling least developed countries to identify and plan adaptation actions for their most urgent climate vulnerabilities. This comprises a major shift from reactive disaster response to proactive resilience planning. The IPCC's Fourth Assessment Report further emphasized that climate impacts would persist even with strong mitigation, positioning adaptation as a necessary component of climate policy worldwide (Intergovernmental Panel on Climate Change (IPCC), 2007). Later conferences, such as the 15th session of the Conference of the Parties (COP 15) in Copenhagen, highlighted the need to limit warming to 2°C, yet progress was undercut by opposing developments, including the rapid expansion of coal power in Asia during the 2010s. Momentum returned in 2015 with the Paris Agreement at COP21, the first truly global climate treaty, under which 195 countries committed to keeping warming well below 2°C and introduced Nationally Determined Contributions (NDCs) (UNFCCC, 2015). This agreement also elevated adaptation to equal standing with mitigation and established the Global Goal on Adaptation. Yet setbacks continued, including the U.S. withdrawal from the Paris Agreement in 2017 and Brazil's rollback of Amazon protections in 2019, as well as a renewed reliance on fossil fuels during the 2022 energy crisis that fueled pushback against green policies in Europe (Eurostat, 2024; Saad-Diniz & Gianecchini, 2021; Tollefson, 2017). Nonetheless, climate ambition persisted: the 2018 IPCC 1.5°C Report sparked global mobilization, and the 2021 Glasgow Climate Pact committed countries to phase down coal and increase adaptation finance.

This report addresses transformative policy directions and governance reforms supporting climate adaptation. Transformative adaptation, being at the core of this report, implies not only scaling up existing tools, but actively reshaping the economic, governance, and value systems that drive climate and biodiversity risks. This definition aligns with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES) understanding of transformative change as system-wide shifts in views, structures, and practices that address the underlying causes of nature's decline (O'Brien et al., 2025). According to the UNFCCC (2024), transformational adaptation involves modifying the fundamental attributes of natural and human systems, often by challenging existing norms and overcoming soft adaptation limits. Therefore, this report investigates policy frameworks and regulations from the angle of promoting Nature-based Solutions (NbS), which are an essential part of transformative adaptation. NbS offer a holistic approach to climate change from a disaster risk reduction, climate adaptation and climate mitigation perspectives. From



a disaster risk reduction perspective, NbS can reduce exposure and vulnerability by restoring wetlands that absorb floodwaters, preserving coastal ecosystems that buffer storm surges, or maintaining forests that stabilize slopes and prevent landslides. At the same time, NbS contribute to climate adaptation by enhancing the resilience of both human and ecological systems by supporting cooler urban microclimates, improving water retention in agricultural landscapes, and strengthening climate-resilient habitats. NbS also play an important role in climate mitigation, as healthy ecosystems such as forests, peatlands, and seagrass meadows act as significant carbon sinks, capturing and storing atmospheric carbon over long timescales. Importantly, NbS can be presented not only as climate adaptation tools, but also as instruments that respond simultaneously to biodiversity loss and social inequities, which are exactly what transformative change demands (O'Brien et al., 2025). Despite their potential, NbS remain underutilized because their implementation is shaped by underlying systemic barriers. According to a review of 1,682 peer-reviewed articles, the UNFCCC (2024) finds that transformational adaptation evidence is low across all regions and sectors, and that where transformation is occurring, it is slow and limited in scope. The IPBES Transformative Change Assessment identifies progress to be constrained by entrenched power relations, structural inequalities, misaligned policy frameworks, unsustainable consumption and production patterns, and limited access to knowledge and technologies. These challenges often prevent NbS from moving beyond project-level measures toward the deeper shifts in governance, economics, and societal values that transformative adaptation requires. In line with the UNFCCC's call for clearer evaluation of transformational progress under the Global Goal on Adaptation (UNFCCC, 2024), this report examines whether current European insurance and finance frameworks for NbS align with the depth, scale, and speed required for systemic transformation. It is within this context that the present report undertakes a stocktaking of current policies, frameworks, and initiatives in the European context, and offers an overview of emerging good practices. However, it does not aim to provide a comprehensive review of all global and European regulations, frameworks, and policies that directly or indirectly influence the implementation of NbS.

NATURANCE has advanced the concept of nature-based insurance and investment solutions (hereafter solutions), for which we have outlined the meaning and scope, articulated guiding principles, and developed shared performance and condition metrics. Here, we go a step further and examine whether the combination of insurance mechanisms with nature restoration and protection can be seen as an example of transformative adaptation, and what conditions would need to be met or developed for such transformation to materialize and scale up.

According to the IPBES Assessment on Transformative Change (2025), transformative adaptation involves *“fundamental, system-wide reorganization across technological, economic, and social factors, including paradigms, goals, and values,”* leading to deep structural shifts that address the root causes of vulnerability rather than merely its symptoms. This and similar definitions remain high-level and abstract and offer limited guidance on how transformative change may unfold in specific contexts. What counts as transformative must be understood within the distinct geographic, socio-cultural, and governance settings that shape local capacities and pathways for change. As a



result, what is accepted as transformational in one context may not necessarily be perceived as such in another, in more advanced or differently structured contexts.

Hence, the aim of this report is to gather and interpret evidence on whether the solutions we have explored truly have the potential to drive transformative change. First, we seek to demonstrate that integrating nature restoration and protection with insurance or insurance-linked schemes is a fundamental shift from practices focused primarily on compensating disaster losses, toward approaches that finance risk reduction and embed ecological resilience within financial systems. Second, we examine whether these solutions remain niche innovations, operating at the margins of how societies currently address climate and environmental risks, or whether they have the potential to scale up and achieve system-level impact that would qualify them as genuinely transformative. We argue that while implementation of these solutions may be constrained by site-specific contextual factors, the underlying principles are broadly applicable across contexts. Third, we consider whether these solutions have the potential to influence deeper shifts in values and paradigms that underpin decision-making and societal responses to risk.

To address these questions, **Section 1** reviews major recent developments and emerging practices across European and international policy and practice arenas. This section serves primarily as a **state-of-play** overview of key initiatives rather than an in-depth assessment. The cases were selected based on our assessment of their potential to influence the adoption, scaling, and institutionalization of nature-based insurance and investment solutions. **Section 2** then examines a set of **emerging trends and signals** identified across these and other related developments. These trends are considered indicative drivers shaping the prospects for broader uptake and transformative impact. We approach this analysis as a horizon-scanning exercise aimed at identifying signals of change and potential pathways toward system-level transformation, rather than as a systematic review.

Section 1 is structured along a stocktaking of current policies, initiatives, and frameworks relevant to Nature-based Solutions in insurance and finance. It reviews key reference points such as the UN Environment Programme Finance Initiative's Principles for Sustainable Insurance, corporate social responsibility-oriented business coalitions, and guidance from the European Insurance and Occupational Pensions Authority. It also examines emerging disclosure and transparency mechanisms, including the Task Force on Climate-related Financial Disclosures and the Taskforce on Nature-related Financial Disclosures, as well as the role of public involvement in hazard insurance. Additional sections address the International Union for Conservation of Nature's Standard on NbS, sustainable finance instruments such as Green Bond Standards and the EU Taxonomy, and evolving concepts including nature credits and the Water Resilience Strategy.

Section 2 is structured along three emerging trends identified through an horizon-scanning exercise. The first examines the growing protection gap for climate- and disaster-related losses and the resulting shift of insurance from a predominantly commercial product toward a public or blended public-private resilience function, driven by rising insurability constraints. The second explores the conditions under which nature is increasingly framed as an investable and potentially insurable



asset, focusing on the interaction between legal recognition of nature, the internalisation of nature-related risks in financial decision-making, and the convergence of metrics and contractual tools that enable investable and insurable arrangements. The third analyses the expanding role of subnational actors in designing and governing locally tailored adaptation and risk-reduction strategies, enabled by the democratisation of climate risk intelligence and the growth of specialised climate and resilience services. Together, these three trends provide the analytical backbone of the report and frame the assessment of whether, and under what conditions, nature-based insurance and investment solutions can emerge, scale, and endure.

Together, these two parts offer both a snapshot of the current landscape and a forward-looking assessment of what is needed to accelerate NbS uptake in practice. The findings underscore that while momentum around integrating NbS into insurance and finance is growing, many of the enabling governance conditions, such as incentive structures, regulatory alignment, and equitable distribution of benefits and responsibilities, remain only partially developed. Transformative progress will depend on coordinated reforms that recognize nature as a critical asset for risk reduction, resilience, and societal well-being, while also ensuring that transitions are fair and inclusive. By identifying where promising frameworks already exist and where further action is required, this report aims to support policymakers, insurers, investors, and practitioners in advancing NbS as a core pillar of climate adaptation strategies.



# 1. Stocktaking of Current Policies, Initiatives and Frameworks

## 1.1. Principles for Sustainable Insurance by the United Nations Environment Programme Finance Initiative

Insurance and Nature-based Solutions (NbS)<sup>1</sup> are closely interconnected, and this relationship is multifaceted. NbS can be employed in adapting to and increasing resilience against changing climate conditions, thereby reducing climate risks, and, in turn, lowering the risk that needs to be insured. A recent example involves a multinational food company that has entered into a multi-year collaboration agreement with a charitable organisation. This organisation provides farmers and ranchers with funding and support to implement NbS, thereby minimising soil disturbance, maximising plant diversity, maintaining living roots year-round, and integrating livestock (Nasdaq, 2022). This collaboration protects against supply interruptions, maximises production and increases resilience against climatic risks. As a result, the initiative benefits not only local producers and the company but also the environment.

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For all industries, even those outside the food industry, there are opportunities to adapt to changing climatic conditions and reduce climate risks through the use of nature. The insurance sector, in particular, plays a critical role in enabling such nature-based approaches by aligning risk management with sustainability goals. The Principles for Sustainable Insurance (PSI), launched in 2012 by the United Nations Environment Programme Finance Initiative, aim to close the insurance protection gap, both reducing exposure to climate risk and providing insurance coverage. The PSI explicitly address environmental, social and governance (ESG) risk by calling on insurers to integrate

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<sup>1</sup> NbS are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human wellbeing, ecosystem services, resilience and biodiversity benefits (UNEPFI, 2024).

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ESG considerations into their decision-making, and emphasis collaboration to raise awareness, manage risks and develop practical ESG-related solutions. Furthermore, the principles urge insurers to regularly disclose their progress in implementing accountability and transparency in terms of ESG risks (UNEPFI, 2012). Building on these foundations, recent proposals explore innovative ESG-aligned financial instruments such as catastrophe bonds that incentivise collective risk reduction behaviour in return for premium discounts or investor returns (D'Amato et al., 2024). These structures reflect the broader PSI vision by aligning financial flows with sustainability goals and offering flexibility to support nature-based climate resilience initiatives.

Insurance can enable and promote NbS directly, for example, by providing financial resources to NbS projects, or indirectly, by covering uncertainties associated with such projects (Linnerooth-Bayer et al., 2023; UNEPFI, 2023a). Both pathways encourage investment in NbS implementation by reducing their financial risks. These approaches are respectively addressed in the PSI's *Global Guidelines on Integrating ESG Risks into Non-Life and Health Insurance Underwriting and Insurance for Nature Positive Initiatives*. Following these guidelines, new insurance solutions for ecosystem conservation and climate change adaptation have been developed with potential for regional and global scaling. Some examples of such insurance include parametric insurance models from Mexico, Belize and areas with mangrove forests.<sup>3</sup> In Mexico, a specific insurance solution uses NbS to provide property owners and local communities with parametric catastrophe insurance, protecting coastal coral reefs from storm damage (Cambridge Institute for Sustainability Leadership (CISL), 2022; Swiss Re, 2020). In this case, insurance payouts fund reef salvage and restoration activities carried out by specialised reef brigades when storms exceed certain wind speed thresholds. A more indirect example is Willis Towers Watson's insurance solution for Belize, which combines Credit Suisse's Blue Bond with a parametric insurance policy. This insurance triggers a payout if an event is expected to cause damage of at least 20% of Belize's GDP. By being partially relieved of the debt repayment burden, the Government of Belize gains greater fiscal space to invest in disaster response and economic recovery. As part of this agreement, Belize has committed to spending a certain amount each year on conservation efforts to enhance the resilience of the Mesoamerican Reef, which protects the country's coastline. Another promising example is mangrove insurance, which is a novel approach to financing mangrove restoration and protection. This risk transfer tool provides immediate funding for post-storm repairs, ensuring rapid recovery and continuity of ecosystem services.

The PSI Working Group publishes regular reports aimed at identifying priority action areas and operationalising approaches to use NbS for risk reduction and loss prevention at different scales and levels, ranging from households to agricultural fields and nature itself (UNEPFI, 2025a). Their more recent report provides a first-of-its-kind set of tailored guidance for insurers to assess and act on their indirect exposure to nature-related issues across underwriting portfolios, with practical implications for green innovation, resilience-building, and ecosystem restoration financing (UNEPFI,

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<sup>3</sup> Parametric insurance, also known as index-based or event-based insurance, is a type of insurance that pays out a pre-agreed amount based on the occurrence of a specific, measurable event, rather than the actual losses incurred.



2025b). While not directly addressing insurance instruments for NbS, the guide highlights the co-benefits of NbS in reducing insurance premiums across product lines, including health, crop, credit and catastrophe insurance, thereby helping to close the insurance gap.

The PSI reports highlight the opportunities and the current challenges of the insurance industry and the role of nature in it. The lack of clear ownership of natural assets, the absence of enabling policies to shift attention away from unsustainable activities, the prevailing demand for short-term economic returns, and, in particular, the mismatch between beneficiaries and purchasers of insurance products. Opportunities, however, lie in the fact that NbS offer a promising way to address a wide range of societal and environmental challenges. Overall, the combined approach of nature-based risk reduction and risk transfer within the PSI framework aligns environmental and risk management objectives, while positively impacting the affordability and availability of insurance.

## 1.2. Business coalitions – Corporate Social Responsibility stream

Increasing interest in and requirements for corporate social responsibility (CSR) are driving shifts in corporate conduct and reshaping views on the purpose of business and its relationship with society and the natural environment (Grayson, 2007). The first significant step in Europe occurred in 2006, when the European Alliance for Corporate Social Responsibility (CSR Europe) was founded to serve as a political umbrella organisation to promote the European Commission's CSR initiatives (Idowu, 2013). The preparation and enactment of the Corporate Social Responsibility Directive (CSRD) further enabled opportunities for firms to report ecosystem-based or adaptation solutions as part of sustainable practices. The requirement to disclose firms' transition plans and the climate resilience of their business models and activities means, in practice, that NbS or similar adaptation measures must be described and quantified (Primec & Belak, 2022).

There are numerous ways in which environmental, social, and governance (ESG) pledges can be converted into tangible and revenue-generating practices using NbS (Caruso, 2023). Firms can directly engage with NbS in a variety of direct and indirect ways. A notable example of CSR implemented through NbS is the start-up service Hortel (Caruso, 2023), which transforms underused hotel rooftops and gardens into organic vegetable plots and biophilic event spaces. Alternatively, firms might choose to invest in NbS and use the resulting credits to reach net-zero targets. The Net-Zero Insurance Alliance was precisely an initiative launched in 2021 by the United Nations Environment Programme Finance Initiative (UNEPFI) with the aim of helping insurers and reinsurers transition their underwriting portfolios to net-zero greenhouse gas emissions by 2050. Naturally NbS would have been a core focus of this initiative that however was discontinued in 2024 (UNEPFI, 2025). Seymour & Langer (2021) map the emerging practice of financing NbS through carbon-offset purchases by companies that have set net-zero or "carbon-negative" goals. They highlight that NbS can deliver cost-effective mitigation, a potential that remains underexplored and significantly underfunded. Such joint efforts can lead to the formation of standards-aligned and climate-oriented business coalitions, shifting CSR from isolated NbS pilots to integrated, scalable,



and long-term strategies. Table 1 provides an overview of some key CSR initiatives. Seymour & Langer (2021) identify four of these initiatives to be business-led alliances that advance this transition: the Natural Climate Solutions Alliance tells firms what to buy, Race to Zero tells them when they can credibly claim it, Taskforce on Scaling Voluntary Carbon Markets defines how credits must be certified, and the Environmental Defense Fund dialogue shows how much integrity companies must demand. By plugging into this emerging “NbS operating system,” corporate alliances can finance nature-positive outcomes, while protecting against greenwashing and regulatory backlash.

Table 1 - Examples of initiatives for CSR

Initiative	Description	Basic Characteristics
Natural Climate Solutions Alliance ( <a href="#">link</a> )	A business-led initiative co-hosted by the World Business Council for Sustainable Development (WBCSD) and the World Economic Forum, that aims to scale finance for high-quality Natural Climate Solutions addressing climate change, biodiversity loss, and sustainable development.	<ul style="list-style-type: none"> <li>• Promotes credible, high-integrity Natural Climate Solutions</li> <li>• Encourages corporate demand for verified NCS carbon credits</li> <li>• Provides technical guidance, policy advocacy, and knowledge sharing</li> <li>• Aligns nature-based mitigation with the goals of the Paris Agreement</li> </ul>
Race to Zero ( <a href="#">link</a> )	A United Nations-backed global campaign that mobilises non-state actors, including businesses, cities, regions, investors, and institutions, to commit to achieving net-zero greenhouse gas emissions by 2050, in line with the goals of the Paris Agreement.	<ul style="list-style-type: none"> <li>• Led by the UNFCCC (United Nations Framework Convention on Climate Change) High-Level Climate Champions</li> <li>• Requires members to meet five criteria: pledge, plan, proceed, publish, and persuade</li> <li>• Participants join through approved partner initiatives and are subject to expert peer review</li> <li>• Emphasises science-based targets and transparent progress reporting</li> </ul>
Taskforce on Scaling Voluntary Carbon Markets ( <a href="#">link</a> )	A private-sector initiative launched by the Institute of International Finance (IIF) that aims to develop a blueprint to scale voluntary carbon markets by increasing liquidity, transparency, and integrity in support of the Paris Agreement goals.	<ul style="list-style-type: none"> <li>• Focuses on creating Core Carbon Principles for high-quality credits</li> <li>• Recommends standard contracts, clear market infrastructure, and governance</li> <li>• Engages over 50 organisations from across the carbon value chain</li> <li>• Promotes private-sector finance aligned with 1.5 °C climate targets</li> </ul>
Environmental Defense Fund ( <a href="#">link</a> )	A U.S.-based nonprofit organisation that uses science, economics, law, and partnerships to drive high-integrity voluntary carbon markets and climate solutions aligned with Paris Agreement goals.	<ul style="list-style-type: none"> <li>• Co-developer of the Carbon Credit Quality Initiative to assess credit integrity</li> <li>• Publishes buyer guidance on high-quality forest carbon credits</li> <li>• Supports Core Carbon Principles and market transparency</li> <li>• Advocates alignment with national climate targets (NDCs)</li> <li>• Engages governments, NGOs, and businesses in carbon market reform</li> </ul>



UN Global Compact – Climate Ambition Accelerator <a href="#">(link)</a>	A six-month accelerator programme run by the United Nations Global Compact to support companies in setting science-based emissions reduction targets aligned with a 1.5 °C pathway, helping them advance toward net-zero greenhouse gas emissions by 2050.	<ul style="list-style-type: none"> <li>• Open to UN Global Compact participants via local networks</li> <li>• Provides training on greenhouse gas accounting and science-based targets</li> <li>• Supports Scope 1–3 emissions reduction strategies</li> <li>• Delivered through peer sessions and online modules</li> <li>• Prepares companies to join global initiatives like Race to Zero</li> </ul>
Business for Nature <a href="#">(link)</a>	A global coalition of forward-thinking companies and conservation organisations advocating for urgent policy action and corporate transformation to achieve a nature-positive economy by 2030, aligned with the UN Global Biodiversity Framework.	<ul style="list-style-type: none"> <li>• Brings together 100+ business and NGO partners</li> <li>• Promotes the ACT-D framework: Assess, Commit, Transform, Disclose</li> <li>• Supports credible nature strategies through tools like the Nature Strategy Handbook</li> <li>• Advocates for strong biodiversity policies at national and global levels</li> </ul>
World Business Council for Sustainable Development <a href="#">(link)</a>	A global, CEO-led network of over 200 leading companies collaborating to drive system-level change toward a net-zero, nature-positive, and equitable economy by 2050 that develops guidance, tools, and policy engagement to help businesses implement sustainability at scale.	<ul style="list-style-type: none"> <li>• Focuses on six pathways, including climate, nature, and circular economy</li> <li>• Develops tools like The Climate Drive and nature-positive roadmaps</li> <li>• Engages businesses, governments, and NGOs on policy and systems change</li> <li>• Supports science-based, sector-wide corporate transformation</li> </ul>

In addition to aligning standards and financing mechanisms, business coalitions also serve as platforms for collective learning and experimentation. Through shared practices and collaborative engagement, companies refine their understanding of how to implement NbS in ways that are both credible and commercially viable. This knowledge-sharing function is especially important in fast-evolving spaces like NbS, where practical experience is still emerging and standards are being co-developed. Hübel et al. (2022), although focused on the meat industry, offer a helpful framework to understand how learning unfolds in such partnerships. They describe three phases: (i) overcoming an inhibition threshold, where firms are hesitant or uncertain about collaboration; (ii) entering a phase of positive learning momentum as mutual understanding and trust grow; and (iii) encountering mixed positive and negative experiences as more complex realities emerge. A key insight from their study is that “learning about partners” remains critical throughout the process, while “learning from partners” is often short-lived. They identify that partner-sensemaking keeps paying off even late in the relationship, eventually leading to a market-transformation effect as combined relational and technical learning can catalyse moves that reshape mainstream markets alongside niche segments.

While CSR is disclosed at the firm level, links to national plans can result in more ambitious targets being set and bigger results being achieved. An example for such an initiative can be the public voluntary programme built into France’s National Biodiversity Strategy & Action Plan (NBSAP),



where any company, NGO, or local authority could first sign a short declaration of adherence to the NBSAP's principles and then submit a tailored commitment plan describing the biodiversity actions it would carry out. Wolff et al. (2018) map a sample of 34 such voluntary corporate action plans covering the period from 2012 until 2016 that address habitat restoration, ecological land management, and invasive-species control. The actions mentioned in these action plans contain direct mitigation practices to avoid, minimise or offset environmentally polluting activities, but also comprise support practices such as knowledge generation, training, tools, governance, finance and communication that enable or scale the direct measures. France's case shows that linking company CSR pledges to the national biodiversity plan can turn voluntary commitments into implemented nature-based projects by anchoring them in a state-endorsed framework. While participation in the NBSAP's voluntary programme does not automatically trigger public funding, the requirement to submit a tailored commitment plan encourages firms to mobilise internal CSR budgets and align their actions with national biodiversity priorities. This alignment, in turn, facilitates partnerships with public authorities, NGOs, and land managers and enables corporate investments to be co-financed or complemented by existing public and EU funding streams, resulting in well-resourced and visible restoration outcomes.

It is important to stress that CSR implementation and its implications can differ widely between countries. Kang & Moon (2012) show that CSR mirrors each country's institutional framework. That is, in liberal market economies such as the United States or the UK, where firms' boards are judged on shareholder returns, CSR is framed as a competitive brand-differentiator and voluntary self-regulation; in coordinated market economies like Germany, where firms negotiate closely with employees, suppliers and unions, CSR emphasises long-term workforce welfare and supply-chain standards; and in state-led market economies such as France, where government actively steers industrial priorities, CSR is often channelled through public programmes (e.g., the National Biodiversity Strategy) and designed to advance national development and environmental goals alongside profit. Hence, the implications CSR carries on NbS can therefore vary among countries as well.

A conceptual contribution from China further illustrates how national context shapes CSR-driven NbS alliances. Ness (2015) presents a conceptual framework on how, in China, with national development priorities that aim for a socialist ecological civilisation, state guidance, carbon markets, and cross-sector collaboration can be combined to turn CSR spending into place-based NbS that both curb emissions and share prosperity. In the proposed model, corporate CSR budgets purchase domestic carbon credits generated by tree-planting projects; the revenue stays in rural areas, funding local enterprise while supplying verified mitigation units to urban firms.

Overall, when CSR moves beyond isolated firm initiatives and becomes the organising logic for business coalitions, it can unlock the scale, finance and know-how that NbS require. Coalitions share knowledge and best-practices, standard-setters safeguard integrity, and national frameworks channel private capital toward public ecological goals. The results are credible CSR commitments attracting partners; partnerships accelerating learning and investments; and well-governed NbS



delivering tangible climate- and biodiversity-positive outcomes. Leveraged in this way, CSR and business alliances are not merely complementary to NbS, they are catalysts that turn promising concepts into landscape-level change.

### 1.3. European Insurance and Occupational Pensions Authority

NbS, being integral components of urban resilience strategies, can be both protected by and financed through insurance instruments (Meyer et al., 2025). Insurers' attitudes and actions contribute to NbS implementation directly through reducing the investment risk associated with NbS by providing tailored insurance mechanisms, or insuring nature itself, or indirectly by creating incentives for NbS implementation through the offer of premium discounts to policyholders undertaking risk-reducing actions, and developing business models for products linked to NbS, such as combining climate resilience with carbon credit generation ("blue credits"), and supporting knowledge co-production by quantifying and communicating climate risk. In Europe, the European Insurance and Occupational Pensions Authority (EIOPA) recognises that NbS can effectively reduce physical climate risks (EIOPA, 2023). EIOPA is prioritizing managing sustainability risks, addressing protection gaps, fostering sustainable behaviour and sharing expertise and data on catastrophic risks. These priorities promote NbS as risk mitigation tools and underscore the role of natural assets in disaster risk reduction.

For example, in a joint work with the European Central Bank, the EIOPA recommends a "ladder approach" to risk delegation whereby coverage responsibilities are assigned across private and public sectors based on event frequency and impact level (EIOPA & ECB, 2024). Furthermore, they stress that simply extending coverage is not sufficient and that insurance must be paired with incentives for resilience, including policyholder- and municipal-level risk reduction. An example of such an approach is through mechanisms like resilience bonds and insurance-linked securities, which help insurers channel global capital towards sustainable, risk reducing urban developments, including NbS (Meyer et al., 2025).

The financial protection gap in the context of natural catastrophes refers to the difference between the total economic losses incurred by extreme weather and climate-related events and the portion of those losses that is covered by insurance or other financial risk-transfer mechanisms. In Europe, this gap remains substantial: for example, historical data show that only about 35% of the total losses caused by extreme weather and climate-related events were insured (European Insurance and Occupational Pensions Authority, 2020). EIOPA promotes insurance mechanisms that can help close this gap. It does this in several ways. First, it publishes dashboards and analytical reports that explain up-to-date information on the size, nature, and trends of protection gaps, particularly for natural catastrophes (EIOPA, 2025a). Second, in late 2024, EIOPA and the European Central Bank proposed a European approach to natural catastrophe insurance. This approach comprises two pillars, an EU Public-Private Reinsurance Scheme and an EU Fund for Public Disaster Financing. The first pillar aims to increase insurance coverage for natural catastrophe risks by pooling private risks



across the EU, while the second provides financial support for post-disaster recovery, funded by Member State contributions (EIOPA & ECB, 2024).<sup>4</sup> At the same time, the EOIPA supports risk prevention and resilience by encouraging premium differentiation based on risk reduction measures (e.g., flood barriers, NbS), and supporting insurance models that reward preventive behaviour (European Insurance and Occupational Pensions Authority (EIOPA) & European Central Bank (ECB), 2024). While the quantification of risk-reduction measures is challenging to quantify and usually place-specific, slowly exemplary cases are being established around the world, such as in the risk reduction achieved through cleaning of dry flammable forest areas and controlled burning in California, which resulted in a reduction of wildfire insurance premia (Williams et al., 2025).

Besides improving consumer understanding of risks and insurance options through public campaigns and simplified disclosures (EIOPA, 2025c), and providing regulatory guidance through issuing technical standards, guidance and best practices for national regulators, EIOPA is also developing innovative and inclusive products for bridging the insurance protection gap. For example, the EIOPA promotes insurers to reward climate adaptation through underwriting and offer premium discounts for resilience upgrades, which supports NbS implementation (EIOPA, 2025b).

In Europe, especially in countries where natural disaster insurance is mandatory, the link between insurance and NbS is already at a level that goes beyond the suggestions by the EIOPA. For example, in Spain, the Consorcio de Compensación de Seguros (CCS) provides mandatory public reinsurance coverage for catastrophic risks and shows growing interest in prevention, including nature-based approaches (Marchal et al., 2019). In France, the mandatory natural catastrophe insurance scheme is directly linked to the Barnier Fund, which finances prevention measures, including ecosystem-based solutions, using a surcharge on insurance premiums. The public reinsurer, Caisse Centrale de Réassurance (CCR), conducts in-house modelling and research to assess the effectiveness of both grey and green protective measures. Moreover, France has institutionalised knowledge sharing through the National Observatory of Natural Risks (ONRN), enabling collaboration between insurers, scientists, and public authorities to support data-driven risk prevention strategies (Marchal et al., 2019). These examples demonstrate how insurance sectors in some EU countries already act as partners and investors in ecosystem-based disaster risk reduction, going beyond risk transfer to actively support the implementation of NbS.

There are ample case studies from outside of the European Union of NbS that have been financed through insurance plans or public-private partnerships. For example, cooperation between public and private actors comprising The Nature Conservancy, the Swiss Re, the Mexican state of Quintana Roo and the Cancún and Puerto Morelos Hotel Owners Association resulted in the creation of the

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<sup>4</sup> The EU already has the EU Solidarity Fund (EUSF) in place which was established in 2002 and provides post-disaster financial assistance to EU Member States and accession countries affected by major natural catastrophes. It helps cover public costs for emergency response and reconstruction once damage exceeds a defined threshold. Note that the proposed EU Fund for Public Disaster Financing differs from the EUSF. While the EUSF offers ex-post grants, the new Fund would operate ex-ante, supporting governments in managing disaster risks through insurance, reinsurance, or other financial instruments. It is intended to complement the EUSF by promoting proactive risk management and greater financial resilience across the Union (European Parliament, 2025).



Coastal Zone Management Trust, which is financed through taxes collected from the tourism industry, purchases a parametric insurance to provide funding for rapid reef repair and restoration after having been damaged by extreme storms (Calliari et al., 2022; Kousky & Light, 2019). A broader application of this model has emerged across other sections of the Mesoamerican Reef. These efforts are supported by collaborations among public actors, conservation organisations, and private insurers, and demonstrate how parametric insurance can fund rapid ecological restoration after extreme weather events (Kousky, 2022). Another example of collaboration of private capital and an environmental NGO collaborating to reduce insured risk exposures is from Canada, where an initiative called Nature Force was formed through a partnership between Ducks Unlimited and a consortium of Canadian insurers. This initiative aims to identify and finance natural infrastructure such as wetlands and vegetated buffers for flood risk reduction in urban-adjacent areas of British Columbia, Ontario, and Quebec (Kousky, 2022).

Increased activity in the NbS insurance and financing is promoting institutional innovations that are supporting NbS. The Terraforma Risk Retention Group, which is an insurance provider owned by the U.S. Land Trusts, offers defense liability insurance tailored to the legal risks associated with conservation easements. Its structure enables premium reinvestment and more favourable terms than traditional private insurers, allowing it to support over 10 million acres of protected land (Kousky, 2022). In another example, a first-of-its-kind wildfire resilience product was developed in the Tahoe Donner community in California, where wildfires were becoming a big threat. To make their neighbourhood safer, the local homeowners' group worked with scientists and an insurance company to clear out dry, flammable plants and trees using special techniques such as thinning forest and controlled burns, a.k.a. fuel reduction, to lower the chance and scope of wildfires. The risk of a damaging wildfire being reduced resulted in residents in the area being given a much cheaper insurance policy by almost 40% (Williams et al., 2025).

These global case studies highlight how preserving forests, reefs, or wetlands can protect communities, reduce insurance costs, and close the protection gap. This evolution has been made possible by the increasing recognition of NbS in disaster risk reduction and growing dialogue between public and private actors, facilitated, among others, by institutions like EIOPA. Although Europe currently hosts fewer such examples, it is likely only a matter of time before similar success stories emerge.

#### 1.4. Task Force on Climate-related Financial Disclosures and Taskforce on Nature-related Financial Disclosures

The Task Force on Climate-related Financial Disclosures (TCFD) was launched by the Financial Stability Board in 2015 to address systemic risks posed by climate change to financial stability (Task Force on Climate-related Financial Disclosures (TCFD), 2017). The TCFD framework is structured around four pillars: governance, strategy, risk management, and metrics and targets, which guide



consistent climate-related financial disclosures. While the TCFD recommendations remain voluntary, their core principles are increasingly embedded into regulations globally.

By framing climate change as a material financial risk, TCFD has helped mainstream environmental dependencies into financial decision-making. This framing lays critical groundwork for recognising the financial relevance of nature loss and ecosystem degradation. While the TCFD focuses on climate, it creates enabling conditions for NbS by prompting companies to assess the financial implications of physical climate risks, risks that NbS can mitigate. Examples include insurance products leveraging NbS (e.g. green infrastructure for flood protection), and risk models integrating ecosystem services, such as natural infiltration reducing flood damage. Moreover, scenario analysis tools, encouraged by TCFD, facilitate comparisons between grey and green infrastructure options, increasingly demonstrating the cost-effectiveness and resilience benefits of NbS (MS & AD Insurance Group Holdings Inc., 2024). This aligns with the European Commission's R&I agenda, which positions NbS as innovation opportunities capable of delivering environmental, social, and economic value simultaneously (Faivre et al., 2017).

The global uptake of TCFD disclosures has normalised the expectation that environmental risks be treated as financially material. The TCFD is now integrated into the International Sustainability Standards Board (ISSB). Moreover, the ISSB has consolidated and built on the work of several market-led reporting initiatives comprising the Climate Disclosure Standards Board (CDSB), the Task Force for Climate-related Financial Disclosures (TCFD), the Value Reporting Foundation's Integrated Reporting Framework and the Sustainability Accounting Standards Board (SASB) (International Financial Reporting Standards (IFRS), 2025). This provides the foundation upon which the Taskforce on Nature-related Financial Disclosures (TNFD) builds. TNFD, launched in 2021, aims to develop a risk management and disclosure framework for organisations to report and act on nature-related risks and opportunities (Taskforce on Nature-related Financial Disclosures (TNFD), 2023). Its objective is to steer capital flows away from nature-negative outcomes and toward nature-positive outcomes. The TNFD's recommendations are built on the TCFD's structure and align with the ISSB's broader goals for sustainability reporting, which makes them a crucial complementary framework to the ISSB's work by providing detailed guidance for the nature-related disclosures intended to be incorporated into ISSB standards (Chartered Banker Institute, 2023; International Financial Reporting Standards (IFRS), 2023).

While voluntary, the TNFD framework is rapidly gaining traction among financial institutions and corporations. According to the World Wide Fund for Nature (WWF) (2024), the TNFD framework encourages investments into NbS in several ways. To start with, the TNFD framework bridges the information gap for investors on nature-related dependencies, impacts, risks, and opportunities. Hence, it increases investor confidence and comparability across projects. Secondly, it offers a structured approach via its LEAP methodology (Locate, Evaluate, Assess, Prepare) to help organisations assess and disclose their dependencies and impacts on nature. Third, the TNFD aligns with the IFRS - Sustainability Disclosure Standards as well as the Global Reporting Initiative (GRI). Therefore, it enables NbS projects, by reporting in TNFD-compatible formats, to communicate their



value in the same language investors and lenders use for sustainability and risk reporting. The report also addresses that the TNFD enhances risk management and adaptive governance by helping to identify both the risk to NbS projects as well as risks mitigated by them, which in turn allows for integrating nature-related risks into project governance and ensures resilience and investor confidence.

At EU level, targeted research efforts have helped develop robust assessment frameworks and demonstration projects to evaluate the performance and financial viability of NbS, providing the empirical backbone for TNFD-style disclosures (Faivre et al., 2017). This is particularly relevant for NbS, which often lack standardised financial risk-return assessments. The TNFD thus supports NbS not only by improving transparency, but also by strengthening the case for their integration into portfolios as risk mitigation assets. By promoting tools such as scenario analysis, dependency mapping, and physical risk assessment, TNFD enables identification of locations where NbS (e.g. forest buffers, mangroves, wetlands) offer high resilience value (United Nations Environment Programme Finance Initiative (UNEPFI), 2023b). These disclosures, in turn, support capital mobilisation towards NbS by reducing informational asymmetries.

In the EU, both TCFD and TNFD principles have been operationalised through the Corporate Sustainability Reporting Directive (CSRD) (European Union, 2022).<sup>5,6</sup> Companies in scope of the CSRD are required to report in line with the European Sustainability Reporting Standards (ESRS), developed by EFRAG. These standards embed double materiality, requiring consideration of both financial and impact materiality (European Commission, 2025a).<sup>7</sup> This dual lens reinforces the business case for NbS by requiring firms to disclose both how they depend on natural systems and how their operations impact them (CSR Tools, 2025).

Several ESRS standards explicitly reference NbS. For instance, ESRS E4 on Biodiversity and Ecosystems mandates disclosure of impacts on biodiversity and the ecosystem services companies rely on (CSR Tools, 2024). Such requirements elevate the visibility of NbS, especially those delivering co-benefits for biodiversity and climate resilience, such as afforestation and wetland restoration. Emerging corporate governance innovations show how disclosure requirements are being operationalised into practice. Recent research identifies four models of ‘Nature-inclusive governance’, Nature as Inspiration, Advisor, Director, and Shareholder, through which companies

<sup>5</sup> The implementation of the CSRD follows a phased approach, beginning with the largest companies. Starting in 2025, companies already subject to the Non-Financial Reporting Directive (NFRD)—primarily large public-interest entities with over 500 employees—must begin reporting in accordance with the new requirements for the 2024 financial year. In 2026, the directive will apply to all other large companies that meet at least two of the following criteria: more than 250 employees, €40 million in turnover, or €20 million in total assets. From 2027, listed small and medium-sized enterprises (SMEs) will be required to report, although they will have the option to opt out until 2028. Finally, by 2029, non-EU companies that generate more than €150 million in annual turnover within the EU and have a significant presence will also fall under the CSRD’s scope and must report for the 2028 financial year (European Parliament, 2022).

<sup>6</sup> These companies include large EU companies, EU-Listed Small and Medium-Sized Enterprises, and non-EU Companies with Significant EU Operations (Schmidt & Farbstein, 2025).

<sup>7</sup> The alignment with global frameworks such as the TCFD and TNFD ensure consistency, comparability, and transparency in sustainability reporting across environmental, social, and governance topics.



such as Faith in Nature, Patagonia, and Tony's Chocolonely have given Nature a formal role in strategic decision-making (Lambooy et al., 2024). These models complement disclosure frameworks by embedding nature directly into governance structures, thereby strengthening the organisational basis for investing in and scaling NbS

The financial case for NbS is further reinforced by evidence that over 85% of the world's largest companies and more than half of the global GDP depend directly on ecosystem services and biodiversity, underscoring the systemic financial materiality of nature loss (World Bank, 2022). By onboarding nature as a stakeholder, companies not only streamline compliance with CSRD and OECD guidelines, but also improve transparency, due diligence, and risk anticipation. This positions NbS as pragmatic instruments for meeting regulatory expectations, while enhancing corporate resilience (Lambooy et al., 2024). Together, the TCFD and TNFD, complemented by binding EU regulations such as the CSRD, are shifting corporate disclosure norms towards recognising and valuing nature-based risk mitigation. As regulatory convergence increases, NbS are likely to gain further traction as investable solutions that contribute to both financial resilience and environmental integrity.

### 1.5. Public Involvement in Hazard Insurance

The role of public involvement in hazard insurance is becoming increasingly relevant, particularly for insurances that encompass novel hazard mitigation practices such as NbS. Gamper & Turcanu (2009) argue that public participation has the potential to improve the efficiency and legitimacy of decisions concerning natural hazard mitigation, particularly where market and bureaucratic approaches alone fall short. Traditional mechanisms often struggle to account for public preferences, leading to inefficiencies or misalignments between policy actions and local needs. Participation is presented not simply as a democratic ideal, but as a tool to enhance decision-making outcomes by incorporating diverse values and fostering consensus, especially in complex, uncertain contexts. This is confirmed by Linnerooth-Bayer et al. (2005), who show through participatory modelling exercises in Hungary and Turkey that stakeholder involvement in disaster insurance design can fundamentally alter policy choices, leading to solutions that better reflect societal values and gain greater political acceptance. These findings are supported by Godschalk et al. (2003) who also address the practical challenges involved in ensuring public participation in hazard insurance. While, for example, in the case of the U.S., public input is formally required in planning processes, actual engagement often remains superficial or narrowly focused due to constraints posed by institutional structures, limited citizen awareness, and a tendency for planning agencies to prioritize technical expertise over community values.

Vari (2002) presents empirical evidence that public knowledge of emergency procedures is often limited, especially in lower-risk areas, while paternalistic attitudes among officials and weak information-sharing practices further constrain participation. Although regions with recent flood experiences show higher levels of public awareness and readiness, the broader system still relies



heavily on technical and hierarchical decision-making. Nevertheless, in the case of Hungary, she identifies that isolated local initiatives demonstrate the potential for effective bottom-up mobilization. Similar evidence can be seen from California, where in response to increasing wildfires, the local homeowners worked with scientists and an insurance company to reduce the wildfire risk through physical interventions on the forest, resulting in reduced premiums for insurance policies made available in the area (Williams et al., 2025). Hence, not only should the public be consulted on hazard insurance, but innovative approaches, that are mutually beneficial, can even arise. However, Kunreuther (2015) shows that besides the involvement of the public, the way such an involvement is framed, is also influential on the outcome. His findings underscore that formal inclusion of citizens does not necessarily lead to meaningful influence, unless accompanied by transparent goals, trust-building, and clarity about the scope of decision-making. He cautions against over-reliance on participation as a legitimizing tool and calls for a more nuanced understanding of how governance legitimacy is co-produced through both procedural fairness and substantive responsiveness.

Thaler & Seebauer (2019) particularly argue that public involvement through self-organized groups can play a complementary role to insurance systems by fostering preparedness beyond financial compensation, such as through physical mitigation and knowledge sharing. In addition, they also find that public involvement bridges trust gaps between communities and authorities, especially when institutional trust in insurance schemes or disaster support mechanisms is low. They address that low insurance uptake is often correlated with a lack of trust in government responses or insurance effectiveness, especially when past disasters led to delays or inadequacies in compensation. All of these aspects could be improved through public involvement in hazard insurance. Ceolotto et al. (2024) add to these findings by reviewing the academic and grey literature and identifying that the uptake of hazard insurance is the highest when state involvement is present, either as a co-insurer, guarantor, or regulator that mandates cover or makes it a pre-condition, such as in the case for mortgages.<sup>8</sup> Furthermore, they identify that where disaster aid is *ad hoc* and generous (e.g., Germany, Italy), households defer buying cover, which is also known as the charity hazard. An exemplary way to overcome the charity hazard phenomenon is for public insurers to steer risk reduction rather than just paying for losses. This is the case in Switzerland's cantonal monopolies, which co-finance hazard maps, enforce building codes, and invest part of premiums in local prevention works.

The *status quo* in most places of state-funded disaster compensations is among the factors affecting low public engagement in shaping insurance policies or disaster risk management. Seifert-Dähnn (2018) presents evidence from Austria that supports this phenomenon by showing that insurance uptake for floods, there, is relatively low, despite high exposure, because public aid schemes reduce perceived need. She addresses that this could be improved through mandatory insurance schemes, risk-based pricing, and stronger public communication about the limits of state compensation.

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<sup>8</sup> The authors identify Denmark's public-backed pool as the current "best performer" because it combines a state guarantee, premium cross-subsidy and clear disaster-relief rules.



However, most importantly, Seifert-Dähnn (2018) calls for better integration of insurance with adaptation measures, so that insurance does not merely transfer risk, but actively promotes resilience, which in turn can be best done through public involvement.

Insurers have a vested interest in hazard mitigation due to rising costs post-disasters and their inclusion in hazard, impact, risk and vulnerability analyses is fundamental given their expertise in risk assessment and mitigation strategies. However, Pearce (2005) also stresses that effective disaster management also requires risk communication and public awareness. Engaging the public in these processes can foster a better understanding of risks, which may indirectly influence insurance uptake by highlighting the need for protection. Therefore, public participation not only in insurance, but also in other aspects of hazard analyses, enhances risk awareness. This result could not only lead to better designed insurance policies, but also increased insurance uptake by fostering a culture of preparedness.

### 1.6. Standard on NbS by the International Union for Conservation of Nature

The International Union for Conservation of Nature (IUCN) launched the Global Standard (referred to as the “Standard” from here on) for NbS in 2020 to provide a globally recognised benchmark for designing, implementing and evaluating NbS that deliver measurable benefits for both people and nature (International Union for Conservation of Nature (IUCN), 2020). To operationalise the concept, the Standard defines eight criteria and 28 indicators, covering: 1) clearly defined societal challenges addressed through inclusive processes, 2) scale considerations (ecological, social, economic), 3) measurable biodiversity gains, 4) long-term economic viability, 5) inclusive governance and rights-based approaches, 6) equitable trade-offs and benefit-sharing, 7) adaptive, evidence-based management, and 8) integration with relevant policy, legal and institutional frameworks. An accompanying Self-Assessment Tool enables structured evaluation of NbS interventions against these criteria (International Union for Conservation of Nature (IUCN), 2025).

The Standard’s value lies in formalising what qualifies as legitimate NbS, preventing greenwashing and promoting consistency in implementation. Studies show that the Standard strengthens the credibility of NbS by introducing definitional rigour and preventing mislabelling (Sowińska-Świerkosz & García, 2022). It also supports systematic comparison and evidence generation, facilitating scaling and replication (Berg et al., 2024). Its process-oriented structure helps policymakers treat NbS as viable alternatives to grey infrastructure, thus promoting policy uptake. Moreover, its alignment with global priorities (e.g. the SDGs) reinforces the relevance of NbS within international development agendas. Beyond assessment, the framework also highlights strategic blind spots in current NbS practice. Recent applications show gaps in thematic coverage, particularly on human health, food and water security, which the framework can help prioritise for future interventions (Dunlop et al., 2024).

Use of the Standard is expanding across geographies and sectors. In marine NbS case studies, e.g. seaweed farming in Zanzibar and mangrove-integrated shrimp aquaculture in Indonesia, it helped



surface both strengths (e.g. economic feasibility) and weaknesses (e.g. governance or biodiversity impacts) (Le Gouvello et al., 2023). Similarly, in the Hindu Kush Himalaya region, the 28 indicators were used to rate NbS cases on a scale from 1 (insufficient) to 4 (strong), generating actionable insights and future implementation guidelines (Mehta et al., 2023).

In summary, the IUCN Global Standard has become a foundational reference for evaluating and improving NbS. While not a regulatory tool, it plays a critical enabling role: enhancing credibility, promoting comparability, informing adaptive management, and supporting policy alignment. Its integration into investment, planning, and monitoring frameworks is a key step towards mainstreaming NbS as robust, scalable, and outcome-oriented solutions to environmental and societal challenges.

## 1.7. Green Bond Standards

The Organisation for Economic Co-operation and Development (OECD) characterizes sustainable investment as a means to expand productive capacity, while simultaneously advancing decarbonization and preserving natural assets, fostering job creation and skills development, and ensuring equal opportunities for all (OECD, 2025). Unlocking such investments requires both adequate financial instruments and robust regulatory frameworks. Green bonds serve as a pivotal mechanism for channeling capital towards projects with verifiable environmental benefits. The Green Bond Principles (GBP), developed by the International Capital Market Association (ICMA) in 2014, provide voluntary process guidelines for the issuance, use of proceeds, project evaluation, and reporting associated with green bonds. These principles have evolved to align with the Paris Climate Agreement and related international commitments (International Capital Market Association (ICMA), 2021). Yet, despite strong growth, green bonds remain marginal compared to the overall bond market, accounting for only 0.39% of outstanding global bonds in 2018 (Deschryver & de Mariz, 2020). This underscores the importance of robust, harmonised frameworks to scale issuance volumes and credibility.

Complementing the GBP, the Climate Bonds Initiative's (CBI) Climate Bonds Taxonomy, first published in 2013, establishes eligibility criteria for climate-aligned investments across sectors. It includes sector-specific thresholds and mitigation/adaptation benchmarks, and specifies certifiable assets and activities. In addition to standardised principles, sector-specific eligibility criteria under instruments such as the Climate Bonds Standard are now increasingly incorporating NbS frameworks, particularly in agriculture, forestry, and water infrastructure. These sectoral pathways reflect a shift from narrowly defined climate mitigation to ecosystem-based co-benefits. For instance, eligible assets now include reforestation, wetland restoration, agroforestry, and nature-based watershed management solutions (Brears, 2022). Together, the GBP and Climate Bonds taxonomy provide a coherent but non-binding framework for market integrity, albeit with differences in purpose, i.e. structuring vs. eligibility as the GBP focuses on *how* a green bond is designed, issued, and managed while the Climate Bonds taxonomy addresses *what* qualifies as a climate-aligned or green investment. (Climate Bonds Initiative (CBI), 2021).



At the European level, both instruments have informed the development of the European Green Bond Standard (EuGB). Unlike its predecessors, the EuGB is legally binding and integrates the EU Taxonomy Regulation's technical screening criteria.<sup>9</sup> Subsequent implementation efforts are focused on standardised disclosure templates and pre-issuance documentation for both EuGBs and other sustainability-linked instruments (European Commission, 2025c).

The EU taxonomy identifies six environmental objectives: climate change mitigation, climate change adaptation, sustainable use of water resources, transition to a circular economy, pollution prevention, and protection and restoration of biodiversity and ecosystems. To be taxonomy-aligned, an activity must substantially contribute to at least one of these objectives, do no significant harm to the others, meet minimum safeguards (e.g. human rights), and comply with sector-specific technical screening criteria (European Commission, 2025f). Yet the operationalization of taxonomies has historically privileged mitigation activities, often marginalizing biodiversity and adaptation criteria. This bias is reinforced by broader market barriers, such as lack of supply pipelines for nature-oriented projects and the higher costs of verification and reporting (Deschryver & de Mariz, 2020). This gap underscores the importance of positioning NbS within the EuGB framework, since they simultaneously deliver on multiple objectives (e.g. carbon storage, water regulation, biodiversity gains).

The Regulation (a) establishes eligibility and procedural requirements for issuers seeking the EuGB label; (b) creates a supervisory framework for accredited external reviewers; and (c) offers optional disclosure templates to encourage broader transparency in the sustainable bond market. It outlines mandatory pre- and post-issuance obligations, including allocation and impact reporting. Unlike earlier voluntary regimes, this legally binding framework directly responds to fragmentation, high issuance costs, and risks of greenwashing identified in the literature (Deschryver & de Mariz, 2020).

The multifunctionality of NbS in delivering carbon sequestration, biodiversity restoration, water quality improvement, and disaster resilience makes them particularly well-suited for green bonds, which increasingly aim to capture multi-dimensional sustainability impacts. Green bond frameworks are evolving beyond climate-only criteria, explicitly recognising nature's capacity to deliver systemic, cross-cutting benefits across ESG categories (Brears, 2022). NbS align intrinsically with multiple taxonomy objectives, notably adaptation and biodiversity conservation, hence qualify for EuGB designation under several screening criteria (United Nations Environment Programme Finance Initiative (UNEPFI), 2024). Empirical literature confirms that EU financial instruments, including green bonds, have facilitated greater integration and financing of NbS in both urban and rural contexts (Biasin et al., 2024; van der Jagt et al., 2023). A notable example from Europe can be found in Gothenburg, where green bonds were issued by the city for environmental projects, such as green housing, green transport, tree planting and water treatment (Baroni et al., 2019). Municipalities play a pivotal role in operationalising NbS via local green bonds. Evidence shows that cities are using

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<sup>9</sup> The legislative proposal was tabled in 2021 after an extensive monitoring and consultation period, and the final regulation entered into force in November 2023.



these instruments to fund nature-integrated infrastructure, such as green roofs, permeable pavements, urban wetlands, and forest corridors, that not only align with green bond taxonomies but also offer cost-effective alternatives to traditional grey infrastructure (Brears, 2022). Project selection and fund allocation are centrally managed by the municipality, ensuring alignment with both environmental goals and transparency standards.

Despite definitional heterogeneity, green bonds have been globally deployed since the mid-2010s to support a broad array of climate-aligned projects. Issuance volumes rose sharply from US\$37 billion in 2014 to US\$594 billion in 2021, before experiencing modest correction to US\$510 billion and US\$588 billion in 2022 and 2023, respectively (Statista, 2024). With the formalisation of the EuGB framework, an acceleration in green bond issuance targeting taxonomy-aligned investments, including NbS, is anticipated across the EU and beyond.

### 1.8. EU Taxonomy

The EU Taxonomy for sustainable activities, introduced under the European Green Deal, provides a harmonized classification system to channel investments into activities demonstrably aligned with the EU's environmental objectives (European Commission, 2023). EU Taxonomy regulations has six environmental objectives at its center which are climate change mitigation, climate change adaptation, the sustainable use and protection of water and marine resources, the transition to a sustainable economy, pollution prevention and control, the protection and restoration of biodiversity and ecosystems. By establishing common criteria for sustainability, the EU Taxonomy not only enhances market transparency and mitigates greenwashing risks, but also functions as a governance tool for steering capital flows towards climate neutrality and environmental resilience (European Commission, 2025b).

As part of an ongoing work, the European Commission identified more than 80 activities compatible with the EU Taxonomy in almost all sectors ranging from forestry, to manufacturing including even the nuclear sectors (European Commission, 2021, 2022). Accordingly, investment volumes in Taxonomy-aligned activities reached €191 billion in 2022 and grew to €249 billion by May 2024. These investments were with 53% predominantly directed towards the utilities sector, and the rest being split between the industrial, energy, residential and other sectors (European Commission, 2024).<sup>10</sup>

In principle, the Taxonomy offers a critical lever for mainstreaming NbS into financial markets by providing a framework which companies can classify NbS-related expenditures within. However, NbS currently capture only a marginal share of this capital flow. One of the critical challenges is that many NbS-related activities remain poorly represented in conventional economic classifications, such as NACE, which makes their contribution to the EU Taxonomy difficult to identify and quantify (Kooijman et al., 2021). Their limited uptake is less a reflection of ecological relevance than of

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<sup>10</sup> In terms of countries of origin, Germany, France, Spain and Italy had the lead with € 114bn, € 63bn, € 60bn and € 48bn respectively.



financial architecture: diffuse revenue streams, extended investment horizons, and higher perceived risks make them less compatible with conventional return profiles (European Investment Bank, 2023). In forestry, this challenge is particularly evident since many non-productive functions, such as biodiversity conservation, water regulation, and recreational services, generate positive externalities, but lack direct revenue streams, requiring subsidies or innovative financing structures to be Taxonomy-compatible (Brožek et al., 2024).

As of 2022, there were 1 364 projects across Europe and the United Kingdom that were classified as NbS<sup>11</sup> out of which 76% comprised urban NbS (European Investment Bank, 2023). Papari et al. (2024) identify that private companies which mostly engage in agriculture, water management, and energy sectors, have become actively involved in including NbS in their daily operations, particularly urban NbS projects. These projects serve as a tool to support the companies' green activities by taxonomy-aligning their capital and operating expenditure and make the company's profile more attractive for equity investors seeking to align their portfolios with sustainable and environmentally responsible criteria. Papari et al. (2024) address that specific urban NbS are eligible for the EU Taxonomy, however these are already NbS that are incentivized through other government schemes and are recipients of corporate funding, e.g. external building greens, blue areas, and green areas for water management. By only including a few specific NbS into specific ET-eligibility criteria, many urban NbS remain underfunded (Schütze & and Stede, 2024).

Despite delivering triple economic, environmental, and social value creation, certain NbS projects are often overlooked within sustainable finance frameworks, leaving activities such as green roofs, urban parks, and ecosystem restoration underfunded due to narrow eligibility criteria (Kooijman et al., 2021). Furthermore, the EU Taxonomy misses out on the co benefits from urban NbS due to its rather restricted focus on climate mitigation and adaptation (Raymond et al., 2017). This limitation can be easily turned into an area for growth and an opportunity, by incorporating more explicitly the value of NbSs' co benefits. The European Green Deal explicitly acknowledges the role of NbS in achieving net-zero targets, but their scaling will depend on formally embedding NbS and their co-benefits into the EU Taxonomy so that they are recognized as a distinct and investable economic sector (Kooijman et al., 2021).

## 1.9. Nature Credits

Nature credits are a relatively new type of environmental credit designed to quantify, certify, and trade the positive impacts of actions that restore or protect nature. While discussions have long been in place on using market-style "credits" to finance nature restoration or introducing biodiversity offsets (which would work through compensating damage by restoring elsewhere), the shift toward credits for positive ecological gains is more recent and has gained traction following the Kunming-Montreal Global Biodiversity Framework, adopted by nearly 200 countries in 2022,

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<sup>11</sup> This also includes projects that were classified as "ecosystem restoration", "green/blue infrastructure" and "ecosystem-based adaptation".



which signalled greater political will to mobilise private finance for biodiversity (Rao et al., 2024). They are now becoming official as the European Commission has launched a “Roadmap towards Nature Credits” (European Commission, 2025d).

In theory, they are similar to carbon credits, but capture a broader range of ecological benefits beyond emission reductions. These benefits include, for example, biodiversity enhancement, water quality improvement, soil health restoration, and disaster risk reduction. In practice, the process would start with project implementation, whereby a landowner, community, or organization undertakes an action that restores or protects ecosystems. As a next step, this action would be assessed in terms of its positive outcomes for nature and biodiversity by an independent body, in line with pre-established standards. Upon assessment, the verified benefits from this action would be translated into tradeable “nature credits,” often representing a measurable unit of ecosystem improvement. These credits can be sold to companies, governments, or investors seeking to demonstrate nature-positive impact or meet biodiversity targets (Simonis, 2025).

The European Commission has outlined a clear timeline for advancing nature credits (European Commission, 2025e). An expert group is currently being established, then the Commission will conduct an EU-wide assessment of supply and demand between 2025 and 2026. Based on these findings, the group will provide recommendations to guide the development of nature credit markets. Between 2025 and 2027, the Commission will launch an EU-funded pilot project and, by 2026, adopt the first carbon farming methodologies under the Carbon Removals and Carbon Farming Regulation, including mandatory biodiversity co-benefits. The expert group will also advise on market criteria and governance frameworks, with particular attention to smallholders and small medium enterprises. In 2027, the Commission will review progress and define next steps for scaling up nature credit markets across the EU.

Since this is a relatively new initiative still under development, there is no proven evidence yet on how certain NbS have been enabled or upscaled through nature credits. However, considering that by definition nature credits would reward aspects of NbS that are currently unaccounted for, the outlook appears promising in terms of synergies. One way in which the push for nature credits can drive investment into NbS is through its requirement for robust metrics and verification systems, which are the same ingredients needed for NbS to be recognised in finance and policy. Furthermore, NbS are clearly proven to deliver significant public benefits such as flood protection, biodiversity, and recreation; however, they often lack direct financial returns. Hence, nature credits could enable the monetisation of these public benefits and help overcome this challenge.

In addition, NbS are currently financed predominantly through public funds, which significantly limits their implementation. Through nature credits, however, blended funding from both public and private sources could be mobilised, creating momentum for upscaling and expanding NbS. For example, an organisation or a farmer undertaking an NbS, in the form of a mangrove restoration project that reduces coastal flooding, could issue nature credits for the biodiversity gains and sell them to insurers or developers seeking to offset their impacts or meet ESG targets.



Most importantly, nature credits can help strengthen the business case for NbS and render them more competitive compared to grey infrastructure by enabling the accounting of co-benefits. In the current setting, stakeholders undertaking NbS do so with one main objective in mind — which, in most cases, is disaster risk reduction. Examples from earlier sections of this deliverable include mangroves for reducing flood risk or the restoration of coral reefs for mitigating hurricane impacts. However, in these examples, there is no accounting of the additional biodiversity gains created through these restoration projects. Nature credits can fill this gap and allow the monetisation of the additional co-benefits of NbS, such as biodiversity, water, and resilience, within one framework.

### 1.10. Water Resilience Strategy

The European Water Resilience Strategy (EWRS) is the European Union's cross-sector strategy to strengthen resilience of the water cycle across Europe, in view of challenges such as climate change, pollution, water scarcity, floods, droughts. It was adopted by the European Commission in June 2025, and has three core objectives which are restoring and protecting the water cycle, guaranteeing clean, affordable water and sanitation for all, and building a water-smart, sustainable, competitive water economy (European Commission, 2025g). Under the EWRS no new binding laws are proposed, but instead the full implementation and enforcement of existing EU water legislation (e.g., the Water Framework Directive, the Floods Directive, the Nature Restoration Law) is emphasized alongside regular progress tracking across Member States (Novo & Tempest, 2025). Whilst not binding, the strategy also sets targets, such as a 10% improvement in EU-wide water efficiency by 2030.<sup>12</sup>

The EWRS is particularly relevant in enabling NbS as both the regulatory measures and initiatives proposed under the strategy have NbS at their center. The strengthened emphasis on implementing and enforcing existing regulations will directly foster a policy environment more conducive to the uptake of NbS. For example, the Nature Restoration Regulation (EU) 2024/1991 is explicitly identified as a vehicle to manage water quantity and enhance resilience to droughts and floods using NbS. The EWRS enforces that Member States must integrate water and climate resilience via NbS in their National Restoration Plans by 2026. Furthermore, by 2033, all EU cities above 100,000 inhabitants must have urban wastewater management plans prioritising NbS and green blue infrastructure. In addition, several of the frameworks and initiatives envisaged for the implementation period of the strategy will directly support the integration of NbS into both rural and urban landscapes. For example, the European Commission is set out to create a Europe-wide framework, called “Sponge Facility”, to coordinate and scale up NbS that restore water retention in

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<sup>12</sup> The EWRS defines water efficiency as using water resources in a way that delivers the same service, economic output, or social benefit with less water, by reducing waste, losses, and unnecessary consumption across all sectors. Precisely, it recommends to curb demand and over-abstractions first, then improve efficiency and reuse, and consider new supply options only as a last resort (European Union, 2025).



landscapes, which directly translates into promoting sponge cities in urban landscapes (European Union, 2025).

The EWRS acknowledges the need for enabling investments into modernizing water systems and pledges to significantly scale up investment in NbS as part of EU and Global Gateway external action. In fact, according to estimates by the European Commission €78 billion per year is needed across the EU to modernize water systems, with one third of this amount currently not being met (Novo & Tempest, 2025). Therefore, the EWRS proposes several financing mechanisms and initiatives, several of which will be supported by the European Investment Bank (EIB), which is referred to as the EIB Water Programme (European Investment Bank, 2025).

The financial mechanism under the EWRS that is most prominent in terms of enabling NbS is the EU-initiative called the Water Resilience Investment Accelerator, which is designed to mobilise investment in innovative water-resilience projects. More precisely, the Water Resilience Investment Accelerator will test 20 pilot cases focused on water retention and efficient use. Consistent with Brown et al. (2022) findings that water resilience requires blended public–private investment approaches, the EWRS will mobilize more than €15 billion via the EIB Water Programme and innovative instruments such as nature credits (Etifor, 2025). An additional initiative under the EWRS will be the Green and Blue Corridors Initiative, which is envisioned to start in 2027, and support river, wetland, and coastal restoration via source-to-sea NbS. The establishment of a Water Resilience Forum, planned for 2026, will further coordinate multi-stakeholder action on NbS-based resilience and facilitate knowledge exchange across Member States and sectors.

As highlighted by Pot (2023), end-of-lifetime water infrastructure investments present critical windows of opportunity to embed long-term resilience and adaptive governance into decision-making. The EWRS builds on this logic by aligning infrastructure modernization with measures that enhance absorptive, adaptive, and transformative capacities through NbS. A detailed implementation timeline is laid out in the EWRS covering the period from 2025 until 2030. In the short term (2025–2026), the European Commission will focus on enforcement and governance measures, which include Structured Dialogues with Member States, the launch of the EIB Water Programme and Sustainable Water Advisory Facility, and the adoption of the Roadmap for Nature Credits. During the medium term (2026–2027), new technical and policy frameworks will be developed that will address drought among others management, water scarcity indicators, and the creation of the Sponge Facility. By 2027, the EU also aims to launch large-scale ecological initiatives such as the Green and Blue Corridors and complete the revision of the Marine Strategy Framework Directive. The late phase (2028–2030) will translate these frameworks into measurable outcomes, such as EU water efficiency benchmarks and national leakage reduction plans (European Union, 2025). Overall, this phased approach provides a clear roadmap that moves from governance reform and pilot initiatives towards full-scale implementation of water resilience and NbS across the EU by the end of the decade.



## 2. Emerging Trends

A central question explored in the NATURANCE project, beyond whether nature-based insurance and investment solutions have a sound rationale, is whether these instruments can flourish and endure over time, demonstrating both financial and institutional sustainability and the capacity to scale across contexts and governance levels. We have addressed this question through a semi-horizon scanning exercise, aimed at identifying and assessing favourable conditions and emerging trends that support the uptake of such solutions. A second question we sought to explore is whether nature-based insurance and investment solutions are transformative in nature, or, at least, whether the transformative changes we observe or expect to materialise can create enabling conditions that allow these solutions to emerge, become part of the mainstream, and scale.

The horizon-scanning exercise we designed for this purpose consists of several steps. **First**, through brainstorming and structured knowledge elicitation within the project team, we identified trends and tendencies that can be associated with a positive uptake of NATURANCE solutions. These trends and tendencies (signals) were then grouped into three broad categories, each further articulated into thematic threads or streams. **Second**, for each identified trend and thematic thread, we formulated robust Google and Scopus (Elsevier) search strings to systematically retrieve a broad spectrum of evidence, ranging from news articles, blogs, and grey literature (via Google) to peer-reviewed academic studies (via Scopus). The purpose of this evidence-gathering step was to test the observability and credibility of the identified signals, assess whether and how they are manifesting in practice, examine associated enabling factors and constraints, and evaluate their relative strength and maturity within the horizon-scanning framework. **Third**, with the support of a large language model (ChatGPT) and carefully designed, robust prompts, we systematically extracted and synthesised evidence from the retrieved sources, identifying arguments and findings that support or challenge the hypothesised trends and thematic threads. Finally, we synthesised the extracted evidence into concise issue texts, which are presented in Sections 2.2–2.4. The detailed source summaries underpinning these issue texts are provided in the Annex, organised by trend and thematic thread. As a caveat, the analysis was conducted on a bounded evidence set, typically comprising around 20 sources per thread (and in some cases more). For Scopus, search results were deliberately refined to yield a manageable corpus of approximately 10 peer-reviewed articles per thread. We deliberately limited the number of sources, as the objective was not to conduct a scoping or systematic review, but rather to sense emerging signals, narratives, and discourses relevant to our hypotheses within a horizon-scanning perspective. Google searches frequently returned peer-reviewed publications alongside grey literature; these were included in the analysis but treated separately from the Scopus-derived peer-reviewed stream, in order to preserve transparency and reproducibility by relying on the original search strings.

The trends are organised around three overarching narratives.

The first relates to financial protection against climate- and disaster-related damage and losses as a public resilience goal and highlights a potential transformational shift in insurance from a predominantly commercially provided financial service toward public or blended (public–private)



partnership models. A key driver of this shift is the growing challenge of insurability, as insurers withdraw from high-risk markets or significantly reshape coverage in response to rising losses increasingly attributed to climate change. The loss or reduction of insurance coverage constitutes a powerful risk transmission channel, as insurance often functions as an enabling condition for development and economic growth and is therefore a critical component of the financial and economic infrastructure.

The second trend examines why nature is increasingly framed as an investable and therefore potentially insurable asset, and under which conditions this shift occurs. Three interrelated threads stand out. First, in a growing number of legal systems, nature and ecosystems are being granted legal rights or personhood, enabling environmental harm or contract breaches to be challenged in courts and increasing enforceability for contracts linked to ecosystem protection. This remains controversial, however, as rights-based, ecocentric approaches to nature are often seen by their proponents as incompatible with financialisation. Second, and less controversially, nature-related risks are increasingly internalised in corporate and public-sector balance sheets, where biodiversity loss and ecosystem degradation are recognised as material sources of liability and value loss affecting asset valuation, creditworthiness, and insurance pricing. Third, this shift is reinforced by growing convergence around metrics, verification methods, and contractual tools, which reduce uncertainty and transaction costs and make it feasible to translate ecological risks and performance into investable and insurable financial arrangements.

The third trend relates to the growing capability of subnational actors, such as cities, regions, and local communities, to design and govern tailored adaptation and risk-reduction strategies, rather than relying solely on nationally standardised schemes. This shift is enabled by the democratisation of climate risk intelligence, which is expanding access to data, analytics, and decision-support tools and empowering local actors to understand their specific risk profiles and to design locally grounded responses, including the use of insurance and other risk-sharing instruments. Closely linked to this development is the rapid growth of climate, adaptation, and resilience services: knowledge-intensive analytical and advisory services that translate complex climate and risk information into actionable insights tailored to the needs of subnational governments and local action groups. Together, these dynamics strengthen local ownership of risk management decisions and create more flexible, context-sensitive pathways for adaptation and resilience building.

## 2.1. Financial protection has emerged as a public resilience goal

**Financial protection against damage and losses from natural, including climate related hazards and risks is a fundamental pillar of resilience at the individual, business, and societal levels.** This is why the absence of adequate financial protection, the financial protection gap, has become a central concern in public policy. The protection gap is not simply the difference between the economic losses caused by disasters and the share covered by insurance; it reflects a system-wide



weakness in financial protection that arises when low insurance penetration, affordability constraints, and uninsurability reduce society's ability to absorb and recover from disasters.

Resilience, sustainable and layered disaster risk financing, and the mobilization of private investment in risk reduction are recurring priorities across major international and European policy frameworks. The financial protection gap features prominently in the UNFCCC Global Goal on Adaptation, the UNDRR Sendai Framework for Disaster Risk Reduction 2015–2030, and the EU Strategy on Adaptation to Climate Change, among others. At the same time, public regulators are increasingly treating the protection gap as both a financial stability issue and a climate resilience challenge. In Europe, EIOPA and the European Central Bank have explored options to strengthen financial protection for households, businesses, and governments. In the United States, the Federal Insurance Office (FIO) has pursued similar work, examining how climate related risks are reshaping underwriting practices. Global initiatives such as the Insurance Development Forum complement these efforts with solutions that aim to strengthen insurability, expand access to financial protection, and promote integrated approaches to risk financing, risk reduction, and climate resilient development.

**Insurance constitutes a critical component of the financial infrastructure that underpins economic development and business continuity.** It supports investment and access to credit (e.g. mortgage lending); therefore, any reduction in insurance coverage has far-reaching consequences for economic growth, financial stability, and market confidence. Insurance absorbs shocks, stabilises incomes, and enables long term investment. Higher insurance penetration strengthens macroeconomic performance and reduces the fiscal burden on governments. For example, analysis by Lloyd's of London shows that even a one percent increase in insurance penetration leads to a thirteen percent reduction in uninsured losses and can lower government liability by up to twenty two percent. Countries with greater insurance coverage experience smaller and shorter disruptions to economic activity after disasters, whereas large uninsured losses prolong downturns, deepen economic hardship, and reduce household savings. Insurance coverage is closely linked to economic resilience and creditworthiness, mortgage lending, business investment, and financial sector stability. A wide financial protection gap is therefore a major barrier to inclusive growth and an important driver of inequality and fiscal vulnerability. Without adequate insurance, governments and households face growing financial strain that undermines confidence in financial markets and weakens the enabling environment for private investment. The gap is also a sign of insufficient investment in climate mitigation and adaptation. When protection remains low, economies risk becoming locked into a cycle of rising and eventually uninsurable losses. This creates direct risks for credit markets, capital allocation, and investor confidence.

**Increasing climate risks undermine existing insurance coverage** and widen the protection gap. Emerging evidence indicates a progressive erosion of insurability in several markets as climate-related hazards intensify and losses outpace the adaptive capacity of insurance systems. Damage and losses from extreme climate events are increasing, although unevenly across regions, as a result of rising hazard intensity, frequency, timing, and shifting spatial patterns, combined with



multilayered vulnerability and growing exposure. Insurers are responding through market withdrawal, non-renewals, stricter underwriting, and significant premium adjustments in areas where risk has become difficult or impossible to price within the bounds of affordability and solvency. This pattern is observable across multiple jurisdictions: in the United States, wildfire-exposed regions of California and hurricane-affected Florida have experienced large-scale insurer exits and an expansion of residual market mechanisms; in Australia, cyclone- and flood-prone communities face rapidly escalating premiums and declining private-market capacity; and in Europe, repeated flooding has rendered certain towns, such as Tenbury Wells in the United Kingdom, effectively uninsurable as insurers decline to renew coverage for public and private assets. These cases illustrate a broader systemic trend in which climate-driven volatility and insufficient risk-reduction investments generate spatially concentrated “insurance deserts”, with downstream implications for mortgage markets, fiscal stability, and long-term economic resilience.

**Solutions to protection gaps rely on public intervention.** Addressing this trajectory requires coordinated public intervention, including enhanced risk governance, investment in adaptation, and the development of complementary public–private risk-financing instruments. Insurance is provided through private insurers and reinsurers, fully public schemes, or various forms of public–private partnerships. Over time, insurance has evolved in many places from a purely financial service into a public policy mechanism for resilience and solidarity. Early insurance schemes emerged as voluntary individual or mutual services designed for individual protection. Regulatory frameworks were established to enable public–private partnerships, in some cases introducing mandatory participation or bundling with other financial products such as loans or mortgages. Public intervention thus served not only to create the necessary market conditions but also to address structural inefficiencies, including selective underwriting and unequal access to coverage. As the damages from extreme climate events intensify, and insurers increasingly withdraw from high-risk areas or set premiums beyond the reach of the most exposed and vulnerable groups, a new phase of public policy intervention, with governments stepping in to preserve access to financial protection, stabilize local economies, and ensure equitable risk sharing. This evolution is not unprecedented. Similar trajectories have occurred in other domains, notably health insurance, pensions, and unemployment protection, where mechanisms that began as private or voluntary gradually became pillars of public policy. In healthcare, for example, the recognition of health as a societal right led to systems based on mandatory participation (universal coverage), public subsidies and cross-subsidization to ensure affordability, and risk pooling across entire populations. This tendency of climate and disaster insurance mirrors this broader historical logic, where financial services evolve into instruments of collective resilience and social justice.

## 2.2. Nature is becoming bankable and insurable

*Nature becomes bankable when its absence is more expensive than its maintenance, and insurable when failure can be priced.*



Nature is no longer seen only as a common pool resource to be protected, but increasingly as something that can be invested in and insured. Forests, wetlands, rivers, and coastal ecosystems are recognised for the concrete services they provide, including, but not limited to, disaster risk reduction. As these benefits become more legally recognised, measurable, and traceable, they can be incorporated into financial decision-making. At the same time, growing awareness of the economic and financial consequences of ecosystem degradation is changing the way nature-related risks are understood and managed. Together, these developments are contributing to a reframing of nature and healthy ecosystems as long-term assets that justify sustained investment. This does not mean owning nature in the traditional sense; rather, it reflects a broader transformation in which legal frameworks, financial practices, and risk governance converge to make the protection and restoration of ecosystems a financially sound and insurable strategy.

This trend can be understood as the convergence of three structural threads:

- ❖ legal subjectification, which defines nature as a rights-bearing entity within legal systems;
- ❖ risk internalisation, which translates ecological degradation into financially material risks at macroeconomic and balance-sheet levels; and
- ❖ operationalisation, which provides the metrics, verification, and contractual tools required to turn rights and risks into investable and insurable arrangements.

**Seeing nature not as a property or resource but as a subject endowed with its own rights and personhood** (legal subjectification of nature).

In a growing number of legal and policy contexts, courts, legislatures, and international bodies have begun to recognise nature not merely as property or an object of regulation, but as a subject endowed with intrinsic rights and, in some cases, legal personhood (Aslanides, 2023; Gilbert, 2023; Harden-Davies et al., 2020). Across diverse jurisdictions and governance arenas, this shift has materialised through Rights of Nature (RoN) and Mother Earth–centric frameworks, guardianship and trusteeship arrangements, and the expansion of legal standing, enabling rivers, forests, and ecosystems to be represented and defended within legal systems (Köbö-Benda, 2025; NetworkNature, 2025). At least in principle, endowing nature with recognised rights fosters liability and accountability for ecosystem degradation or loss, and major enforceability of environmental remedy addresses long-standing gaps in environmental law (European Parliament, 2021; Sowery, 2024).

From a financial and economic governance perspective, proponents argue that this legal ‘subjectification’ could reshape the conditions under which nature-related financial instruments operate. Financial contracts that underpin insurance, risk-transfer mechanisms, and long-term investments require well-defined legal responsibility and enforceable obligations. Granting nature legal standing allows ecosystems to be treated as rights-bearing entities and enables legal claims, and in some cases compensation, for damage to nature (Harden-Davies et al., 2020; Ito, 2025). In this view, RoN may enable or improve investments in nature protection and restoration, as well as



support the development of insurance and risk-finance instruments by clarifying liability, strengthening fiduciary duties, and reducing legal uncertainty (Roor-Wubs et al., 2025).

However, a substantial body of literature is critical of the idea that the RoN could facilitate the transformation of nature into financial assets that are priced, traded, and invested in. Critics argue that RoN should not be absorbed into market-based frameworks that allow private actors to capture the value of ecosystem services while shifting long-term risks, liabilities, and enforcement burdens to governments and the public sector (Figueredo-Medina, 2024; Monsalve Suárez, 2021; Seufert, 2023). They fear that ‘financialising’ nature undermines the transformative intent of RoN by reinforcing, rather than restraining, extractive economic logics (Gilbert, 2023; Peck et al., 2024).

Reflecting these concerns, European policy-oriented debates call for strong rights-based frameworks before any engagement with finance. A study prepared for the European Economic and Social Committee advances the idea of a Charter of Fundamental Rights of Nature as a transformative legal framework capable of addressing the structural limitations of existing EU environmental law (Carducci et al., 2020). Rather than promoting financial instruments, the Charter is conceived as a disciplining framework that sets clear legal boundaries, duties of care, and accountability mechanisms for any future investment, insurance, or risk-transfer mechanisms. In this framing, finance is not rejected outright but is subordinated to ecological integrity, regeneration goals, and public-interest governance, preventing commodification and the shifting of environmental risk.

### **Nature-related risks are progressively being embedded within economic and financial systems.**

Nature-related risks are increasingly being internalised within economic and financial systems, as a growing body of economic, actuarial, supervisory, and financial analysis converges on the conclusion that these risks are financially material rather than external environmental externalities (EIOPA, 2025; Financial Stability Board, 2024; IFoA, 2025; TNFD, 2022). Empirical evidence shows that ecosystem degradation affects macroeconomic performance through multiple channels, including reduced productivity, disrupted supply chains, higher price volatility, deteriorating public finances, and lower long-term growth, with particularly pronounced effects in nature-dependent sectors and economies (Green Finance Institute et al., 2024; Hokyoung et al., n.d.; La Notte et al., 2025).

These real-economy impacts increasingly migrate onto public and private balance sheets, materialising as asset devaluation, stranded assets, higher credit and market risk, rising insurance claims, and growing contingent liabilities for governments and financial institutions (EIOPA, 2025; Financial Stability Board, 2024; Giglio et al., 2023). This shift is reinforced by the emergence of risk assessment, disclosure, and supervisory frameworks; notably TNFD, Solvency II/ORSA, NGFS-aligned stress testing, and actuarial guidance; that explicitly frame physical, transition, and liability risks related to nature as financially relevant and increasingly subject to oversight, even as data gaps and methodological challenges persist (Climate Financial Risk Forum (CFRF), 2024; IFoA, 2025; TNFD, 2022; Thomasson, 2025).



Within this evolving paradigm, ecosystems are increasingly understood as macro-critical assets whose integrity underpins economic resilience, shock absorption, and financial stability, and whose degradation amplifies systemic risk and non-linear losses (EIOPA, 2025; Financial Stability Board, 2024; Green Finance Institute et al., 2024). Therefore, investments in ecosystem protection and restoration are framed not only as an environmental objective but as a financial risk-management and loss-avoidance strategy, capable of reducing future insurance losses, preserving insurability, stabilising asset values, and supporting public–private risk-sharing and risk-transfer mechanisms (IFoA, 2025; TNFD, 2022; Thomasson, 2025). However, the literature remains ambivalent and partly critical: while nature-positive investment and insurance mechanisms may mitigate risk, their effectiveness depends on robust governance, regulation, and public intervention, and there is concern that market-based approaches may repackage ecological risk without addressing underlying drivers of degradation or systemic exposure (te Kaat & Raabe, 2025; Zu Ermgassen et al., 2025).

While the recognition of nature-related risks within financial and economic balance sheets suggests a durable and transformative change, the practical impact may remain under expectation and largely reactive. Persistent data gaps, uncertainty surrounding non-linear ecological change, and weak alignment between financial incentives and public policies can limit the translation of risk recognition into effective risk reduction.

**Nature and ecosystems are increasingly rendered measurable, verifiable, and contractible through metrics, monitoring, and performance-based approaches.** Nature-based solutions, ecosystem service assessments, biodiversity integrity indicators, and digital monitoring tools allow aspects of ecosystem condition and performance to be observed, analysed over time, and reported, i.e. operationalised. This makes it possible that legal obligations toward nature are translated into enforceable contracts and nature-related risks are priced, transferred, and managed through financial and insurance mechanisms. By defining performance thresholds, trigger conditions, and verification processes, it becomes possible to link insurance coverage, investment decisions, and credit conditions to ecosystem health or performance. What becomes investable or insurable is not nature itself, but those dimensions of nature that governance systems succeed in stabilising, monitoring, and making accountable. At the same time, this shift raises important governance questions about which dimensions of nature are measured, who sets the standards, and how ecological integrity is safeguarded as ecosystems become increasingly embedded in financial and risk management frameworks.

### 2.3. From centralised management to place-based risk governance and agency

*As risk knowledge becomes more widely accessible and governance becomes more place-based, success will depend on the capacity to turn risk intelligence into coordinated action and sustainable risk-sharing solutions.*



Advances in risk data availability, analytics, and climate intelligence are lowering barriers for a wide range of actors to access, interpret, and use information on climate and nature-related risks. This democratisation of risk knowledge paves the way for designing tailored solutions that reflect local exposure, vulnerability, and adaptive capacity, rather than relying on nationally standardised approaches. As a result, subnational actors such as cities and regions are acting as promoters of customised risk management arrangements, including negotiated or mutual insurance schemes and integrated resilience strategies. Climate, adaptation, and resilience services play a growing role as intermediaries, brokering understanding of climate- and nature-related risks and fostering risk management agency by linking analysis to actionable solutions. Insurance and finance become tools within a broader governance process, supporting locally driven adaptation, resilience investment, and collective risk-sharing rather than operating as standalone financial instruments.

This trend reflects the convergence of three structural threads that together are reshaping how climate and nature-related risks are governed and managed:

- ❖ The growing availability and accessibility of risk data, analytics, and climate intelligence enable a wide range of actors to understand, anticipate, and manage climate and nature-related risks in context-specific ways, moving beyond nationally standardised, expert-driven assessments.
- ❖ As access to risk intelligence expands, cities and regions increasingly take ownership of risk management decisions, designing and negotiating tailored risk-sharing, insurance, and resilience solutions aligned with local priorities and capacities.
- ❖ Acting as intermediaries, climate, adaptation, and resilience services translate risk knowledge into actionable strategies, support co-design and implementation of solutions, and integrate insurance and finance within locally governed resilience pathways.

**Advances in data availability, analytics, and climate and nature intelligence are transforming how risk information is produced, accessed, and used**, shifting away from domain-specialised institutions toward more accessible, participatory, and place-based knowledge systems. Increasingly open, interoperable, and user-oriented datasets and tools are lowering technical barriers for public authorities, communities, and private actors to engage directly with climate- and nature-related risk information. This trend is reflected in policy-relevant tools such as FAIR-aligned disaster data infrastructures supporting interoperable risk assessment (Song & Li, 2017), AI-enabled early warning systems which integrate Earth observation, socioeconomic data, and user feedback into localised, impact-oriented warnings (Reichstein et al., 2025), and co-created dashboards designed that translate complex urban resilience data into actionable insights for municipal decision-makers and communities (Villani et al., 2023). This *democratisation of risk knowledge* allows risks to be assessed in context, explicitly combining scientific data with local and experiential knowledge on exposure, vulnerability, and adaptive capacity. This is exemplified by real world labs that enable scientists, public authorities, and local stakeholders to co-define risk challenges and response options (Parviainen et al., 2023), and by locally led adaptation practices where



communities produce and apply climate risk information to support planning and investment decisions (Global Center on Adaptation, 2025). As a result, risk is no longer understood solely through centralised models or expert-driven assessments, but through shared and place-specific intelligence that can enhance relevance, legitimacy, and uptake in decisions on preparedness, land use, infrastructure, and adaptation pathways (Shaw, 2025; United Nations Disaster Risk Reduction (UNDRR), 2019).

In Europe, the [EU Mission on Adaptation to Climate Change](#), a flagship initiative under the Horizon Europe Framework Programme, is an example of a transformative research and innovation programme that embraces the democratisation of climate risk knowledge. Within the Mission, national and subnational public authorities work side by side with research and innovation institutions as equal partners to enhance Europe's resilience to climate risks and shocks. Serving as the innovation arm of the [EU Strategy on Adaptation to Climate Change](#), the Mission sets out bold objectives focused, inter alia, on empowering Local and Regional Authorities (LRAs) with tools and knowledge to access, interpret, and apply climate risk data, methods, and tools, thereby enabling the design and implementation of robust, science-informed adaptation strategies and investments. To support this ambition, the [CLIMAAX](#) project (Climate Risk and Vulnerability Assessment Framework and Toolbox, 2023 - 2027, Grant Agreement No. 101093864) has developed an advanced, open-source and open-access framework and toolbox for Regional Climate Risk Assessment (R-CRA), hosted by the European Centre for Medium-Range Weather Forecasts (ECMWF). In parallel, the project has provided cascading funds to a transparently selected, merit-based group of LRAs, along with targeted guidance and technical assistance to support the effective use of the toolbox in identifying and analysing key climate-related vulnerabilities and risks.

However, open access and digital systems can exacerbate rather than reduce pre-existing inequalities where data literacy, connectivity, or institutional capacity are uneven (MacManus et al., 2024; Song & Li, 2017). Participatory processes may be resource-intensive and unevenly representative if power asymmetries are not explicitly addressed (Marchetti et al., 2025; Villani et al., 2023). AI-driven or model-intensive approaches may introduce biases, obscure assumptions, or re-centralize authority through proprietary platforms and data governance arrangements (Modafferi et al., 2025; Reichstein et al., 2025). The trend towards the democratisation of risk knowledge and intelligence is real but uneven: it delivers clear benefits when openness is coupled with co-production, capacity building, and inclusive governance, but remains fragile and contested where digital divides, governance constraints, and entrenched power relations persist (Government Office for Science, 2012; Wong-Pérez et al., 2022).

**As access to climate risk data and analytics expands, cities, regions, and other subnational actors are taking on a more active role in governing climate- and nature-related risks**, moving beyond implementation toward partial ownership of how risks are framed, prioritised, and addressed. Rather than relying exclusively on nationally implemented and standardised instruments, subnational policy actors increasingly promote tailored, place-based solutions that reflect local



exposure, vulnerability, and development priorities, as seen in city- and inter-municipal adaptation planning, collaborative spatial risk governance, and regionally coordinated resilience programmes (Barquet et al., 2024; D’Onofrio et al., 2023; Radmehr, 2025; Schindelegger, 2019). In a smaller but growing number of cases, this also applied to risk-sharing and insurance-related arrangements, including locally governed trusts purchasing parametric insurance for ecosystem protection (Beck et al., 2019), municipal adaptation investments linked to insurance premium incentives (Marchal et al., 2019), and meso-level pooling mechanisms where local authorities, cooperatives, or intermediaries act as aggregators within broader resilience and social protection strategies (Mirwald et al., 2025). These approaches differ from nationally standardised schemes by permitting greater flexibility in design, governance, and use of payouts, and by embedding insurance within wider adaptation pathways rather than treating it as a stand-alone recovery tool. However, this trend remains uneven and still emerging: while subnational entities increasingly own risk governance processes; that is planning, coordination, and implementation; formal authority over insurance regulation, affordability, and large-scale pooling largely remains national, and locally negotiated mutuals or durable subnational pools are still the exception (International Association of Insurance Supervisors, 2025; Trell & Van Geet, 2019; Wamsler, 2016). The trend points toward greater subnational ownership of risk management solutions, delivering more responsive and context-sensitive outcomes where local capacity, financing, and mandates align, but remaining constrained by fiscal limits, regulatory frameworks, and equity concerns where decentralisation outpaces institutional support.

**Climate, adaptation, and resilience services are playing an increasingly central role as intermediaries in this evolving risk governance landscape.** Beyond providing data and analysis, these services support actors in translating risk information into actionable strategies and concrete solutions. By facilitating co-design processes, linking risk assessments to investment and insurance options, and supporting anticipatory planning, they help build the capacity of local and regional actors to act on risk. In doing so, these services foster risk management agency, enabling insurance and finance to function as tools within locally driven resilience pathways rather than as externally imposed or purely technical instruments.



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