



WHITE PAPER

TACKLING THE INSURANCE PROTECTION GAP

Leveraging climate mitigation and nature to increase resilience

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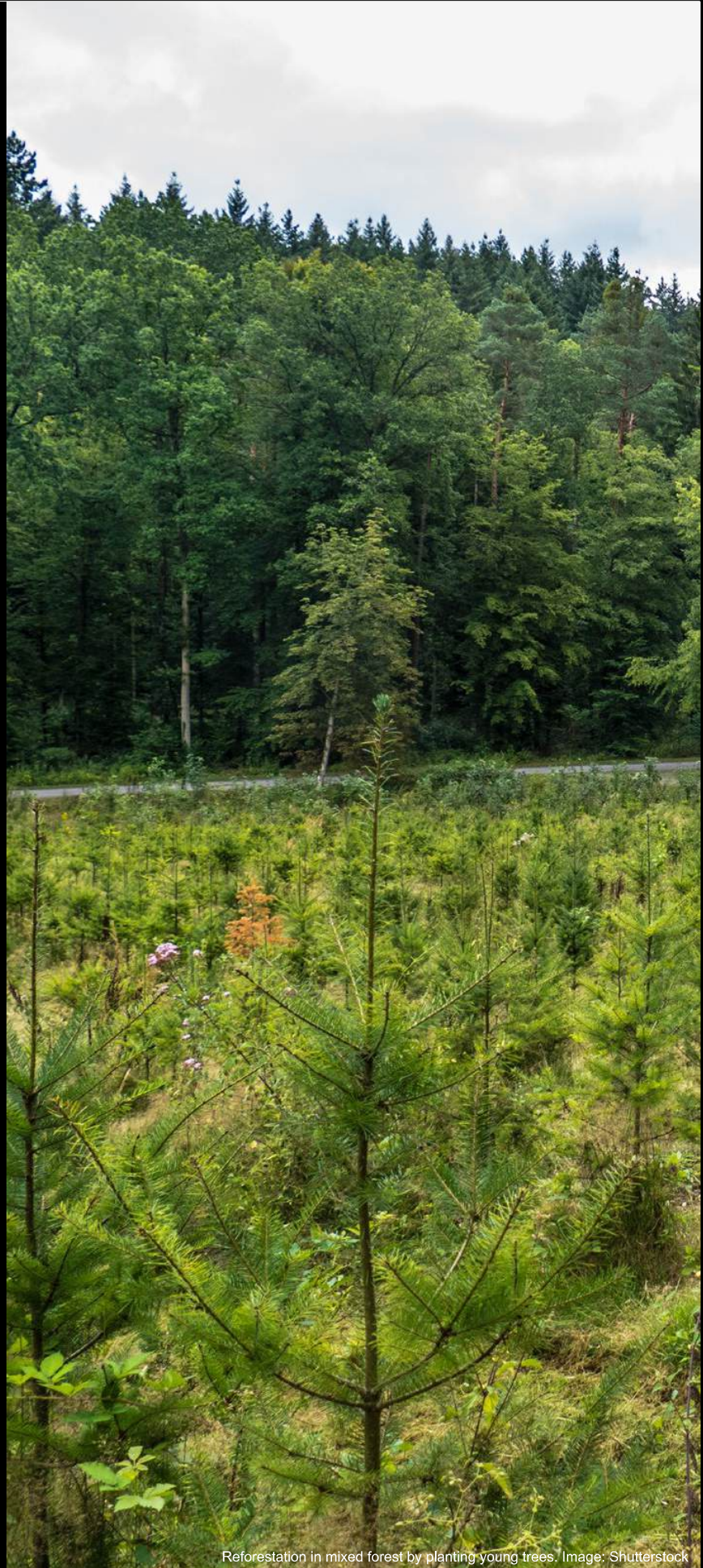
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Cover Image: Major landslide and flooding in the Blessem district of Erfstadt, Germany, during the 2021 floods. Image: ©Daniel Schlich

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The mission of WWF is to stop the global destruction of the environment and shape a future in which people and nature can live together in harmony. In order to fulfil this mission, WWF is dedicated to preserving global biodiversity. WWF also fights to reduce the use of natural resources to a sustainable level. In order to meet its objectives, WWF works at four levels: in the field, with companies, in the political arena and with the population. WWF regularly performs company ratings and thus assesses the sustainability performance of companies in important sectors.



Reforestation in mixed forest by planting young trees. Image: Shutterstock

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Effects of Storm Alice in Paiporta, Spain. Image: © Brais Lorenzo

EXECUTIVE SUMMARY

This report analyses how climate change and nature loss are undermining insurability widening the global insurance protection gap and sets out policy solutions to strengthen resilience for households, businesses and governments. It is directed at governments, policy makers, financial regulators and the insurance sector, highlighting the need to address the root causes of risk – climate change and nature loss – to ensure societies remain insurable.

Modern economies depend upon insurance as a cornerstone for economic development and financial stability. By enabling the transfer of risk, insurance protects households and businesses from financial shocks, supports faster and fairer recovery after disasters, and underpins long-term investment.

INCREASED TEMPERATURES AND THE DEGRADATION OF NATURE ARE DRIVING ECONOMIC LOSSES

The climate and nature crises are rapidly undermining the foundations of the insurance system. Extreme weather events are becoming more frequent and severe. Degraded ecosystems are less able to mitigate their impacts – for example, the risk of a large-scale flooding event can increase by as much as 700 per cent in areas of widespread deforestation.

This results in growing economic losses. Globally, the UN Office for Disaster Risk Reduction estimated the costs of disasters in 2023 at around US\$2.3 trillion (i.e., about 2 per cent of global GDP), when indirect costs and ecosystem costs are accounted for.

CLIMATE AND NATURE RISKS CONTRIBUTE TO THE INSURANCE PROTECTION GAP

As losses caused by extreme weather events and chronic hazards like sea-level rise mount, the gap between total economic losses and the amount of those losses covered by insurance – what we term the climate insurance protection gap – is growing. This is leaving more people and businesses exposed to increasing risks. Conservative estimates of this protection gap averaged US\$64 billion per year (over 2021-2024) in the US and €59 billion per year (over 2021-2023) in the EU.

The insurance gap is an even more serious problem in developing economies, where it stands at above 90 per cent. However, given the different challenges they face, this report focuses on analysis of and recommendations for developed countries.

Traditional models of insurance are struggling to respond and cannot provide the necessary coverage for increasing risks without government intervention, even in countries with traditionally high insurance penetration. With a changing climate, past data can no longer reliably forecast future losses, creating a challenge for insurers who use historical trends to assess and price risk. Climate risk is also affecting wider and different geographic areas, creating new vulnerabilities for often unaware populations and businesses.

Escalating climate losses are straining the ability of insurers to provide affordable coverage. Insurers are responding to their microeconomic incentives by increasing premiums for property and casualty insurance, reducing the coverage they are prepared to offer or withdrawing entirely from high-risk areas.

HEALTHY ECOSYSTEMS STRENGTHEN RESILIENCE

Intact and healthy ecosystems such as wetlands, forests and mangroves provide vital services, including water purification, climate regulation and soil stabilization. By acting as regulators and buffers, reducing flood, heat and storm impacts, they can save lives and billions of dollars in damages.

Nature-based solutions often offer cost-efficient opportunities for risk mitigation. In Switzerland, for instance, the protective function of forests is valued at around CHF4 billion (US\$4.5 billion) annually and protecting forests can be up to 25 times more cost-effective than equivalent technical measures.



A flock of pied avocets in flight above a wetland nature reserve at Wallasea Island, Essex, UK. Image: Adobe Stock

“The insurance protection gap leaves people vulnerable as extreme weather events hit people hard. Half of climate-related losses globally, and more than 90% in developing countries, are uninsured. This is no longer just an insurance market issue, but a systemic threat to people’s livelihoods, economic resilience and even financial and fiscal stability.”



LAURENCE TUBIANA,
SPECIAL ENVOY TO EUROPE FOR COP30

For example, in the UK, the average cost per weather-related claim increased by 73 per cent between 2018 and 2023, driving premiums to new peaks. On the other side of the globe, 15 per cent of Australian homeowners are spending over a month's income on annual premiums. Overall, insurance premiums for American homeowners rose on average 38 per cent between 2019 and 2024, almost twice the rate of inflation.

The impacts of climate change and nature loss are felt across all parts of the insurance sector – not just on homeowner insurance:

- Climate litigation is on the rise and is cascading into **liability insurance** and the wider insurance system.
- As extreme weather intensifies, the cost of **business interruption insurance** is increasing, although business interruptions resulting from damage to infrastructure or supply chains are often not covered.
- Climate and nature hazards damage **public infrastructure and natural assets** severely, while these assets are often not formally insured. Without adequate public funds and efficient deployment processes, their recovery is slowed.
- Climate and nature crises are driving agricultural losses, in turn pressuring often highly subsidized **agricultural insurance systems**. Large protection gaps, especially in Europe, are undermining recovery and future harvests.
- Rising temperatures are affecting health in many ways. Increasing mortality and decreasing productivity eventually lead to higher **health (insurance) costs** and, where available, **social security payments**.

Higher premiums or widening gaps in insurance protection are leaving people, businesses and governments with higher bills and/or less protection from damage to physical assets.

INCREASING LOSSES AND PROTECTION GAPS HAVE FINANCIAL, ECONOMIC, SOCIAL AND FISCAL CONSEQUENCES

The combined effects of extreme weather and protection gaps on income, asset prices, credit and mortgage markets, and public finances threaten economic and financial stability, prosperity and social cohesion.

How insurers underwrite and price risks from extreme weather events has systemic consequences that extend far beyond the insurance sector. There are numerous channels by which climate-related risks to the real economy and financial stability can be transmitted from the insurance sector. These include direct physical impacts on assets and infrastructure, indirect effects through insurance and credit markets, and broader macroeconomic feedback loops:

- Climate and nature risk is **reshaping mortgages and real estate markets**. Lenders typically require insurance before they write mortgages: if insurance is unavailable or unaffordable, mortgages may become unavailable. There is also a direct link between climate risk, lack of insurance and adverse mortgage outcomes: abrupt premium increases and insurance policy non-renewals significantly increase mortgage delinquency rates.
- Extreme weather events reduce **household income** through various mechanisms, especially when losses are not insured. Without insurance, extreme weather

events can translate into lasting destruction of inter-generational wealth.

- Climate-driven insurance pressures can threaten **business growth and competitiveness**. Commercial loans and investment arrangements usually depend on adequate insurance coverage. Insufficient insurance coverage for businesses could thus make credit more difficult to obtain, leading to knock-on impacts on the economy.
- The protection gap eventually **increases the financial burden for the public to shoulder**. Extreme weather events affect government budgets through the direct costs of public aid for response and recovery, indirect costs through publicly supported insurance schemes and increased public spending on disaster prevention and infrastructure. In addition, damage to nature is often overlooked and underfunded, with costs for restoration mostly absorbed by taxpayers.
- **Prevention delivers greater value than post-disaster relief and insurance payments**. A 2024 economic study by the US Chamber of Commerce found that every dollar spent on climate resilience and preparedness can save communities up to US\$13. Similarly, a report from the UK concludes that every £1 invested in flood risk management prevents £8 of damages, including £3 in direct savings to the government.
- Losses from extreme weather events and chronic climate hazards create **lasting economic damage**. A lack of insurance significantly slows recovery and growth, which can put a strain on public budgets, as they reduce the volume of taxes that can be collected.
- Through their effect on public finances, climate and nature risks and protection gaps increase **public debt and undermine sovereign creditworthiness**. This can crowd out essential investments in climate adaptation.



Forest fires in Var region, France 2021. Image: © Daniel Vallauri / WWF -

These economic impacts amplify social and political risks. The effects of climate change and nature loss disproportionately affect vulnerable communities. Marginalized and lower-income groups tend to be less insured, further amplifying existing socio-economic and ethnic inequalities. A lack of economic resilience in the face of extreme weather also increases migration. Deepening inequality and migration can add to political tensions and undermine political institutions.

All these consequences occur in an interconnected global economy where uninsured climate- and nature-related risk transmits to credit risk and the banking sector. Insurance companies can be affected on both sides of their balance sheet when companies or government default. Shocks diffuse across borders, with global (re)insurance companies often headquartered outside the most affected areas, while losses can cascade through supply chains and global trade, amplified by insufficient commercial insurance penetration.

GOVERNMENTS ARE BEGINNING TO ACT, WHILE NEGLECTING ROOT CAUSES

There is growing recognition among governments and supervisory bodies of the implications of the expanding protection gap, and they are taking measures to reduce it.

These include:

- **Publicly supported insurance schemes**, or public-private insurance arrangements, to cope with the growing difficulty of insuring extreme weather events. Such insurance schemes may struggle with rising costs, and they are not always carefully designed so as not to undermine risk mitigation through misaligned price signals and incentives.
- **Increasing supply of and/or demand for insurance** to provide some level of cover against climate risk. Governments are increasingly making insurance compulsory, while affordability concerns have prompted them to intervene more actively in insurance pricing. They are seeking to improve risk transparency through hazard mapping and disclosure requirements.

- **Taking measures to increase risk prevention and resilience** by updating building codes to strengthen buildings against climate-related hazards, updating zoning regulations to prevent development in high-risk areas and drawing up national climate adaptation strategies. However, public investment remains far below what is required to limit escalating climate-related losses.

However, efforts to strengthen financial resilience and climate adaptation are not matched by sufficient reductions in GHG emissions or by robust measures to protect and restore natural ecosystems to contain the escalating risks. Trying to address the insurance protection gap while emissions continue to rise steeply and ecosystems are further degraded is like fighting a fire while simultaneously adding fuel to the flames.

In addition, central banks and financial supervisors are increasingly acknowledging the challenges posed by the widening protection gap and are seeking to encourage action by the entities they oversee. Most common measures include additional research into the protection gap and its implications, as well as additional regulatory requirements for climate risk disclosure and management by regulated entities.

Despite this progress, current responses by governments and financial regulators are incomplete and, even if implemented fully, are unlikely to close the protection gap.

WWF PROPOSES A STRATEGIC APPROACH TO REDUCE THE PROTECTION GAP FOR THE BENEFITS OF PEOPLE, NATURE, BUSINESSES AND GOVERNMENTS

Given the above, WWF, with an advisory group comprised of representatives from the insurance industry, academics and an insurance regulator, has drawn up the following recommendations for public actors to tackle the insurance protection gap strategically. Such an approach includes strategies to reduce disaster risk and increase resilience, addressing the root causes of increasing risks and using the capabilities of the insurance sector.

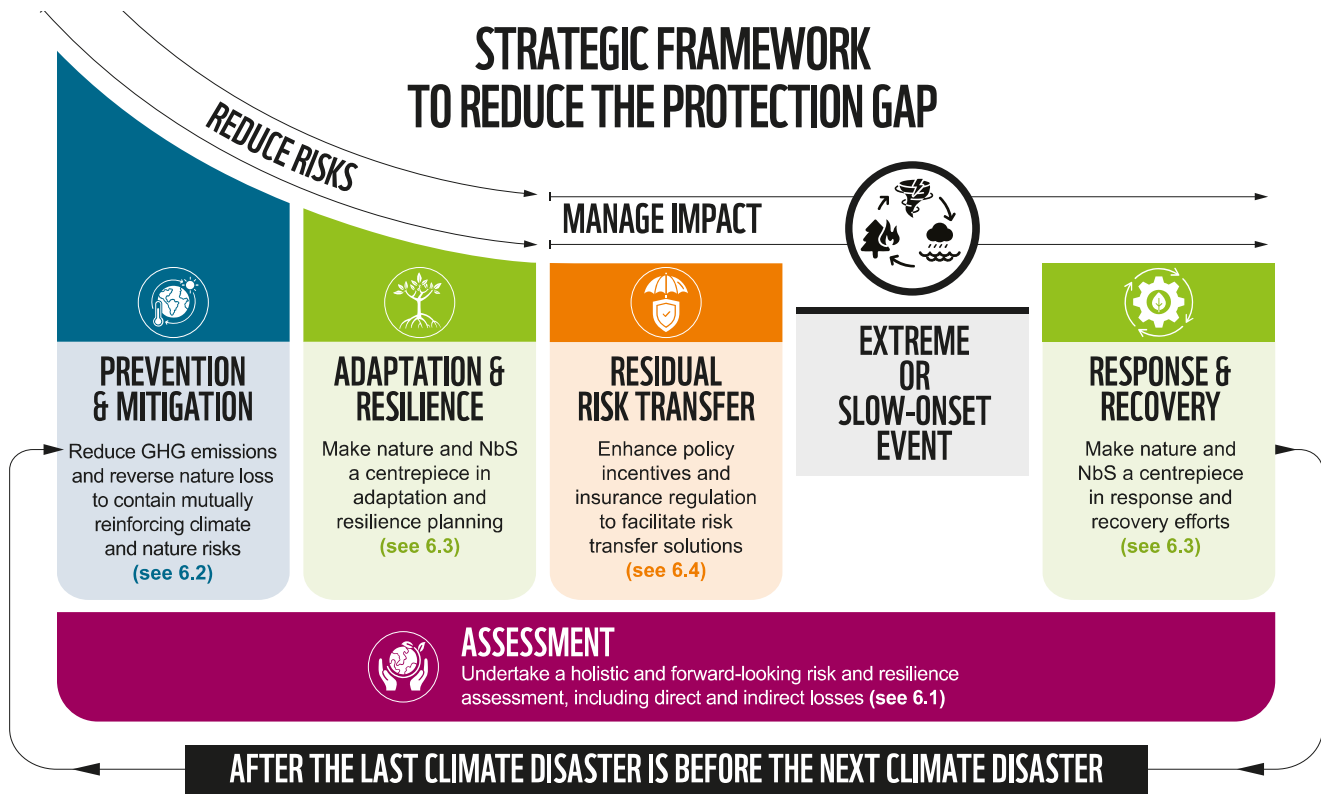
“The exponentially growing losses and damages from extreme weather events that are undermining the insurance market are caused both by increasing temperatures and the destruction of ecosystems that are protecting us. Forests, mangroves or wetlands are crucial for reducing the devastating impact of these extreme events and therefore need to be at the heart of the strategies to increase our resilience and keep regions insurable.”



KIRSTEN SCHUIJT,
DIRECTOR GENERAL OF WWF INTERNATIONAL



Schwachat river canal after a severe flood in Baden, Austria, where a high canal protects houses from water. Image: Adobe Stock



Adapted from J. A. Richards, (2022). After the last climate disaster, is before the next climate disaster. The Loss & Damage Collaboration.

RECOMMENDATIONS:

1. Conduct holistic and forward-looking risk and resilience assessments.



- Reflect climate change, nature loss and the insurance gap, and capture both individual institutions and systemic exposures and adopt a precautionary approach
- Incorporate insurance dynamics and co-benefits into resilience planning, considering insurance availability, affordability and the protection gap to identify the most important resilience measures
- Properly value and prioritize nature and nature-based solutions in risk assessments, government interventions, loss accounting and investment in recovery.

2. Reduce GHG emissions and nature destruction domestically and through international cooperation to contain mutually reinforcing climate and nature risks.



- Enhance and implement their strategies to mitigate climate change and halt and reverse nature loss
- Deepen international coordination for managing global public goods such as climate and nature
- Develop national transition pathways and require private sector transition plans to unlock private investments
- Mobilize private capital for nature-based and green solutions.

3. Make nature and nature-based solutions a centrepiece in adaptation and resilience planning and in response and recovery efforts.



- Integrate nature into zoning codes and land-use planning
- Update building codes to incorporate new climate realities and integrate nature-based solutions
- Accelerate and coordinate national adaptation planning and integrated landscape management
- Align public or publicly backed insurance schemes with risk reduction incentives
- Embed nature in disaster recovery frameworks for the benefit of people and nature
- Incorporate ecosystem services into insurance models
- Strengthen the resilience of ecosystems to climate change.

4. Enhance policy incentives and insurance regulation to support risk transfer solutions and financial resilience.



- Adopt a regulatory approach that integrates macroprudential considerations and tools with updated supervisory expectations for climate and nature
- Expand targeted public interventions in insurance markets to climate perils and regions where protection gaps are most acute
- Make insurers' eligibility for state support and public backstops conditional on mitigation and adaptation requirements
- Incentivize investments in resilience through carefully designed multi-year contracts
- Support market innovation to expand risk coverage.

01 INTRODUCTION



Homes flooded by Hurricane Debby, Florida. Image: Adobe Stock

Insurance is one of the cornerstones of modern prosperity. By underwriting and mutualizing risks, the insurance system enables investment, protects livelihoods, accelerates recovery after adverse events and underpins economic development. In regions with high insurance penetration, post-disaster recovery is not only faster, but its costs are more orderly and equitably distributed. Insurance provides financial protection for homes, businesses, public infrastructure and finances and, ultimately, people's wellbeing.

The climate and nature crisis is rapidly undermining the foundations of the insurance system. Both climate change and the destruction of nature are increasing the frequency and severity of extreme weather events, such as floods, storms, wildfires and droughts, while at the same time diminishing the capacity and resilience of nature to protect communities and businesses by providing natural buffers against catastrophes. In coastal areas, insurance is more unaffordable or unavailable where coral reefs and mangroves, which can protect against extreme weather, are degraded. Similarly, in wildfire-prone areas where forests degraded by climate change and economic development offer less natural firebreak protection, insurers are withdrawing coverage or dramatically increasing premiums.¹

Despite growing investments in disaster risk reduction, these mutually reinforcing negative dynamics are driving up damage and insured losses from extreme weather events, at a financially unsustainable rate of 5-7 per cent annually in real terms.² While a growing concentration of assets and people in high-risk areas is a significant factor, the underlying risk drivers of climate change and nature loss are making entire regions increasingly uninsurable.³

Like the proverbial 'canary in a coalmine', insurance acts as an economic warning mechanism of the growing losses and risks associated with climate change and the degradation of nature. The insurance sector is detecting and pricing these escalating climate risks in line with actuarial principles, and responding through a combination of premium adjustments, reduced coverage and, in some markets, complete withdrawal. A study by the European Central Bank (ECB) and the European Insurance Occupational Pensions Authority (EIOPA) concludes that, "as natural catastrophes become more frequent and more severe, insurance is expected to become less affordable and the already sizeable insurance protection gapⁱ is likely to widen further."⁴ When risks become uninsurable or when insurance premiums become unaffordable for many individuals and businesses, the virtuous cycle of financial resilience and recovery can break down into a vicious cycle of physical vulnerability, delayed reconstruction, reduced investment and deepening inequality.

i. The insurance protection gap is the total losses from an incident minus the insured losses.

Hazard exposure, asset vulnerability, market structure and regulatory interventions vary widely by region.

A similar increase in risk can trigger very different insurance outcomes, from modest repricing to withdrawal of coverage from high-risk communities or properties to full market exit. What is universal, however, is the broader macro-financial threat that an expanding insurance protection gap against extreme weather events and other climate-related catastrophes poses to societies and economies.

The risk posed by the insurance protection gap is now recognized across the policy, regulatory and industry landscape. Jerome Powell, Chair of the US Federal Reserve, warned that insurers and banks are already “pulling out of coastal areas, areas where there are a lot of fires... In 10 or 15 years there are going to be regions of the country where you can’t get a mortgage.”⁵ The insurance industry itself has highlighted increasing risks from climate change for decades and is now sounding the alarm, with a recent report from the Geneva Association emphasizing the urgent need for a paradigm shift towards a collective, all-of-society approach to minimize exposure and strengthen local resilience to extreme weather.⁶

This white paper contributes to this growing effort and body of work by examining how climate and nature risks are reshaping the insurance landscape. It considers what this means for people, businesses, communities, economies and governments, with a specific focus on Europe (including the UK) and the US. While many insurance companies are stressing necessary improvements in zoning policies, building codes,

insurance market regulations and institutions, this report first and foremost underlines the urgent need for coordinated public and private sector action on climate change mitigation – that is, rapid reductions in greenhouse gas (GHG) emissions and the destruction of nature to keep risks from spiralling out of control and destroying the economic and social backbone of our societies.


Trying to contain the protection gap while emitting record amounts of GHGs and further degrading nature is like fighting a fire while pouring gasoline on it at the same time. This is true for both governments and those in the insurance industry that are still insuring and investing in new and existing fossil fuel projects.

This report also specifically examines the role of nature and the ecosystem services it provides, the opportunities it presents for increased resilience, and the implications of its destruction for increased losses. This subject is often overlooked. The report calls on public officials and the insurance industry to consider the role of nature in risk reduction, resilience, adaptation and mitigation in insurance underwriting and pricing as well as in public policy, regulation and public investments. For example, restored wetlands or intact coral reefs can provide a triple benefit: climate mitigation through absorbing carbon dioxide; reducing insurance losses; and providing resilience, health and cultural benefits for communities. Any plan for preventing and mitigating damages from extreme weather events and thereby helping to contain the protection gap should take nature’s multiple benefits into account.



This report analyses the situation in advanced economies, with a main focus on the EU, the UK and the US. As challenges related to the protection gap and the respective responsibilities regarding historical GHG emissions differ between advanced and developing economies, addressing the same recommendations to all countries would be of limited relevance.

Devastating floods in Valencia caused by Storm Alice, Spain 2024. Image: Shutterstock



02 HOW CLIMATE CHANGE AND NATURE DESTRUCTION ARE DRIVING ECONOMIC LOSSES FROM EXTREME WEATHER EVENTS



Trees uprooted during storm. Image: Adobe Stock

2.1 THE INTERPLAY BETWEEN CLIMATE, NATURE AND EXTREME WEATHER EVENTS

Global warming has already surpassed critical thresholds, driving unprecedented and widespread extreme weather events. Over 2024, average global temperatures were more than 1.5°C (2.7°F) above pre-industrial levels for the first time,⁷ with sea surface temperatures also reaching record highs.⁸ We are already seeing profound transformations in climate patterns, leading to more frequent, unpredictable and intense extreme weather events such as hurricanes, tropical cyclones, storms, droughts, wildfires, extreme heat, floods and landslides.

Rising GHG emissions are locking in further warming, and disruptive and dangerous weather events will only get worse. Even if we stopped emitting GHGs today, our climate will continue to change for many decades to come, and every fraction of a degree of temperature rise makes the situation worse. With 1.5°C of warming, extreme heat waves will occur every five years, compared with once every decade before; with 2°C, they will occur every three to five years; and with 4°C, once every 15 months.⁹

Robust and healthy ecosystems are vital to reduce the impacts of these extreme weather events. Intact forests, wetlands and free-flowing rivers act as natural flood control; by slowing the movement of water, they reduce the likelihood and severity of floods. By stabilizing slopes, forests reduce the risk of landslides, avalanches and rockfalls, especially in mountainous areas (see Textbox 1 on Protective forests). Coastal ecosystems provide natural barriers that mitigate storm surges and coastal flooding. In the United States, for instance,

coastal wetlands prevented an estimated US\$625 million in flood damages during Hurricane Sandy in 2012.¹⁰ In urban areas, tree canopies help lower temperatures, reducing the impact of extreme heat (see table on p. 16 and case study on p. 43).

However, human activity is destroying and degrading ecosystems around the world. Conversion of land and sea, overexploitation of natural resources, pollution and climate change are destroying nature at an unprecedented speed. According to WWF's 2024 *Living Planet Report*, global wildlife populations have fallen by an average of 73 per cent in less than a lifetime.¹¹ This degradation is undermining the provision of ecosystem services provided by nature, such as climate regulation, clean water, food and fibre provision and pest control. A study by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) found that 14 of 18 assessed ecosystem services are now declining.¹²

The degradation of natural ecosystems is increasing the vulnerability of people, places, economies and the ecosystems themselves. For instance, deforestation not only removes carbon sinks, contributing to more rapid climate change, but it also disrupts water cycles, leading to increased flood risk. For example, the risk of a large-scale flooding event can increase by as much as 700 per cent in areas of widespread deforestation.¹³ Adding to this, the loss of biodiversity weakens ecosystem stability, making these systems more susceptible to further degradation.

Climate change is putting our planet's ecosystems at risk of further degradation and collapse. Through extreme events like fires and floods, as well as through chronic stresses such as from lower precipitation, climate change is putting additional pressure on already degraded ecosystems. Climate change is rapidly becoming a leading cause of biodiversity loss and may be its biggest driver by mid-century.¹⁴

Climate change and ecosystem loss create a self-reinforcing vicious cycle that undermines system resilience. As climate change and nature degradation intensify due to human activity, the planet's complex and interconnected ecosystems are becoming increasingly vulnerable. As ecosystems lose the qualities that make them resilient to climate change (such as connectivity, biodiversity and functional redundancy), we move closer to tipping points. When ecosystems collapse, they do not longer sequester GHG emissions, and may become sources of additional emissions, further accelerating climate change.¹⁵ For instance, carbon emitted from wildfires in North America is canceling out emissions reductions achieved elsewhere.¹⁶ Oceans are also absorbing less and emitting more CO₂ due to increased water temperatures.¹⁷

Human activity is pushing the world toward irreversible tipping points. Exceeding 1.5°C, the Paris Agreement threshold, will accelerate climate instability, potentially triggering glacier and ice sheet collapse, permafrost thaw, Amazon dieback,

coral reef loss and disruptions to ocean currents. Crossing these tipping points would create cascading effects, with severe impacts on ecosystems and societies worldwide.¹⁸

Crossing tipping points makes adaptation itself more difficult, expensive and potentially impossible. Cascading and non-linear effects in Earth systems increase the uncertainty of local climate outcomes. For instance, many European countries, cities and farms are taking steps to adapt to a warmer climate by, for example, planting new tree species or farming crops more adapted to a hotter climate. However, climate scientists warn that the weakening and potential collapse of the Atlantic Meridional Overturning Circulation, which brings warm water from the Equator to north-west Europe, could significantly reduce temperatures in the future, undermining these well-intentioned adaptation strategies.^{19, 20}

Reducing pressure on and restoring ecosystems is a cost-effective strategy for reducing vulnerability towards and the severity of extreme weather events – but it must be done in parallel with climate mitigation. Maintaining and restoring ecosystems can deliver invaluable benefits, with costs often much lower than disaster relief and infrastructure repair – if climate change is contained to manageable levels and rates. Moreover, nature-based solutions (NbS) can, for certain perils, deliver more cost-efficient risk reduction than human-built alternatives (see Textbox 1).



“We need to turn the vicious cycle between increasing temperature and ecosystem degradation into a virtuous cycle of nature restoration, reduced climate change and increased resilience for people and nature.”



THOMAS VELLACOTT
CEO WWF SWITZERLAND

TEXTBOX 1: PROTECTIVE FORESTS AS A SUCCESSFUL NBS FOR RISK REDUCTION

Protective forests represent a prime example of successfully implemented nature-based solutions that combine disaster risk-reduction benefits while providing a broad spectrum of ecosystem services.²¹

Protective forests are woodland stands, particularly those on slopes or in otherwise hazard-prone areas, that can protect people, infrastructure and adjacent resources from natural hazards. They act as barriers and buffers that reduce the likelihood and severity of hydrological, gravitational or wind-related events and resulting hazards, such as avalanches, landslides, flooding or erosion.²² The more resilient, the greater the forest's capacity in reducing potential losses.²³ Combining protective forests with financial insurance can contribute to holistic resilience: the forests can mitigate frequent, lower-impact incidents, while financial insurance provides coverage for high-damage, low-probability events.²⁴

Recognizing their protective value, these forests have been managed by local communities since the 12th century. With the emergence of modern nation states in the 19th century, local customs were codified into national legal frameworks in Austria,²⁵ Bavaria (Germany),²⁶ France²⁷ and Switzerland.²⁸

For example, the Swiss federal government contributes to protective forest management with annual payments of CHF5,000/ha (US\$6,280/ha) or 40 per cent of average net costs,²⁹ while the remaining expenses are borne by cantonal or municipal authorities (around 40 per cent) and third parties such as infrastructure operators,³⁰ such as SBB, the Swiss railways operator.³¹ The underlying principle is that forest owners should not bear residual costs unless they carry public responsibility for natural hazard protection or directly benefit from the protective function.³²

In 1986, the Forest Administration in Bavaria established specialized Protection Forest Restoration Units, investing €70 million over 25 years to rehabilitate degraded forests that could no longer fulfil their protective function. More recently, as part of Bavaria's 2020 climate programme, a new initiative was launched to secure the long-term protection of these forests, regardless of whether they are privately or commercially owned.³³

These contributions have led to a significant increase in the area covered by protective forests over recent decades. As of today, nearly half of all forest areas in both Austria³⁴ and Switzerland³⁵ serve a protective function. In the Bavarian Alps, protective forests account for approximately 60 per cent of forest area.³⁶

The insurance value of protective forests has not thus far been integrated into standard insurance products. Nonetheless, research quantifying their protective functions in theoretical risk modelling continues, indicating that their inclusion could generate mutual benefits for both insurers and property owners.³⁷ In Switzerland, protective forests have already become an accepted component of the integrated risk management modelling applied by public authorities.³⁸

FIGURE 1: AREA DISTRIBUTION OF PROTECTIVE FOREST AND OTHER FOREST IN SWITZERLAND



Translation based on Neue Zürcher Zeitung, (2025). Verjüngungen sind angesagt.

As an industry example, Helvetia, a Swiss insurance company, recognizes the direct benefits of intact protective forests and actively invests in their preservation. As part of its protection forest commitment, Helvetia supports targeted reforestation projects to ensure the long-term survival of protective forests.³⁹

The Swiss forest owners' association estimates the forest's protective function to be worth approximately CHF4 billion (US\$4.5 billion) annually.⁴⁰ Over a 100-year period, maintaining 1 ha of protective forest costs around CHF40,000 (US\$50,000) – compared to the roughly CHF1 million (US\$1.2 million) needed to construct and operate technical measures, such as avalanche barriers, with an equivalent protective effect. This makes forests about 25 times more cost-effective than such measures.⁴¹

Protective forests also provide a broad spectrum of ecosystem services.⁴² Importantly, management approaches that strengthen forest resilience often simultaneously enhance biodiversity and the provision of these ecosystem services, thereby increasing their long-term insurance value.⁴³ This integrated perspective underscores that maintaining and restoring protective forests is not only an ecological imperative but also a cost-effective strategy for safeguarding communities, capital and economies.⁴⁴

The successful large-scale implementation of protective forests should serve as an inspiration and motivation for all actors currently seeking to implement nature-based solutions. The recognition that such forests, are – similarly to railways or electricity grids – necessary public infrastructure that requires public financing and enforcement are two main factors for their success. However, as protective forests struggle with resilience, especially in the face of a changing climate, it is also important to learn to build more resilient ecosystems.

2.2 ECONOMIC COSTS ASSOCIATED WITH CLIMATE CHANGE

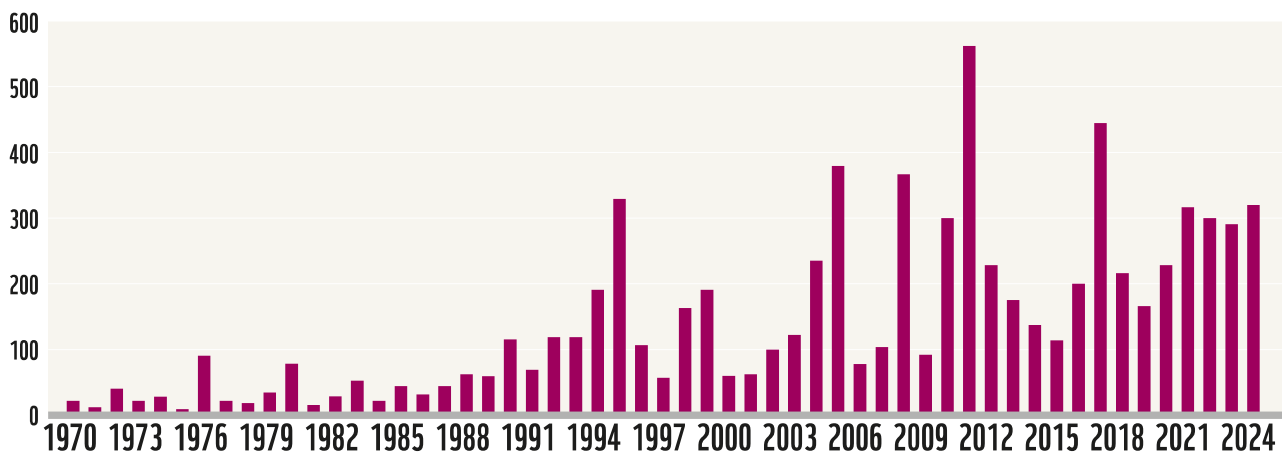
The economic losses from extreme weather events are increasing (see Figure 2).⁴⁵ Swiss Re states that, in 2024, economic damages from all natural disasters reached US\$318 billion.⁴⁶ Meanwhile, the number of severe disasters globally is forecast to double by 2040.⁴⁷ As a result, the financial burden on societies is intensifying, underscoring the urgent need to tackle the root causes of these losses.

Economic loss estimations typically omit most indirect effects and chronic factors such as sea-level rise.

Estimations, such as those from Swiss Re and a similar report from Munich Re,⁴⁸ that are most widely used to track the increasing losses from extreme weather events generally do not account for indirect effects and unreported damages. When estimates do include such indirect effects, e.g., on productivity loss, income loss, long-term health impacts, loss of biodiversity or disruption to business operations

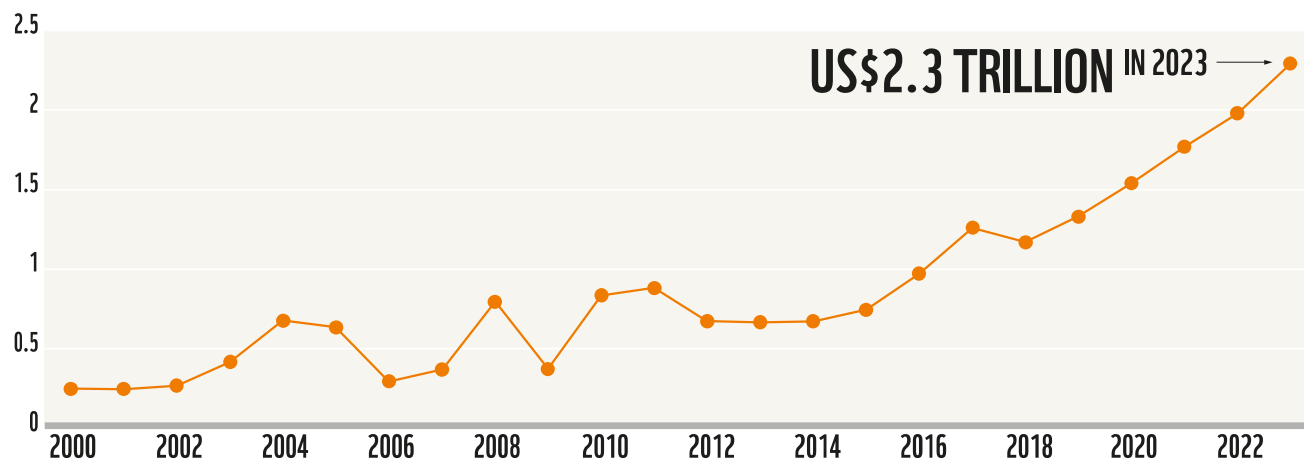
and supply chains, estimates are considerably higher. For example, the United Nations Office for Disaster Risk Reduction estimates annual disaster risk costs in 2023 at around US\$2.3 trillionⁱⁱ when indirect costs and ecosystem costs are accounted for.⁴⁹ According to a recent study, extreme summer weather in 2025 caused an estimated €43 billion in direct and indirect damages in the European Union alone, equivalent to around 0.26 per cent of the EU’s economic output in 2024.⁵⁰ Meanwhile, the United States has faced almost US\$1 trillion in combined reactive and proactive climate-related expenditures in the 12 months to May 2025.⁵¹ Overall, Moody’s anticipates that the economic impact of physical risk due to climate change may reach US\$41.4 trillion, or a 14.5 per cent loss in global gross GDP by 2050, and annual costs of 9.5 per cent of GDP in the United States.⁵²

FIGURE 2: GLOBAL DIRECT LOSSES IN US\$ BILLION AT 2024 PRICES (1970-2024)



Source: Swiss Re. (2025). Total Insured and Uninsured Losses in USD Billion at 2024 prices (1970-2024). In *sigma* 1/2025: Natural catastrophes: insured losses on trend to USD 145 billion in 2025.

FIGURE 3: GLOBAL DIRECT AND INDIRECT DISASTER DAMAGE LOSSES IN US\$ TRILLION (2000-2023)



Source: UNDRR. (2025). Global Disaster Damage Losses (2000-2023).

ii. Mostly due to climate-related disasters

Most economic loss estimates understate impacts in lower-income countries and places with lower insurance penetration. Aggregated loss figures also tend to omit many forms of unreported damage, particularly in poorer regions where assessment and reporting are limited. Because economic loss valuations are often focused on wealthy countries with dense, high-value assets and high insurance penetration (such as the United States, Europe and Japan), similar extreme weather striking a poorer country is calculated to cause much lower economic and insurance losses, even if the human toll or ecosystem damage is as severe or greater. Together, these omissions paint a picture in which the most frequently cited damage estimates from extreme events likely significantly understate the true scale of climate-driven economic harm, obscuring the urgent need for more ambitious adaptation and mitigation measures.

Economic losses from extreme weather events escalate despite significant investment in risk reduction, due to the compounding effects of exposure, vulnerability and amplifying climate-driven hazards. It is important to stress that overall losses are increasing despite investments in risk reduction. While damage from residential fires was reduced significantly in the 19th and 20th centuries due to prevention measures, increased flood protection and stricter building codes are not delivering the same results for losses from extreme weather events. This is because several underlying trends are outpacing (insufficient) risk reduction measures, while their specific contributions to increasing losses are location specific. Economic growth and urban development are increasingly concentrated in high-risk areas, such as coastal cities and river floodplains, where property values have outpaced inflation.

Vulnerability is further compounded by outdated policies and planning practices that were designed based on historical risk assessments, which no longer reflect the changing climate. The decline in vulnerable natural ecosystems – such as mangroves or wetlands – removes the natural defenses that once helped absorb storm

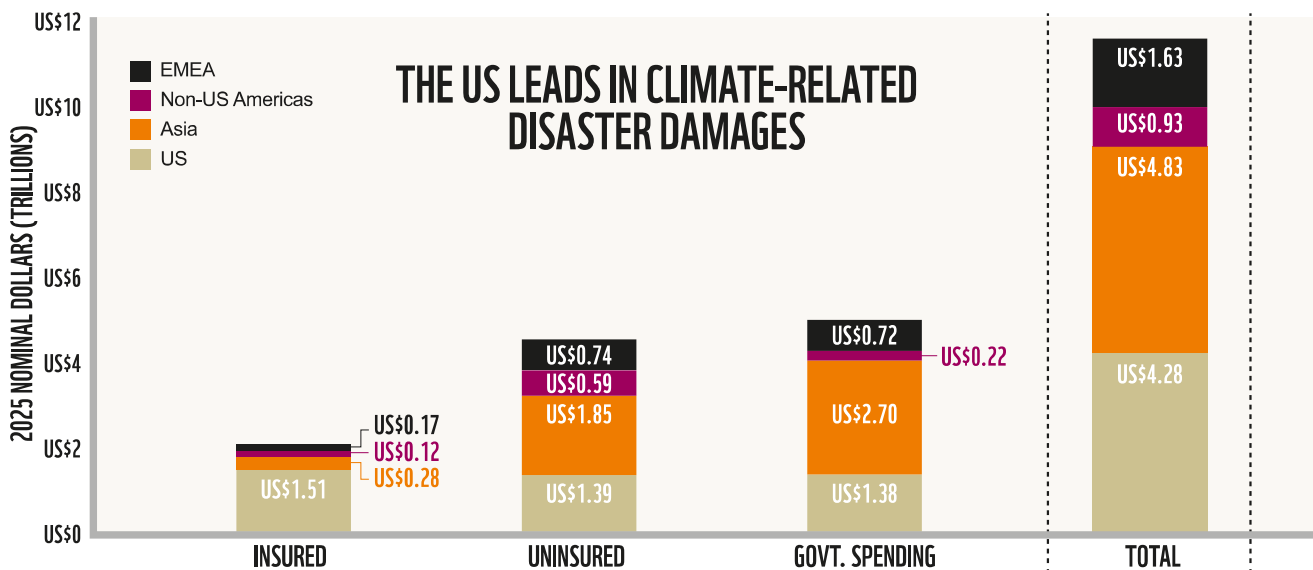
energy, mitigate floods and protect infrastructure. As a result, communities in these areas face escalating costs, both in terms of property damage and in the growing need for more expensive engineering and insurance solutions to protect against disasters. Climate change itself then acts as a potent multiplier, increasing both the frequency and severity of extreme weather events. The result is a feedback loop where more destructive hazards impact more exposed, vulnerable and inadequately protected assets, pushing economic damages to unprecedented levels.

However, local examples show that investments in adaptation and resilience can bend the loss curve.

In many cases, damage from extreme weather can be reduced by improved preparedness, infrastructure upgrades and protective measures. For example, Switzerland has invested heavily in flood defenses, warning systems and land-use planning, leading in some modeled scenarios to as much as a 90 per cent reduction in damage compared with a business-as-usual scenario.⁵³ Similarly, in many western European countries, mortality rates from heat waves have declined, even though recent events have matched or exceeded the intensity of the deadly 2003 European heatwave. This is due to early-warning systems, public health interventions and wider access to cooling.⁵⁴

Investment in risk prevention, resilience and mitigation is much more cost-efficient than paying for disaster relief and recovery and needs to be integrated in a total cost perspective. The investments required for adaptation and resilience, while more efficient (see Section 4.5.4) are themselves part of the growing economic burden imposed by more frequent and intense extreme weather and need to be integrated into a total cost perspective. Moreover, government support for insurance schemes such as agricultural subsidies should also be part of that equation. This total cost perspective⁵⁵ is shown in Figure 4, which breaks down total disaster costs worldwide since 2000. It highlights the substantial share of government spending directed to the costs of climate-related disasters, including that allocated to the measures mentioned above.

FIGURE 4: CLIMATE-RELATED DISASTER COSTS SINCE 2000, GLOBAL BREAKDOWN



Source: Bloomberg Intelligence. (2025). Climate-related Disaster Costs Global Breakdown. In: *The Climate Economy 2025 Outlook*.

TEXTBOX 2: HEALTHY ECOSYSTEMS STRENGTHEN RESILIENCE

Intact and healthy ecosystems such as wetlands, forests and mangroves provide vital services, including water purification, climate regulation and soil stabilization. By acting as regulators and buffers, reducing flood, heat and storm impacts, they can save lives and billions of dollars in damages.⁵⁶

However, since the 1950s, approximately 60% of global ecosystems have been significantly degraded.⁵⁷ This creates a vicious cycle. Ecosystems become less resilient and more vulnerable to extreme weather events, which then further weaken these systems, pushing them closer to tipping points where they can no longer provide their vital ecosystem services. This in turn exacerbates climate change, which feeds back into further ecosystem decline and the loss of their protective functions.⁵⁸ The World Bank estimates that the loss of selected ecosystem services (wood provision, pollination and marine fisheries) will lower global annual GDP in 2030 by US\$2.7 trillion, if major ecosystems continue to collapse.⁵⁹

HAZARD	NATURE'S PROTECTIVE ROLE	NBS ILLUSTRATION
 <p>DROUGHT</p>	<p>Intact wetlands, peatlands, vegetation, and healthy soils improve water retention and regulate water flows.</p>	<p>UK peatland restoration in Yorkshire improves summer groundwater flows and pluvial water retention.⁶⁰ Alpine meadow conservation in Canada enhances water storage.⁶¹</p>
 <p>WILDFIRE</p>	<p>Mixed and well-managed native forests show higher moisture retention and slower ignition spread versus monocultures.</p>	<p>Aspen stands in California reduce fire intensity.⁶² Cork oak landscapes in Portugal support natural fire breaks.⁶³ Sustainable forest management programmes in Germany, Portugal and Spain enhance resilience against wildfires and water scarcity.⁶⁴</p>
 <p>EXTREME HEAT</p>	<p>Urban trees, green roofs, parks and vegetation lower air and surface temperatures through shading and evapotranspiration, providing health benefits.</p>	<p>London's citywide planting programmes,⁶⁵ Barcelona's Trees for Life Masterplan,⁶⁶ New York City's Million Trees initiative⁶⁷ and green roof initiatives in Berlin,⁶⁸ Chicago,⁶⁹ Paris,⁷⁰ Warsaw⁷¹ and Toronto⁷² all reduce peak urban temperatures and summer heat stress.</p>
 <p>FLUVIAL FLOODS AND SURFACE RUN-OFF</p>	<p>Forest canopies, root systems, wetlands and floodplains slow runoff and store floodwaters.</p>	<p>Swiss Alpine reforestation reduces snowmelt flood risk.⁷³ Floodplain reconnection on the Danube restores natural overflow capacity.⁷⁴ Hedgerow networks in southern England⁷⁵ and Elbe dyke relocation in Lenzen, Germany, increase water retention.⁷⁶</p>
 <p>LANDSLIDES</p>	<p>Vegetation root systems anchor soil, intercept rainfall and improve slope stability.</p>	<p>Forests in Alpine regions like Switzerland stabilize slopes and provide physical barriers.⁷⁷</p>
 <p>TROPICAL CYCLONES, HURRICANES AND WINTER STORMS; COASTAL FLOODS AND EROSION</p>	<p>Mangroves, seagrass meadows, coral reefs, dunes, wetlands and other coastal habitats offer buffers against storm surges and wave energy, reconnect water flows, stabilize sediments and reduce shoreline erosion.</p>	<p>Wetlands along the US Atlantic coast reduced damages during Hurricane Sandy in 2012.⁷⁸ Restored salt marshes in New England reduce storm impacts.⁷⁹ Restoration of former saltworks into functional coastal wetlands in the Rhône Delta (Camargue, France) serve as buffer zones to enhance inland flood protection.⁸⁰ Mangroves protect coastlines in Florida.⁸¹</p>

03 CLIMATE RISK AND THE INSURANCE PROTECTION GAP



Rescue workers use boats to navigate floodwaters in the centre of York after the River Ouse burst its banks. Image: PA Images / Alamy Stock Photo

WHAT WE MEAN BY THE CLIMATE INSURANCE PROTECTION GAP

For a given event or category of events, the insurance protection gap is the difference between total economic losses and the insured part of these losses. We use the wider definition of the term, to best capture the uninsured contingent liabilities of private actors and public budgets.⁸² In the rest of the report, we will generally use the shorter expression 'protection gap' to refer to the insurance protection gap relating to extreme weather events due to climate change and nature loss. This protection gap includes acute catastrophic events, their secondary effects and the chronic consequences of a warming planet and the degradation of nature. The protection gap can be expressed in absolute (i.e., monetary) terms or in relative terms (i.e., as a percentage of total economic losses).

Due to climate change and nature loss, the gap between total economic losses from extreme weather and the losses covered by insurance is widening. As the frequency

and severity of extreme weather events and other climate-related natural catastrophes increase, they drive economic losses higher. Even with stable insurance coverage, this results in an increasing absolute protection gap. The relative protection gap also increases where insurance companies reduce their coverage for some regions, perils or lines of business to manage their exposure to growing risk, and when they increase premiums to levels which become unaffordable to some households and businesses. The geographical spread of climate-related catastrophes to previously unaffected regions also contributes to a widening protection gap, as people living in such areas are often unaware of the need to buy insurance.

Rising climate risk and market dynamics combine to limit the private insurance sector's ability to close this gap. This chapter analyses the insurability challenges faced by the insurance sector and how private markets cannot be expected to solve the climate insurance protection gap alone, given existing financial incentives (3.1). It then provides evidence about how increasing losses from extreme weather events lead to higher premiums, reductions in coverage and a growing protection gap for property insurance (3.2). It concludes with an overview of the consequences of the protection gap for other lines of insurance business (3.3).

3.1 EXTREME WEATHER CHALLENGES TRADITIONAL INSURANCE MODELS

3.1.1 HOW INSURANCE WORKS

Insurance provides a financial safety net that supports households and economic activities. By underwriting and mutualizing risks, the insurance system protects livelihoods, accelerates recovery after adverse events, enables investment and underpins economic development. In regions with high insurance penetration, post-disaster recovery is not only faster, but its costs are more orderly and equitably distributed. Insurance provides financial protection across various business lines for people, businesses, public infrastructure and finances:



HOME INSURANCE

protects households from financial losses caused by floods, storms, fires, or other extreme events.



BUSINESS INSURANCE

covers property damage, operational disruptions and supply chain interruptions, helping enterprises recover and sustain employment after crises.



AGRICULTURAL INSURANCE

safeguards farmers against droughts or crop failures.



PUBLIC & INFRASTRUCTURE INSURANCE

provides coverage for transport, utilities and government assets, ensuring essential services can be restored quickly after disasters.



LIABILITY INSURANCE

(also known as casualty insurance) protects individuals and organizations against claims for damage they may cause to third parties.



LIFE & HEALTH INSURANCE

provides financial security by covering medical costs, income loss or death benefits, supporting household resilience.

Insurance relies on statistical and actuarial principles, mutualizing risks to ensure predictable outcomes and financial resilience. Insurance companies generally estimate the severity and frequency of losses by analyzing historical data and extrapolating future claims. To achieve diversification, they spread their exposure across a broad portfolio of independent risks, insuring many policyholders, across different regions, and covering various types of perils. For instance, flood damage to residential property is generally not correlated with liability claims arising from workplace accidents. Such diversification prevents accumulations of risk and helps ensure that aggregate losses remain within insurers’ solvency capacity. Reinsurance further supports insurers’ financial resilience by enabling insurers to transfer the risk of peak events that exceed their individual risk capacity to specialist reinsurers.

from major rivers or lakes may not realize that their property is still exposed to flood risk, perhaps from surface run-off or from a small neighborhood brook. Without this risk awareness, demand for insurance coverage remains limited. Insurance premiums must also be priced at a level that makes protection affordable, ensuring that risk awareness translates into actual insurance uptake.

The availability and affordability of insurance depend on actuarial and market conditions. The limits to insurability are illustrated on the graph below, based on the criteria of Berliner.^{83,84} The preconditions for a risk to be insurable notably include a predictable loss frequency and severity, diversified exposures to avoid large claims accumulation, and premiums set at levels that policyholders can reasonably afford.⁸⁵

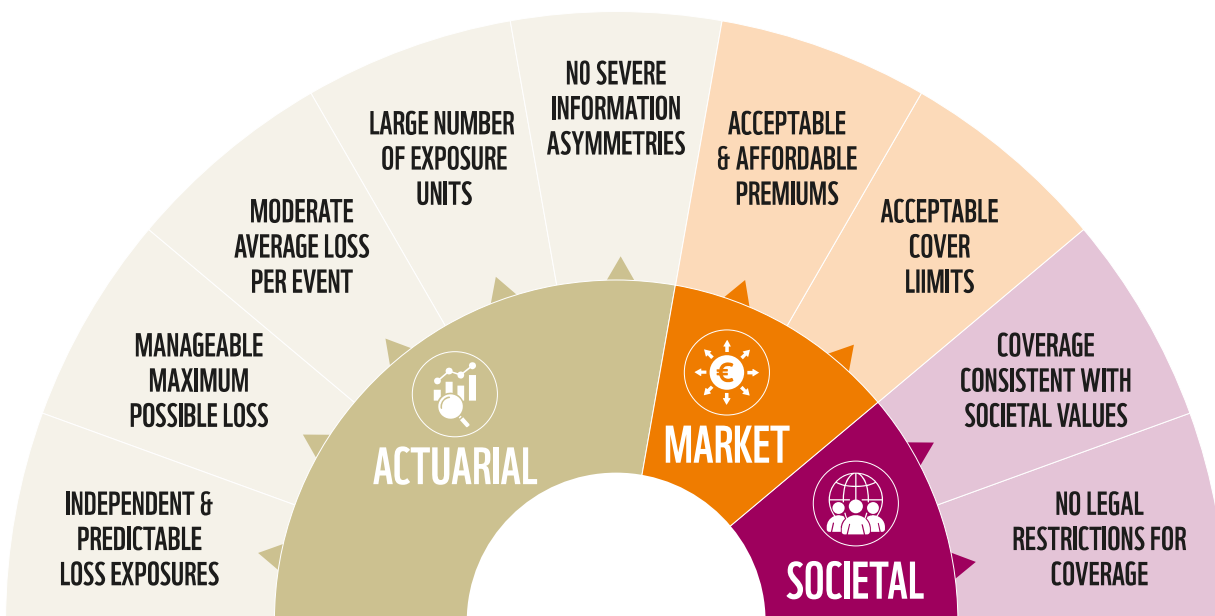
WHAT DO REINSURERS DO?

Reinsurance is insurance purchased by insurers from specialized reinsurance companies. By transferring some of their risks to reinsurers, primary insurers can stabilize their results, increase their underwriting capacity and safeguard their solvency against catastrophic events, including climate- and nature-related disasters. Reinsurers can assume catastrophe risks because they diversify exposures across global markets. Collectively, the reinsurance system forms the backbone of global risk-sharing.

Insurance uptake depends on customers’ awareness of risks and on the affordability of coverage. For insurance to be purchased, households and businesses must first recognize the risks they face. For instance, people located far

Insurance protection gaps arise and widen when the key conditions for insurability are not met. The extent of protection gaps varies widely, depending on jurisdiction and economic model. In the United States, private insurance penetration is generally high, yet significant gaps remain in some regions for natural catastrophe coverage. In contrast, in many developing countries, risk management has historically relied on informal community arrangements rather than market insurance mechanisms, leaving most households uninsured. In some cases, it can also make sense for states to self-insure public infrastructure, since relying on private insurance may be more costly. Similarly, in several Scandinavian countries, strong state-based social insurance systems reduce reliance on private insurance in certain sectors. While limited private insurance is not always problematic in all contexts (and entirely eliminating protection gaps is neither feasible nor optimal), the reduced availability of insurance in sectors or populations that traditionally depend on it can create significant vulnerabilities.

FIGURE 5: MARKET CRITERIA FOR INSURABILITY



Source: The Geneva Association. (2018). *Understanding and Addressing Global Insurance Protection Gaps*. Concept originally proposed by Berliner. (1982). Limits of insurability of risks.

3.1.2 THE THREAT TO INSURABILITY FROM CLIMATE CHANGE AND NATURE LOSS

Over the last decade, insurance protection gaps in absolute numbers and corrected for inflation have been increasing. This section considers the dynamics between climate and nature risks and the protection gap.

Rising climate-related risks and changing natural conditions undermine traditional methods of insurability by making future losses harder to predict.

In a changing climate, past data can no longer reliably forecast future losses, creating a fundamental challenge for insurers and actuaries who primarily depend on historical trends for risk assessment. Feedback loops between climate change and nature loss, along with the possibility of physical tipping points accelerating change, further complicate risk assessments. As a result, standard insurance approaches are increasingly inadequate, prompting recalibration of pricing and capital models and restricting underwriting appetites. Stricter risk selection limits the availability of insurance coverage when insurers and reinsurers reduce their exposure to growing and increasingly unpredictable risk.

Climate risk is affecting wider geographic areas.

Individual extreme weather events are localized, but various climate hazards can potentially strike different geographies at the same time and affect large numbers of policyholders in multiple regions. This is making these risks hard to diversify, therefore challenging the insurance sector's foundational principle of mutualization (i.e., the mechanism by which risks are shared collectively, enabling individual losses to be absorbed by premiums from all contributing policyholders). For instance, in the UK, the government's 2025 National Flood Risk Assessment maps (NAFRA2) show increases in the number of households at risk of flooding from 5.5 million in 2024 to about 6 million (including 4.6 million due to surface water/flash flooding, which is hard to predict).⁸⁶ This figure is expected to rise to 8 million households by 2050 because of climate change. These large and growing absolute exposure numbers make it increasingly difficult to pool flood risks affordably.

The dynamics between nature loss and landscape resilience are not widely recognized in insurance models.

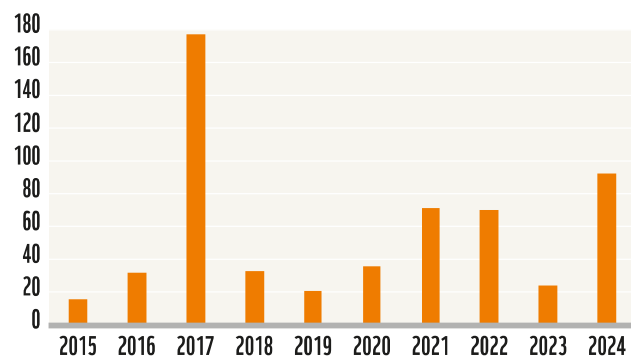
The consequences of nature degradation are complex and interconnected, with cascading effects making them difficult to quantify. For example, the loss of pollinators can decrease agricultural productivity, ultimately leading to business interruption and crop insurance claims for insurers.⁸⁷ There are no accounting methodologies for the impacts of nature loss such as those which exist for climate risk. There is also a large range of potential natural pathways and no nature-related standardized equivalents of the Representative Concentration Pathways (RCPs) used in physical climate risk scenarios. Insurance underwriters often lack systematic data collection and modeling tools focused on the efficiency of resilience measures, particularly regarding NbS. This limits their ability to offer actionable advice to insurance clients (especially for individuals and smaller businesses) about increasing resilience through nature-based risk reduction, and to take such measures into account in their pricing, underwriting and capital models.

The signals about risk that market-based premiums provide are challenged by contradictory objectives, including ensuring insurance availability for high-risk communities.

Insurance premiums are the point in the economic system where climate risks are being priced and made visible to insurers, reinsurers and insurance customers. There is a difficult balancing act between maintaining a price signal that accurately reflects risk (through actuarially risk-based insurance premiums) and ensuring that insurance remains available and affordable to individuals and businesses who need it. For example, for new buildings, risk-based premiums set by private insurance markets, coupled with appropriate zoning and building regulations from public authorities, can help discourage development in climate-vulnerable areas. However, this dilemma is far more complex for most existing structures, as human settlements have historically clustered around rivers, coasts and floodplains, and whose development has often compromised the resilience of nature in the first place.

FIGURE 6: US PROTECTION GAP FROM NATURAL CATASTROPHES

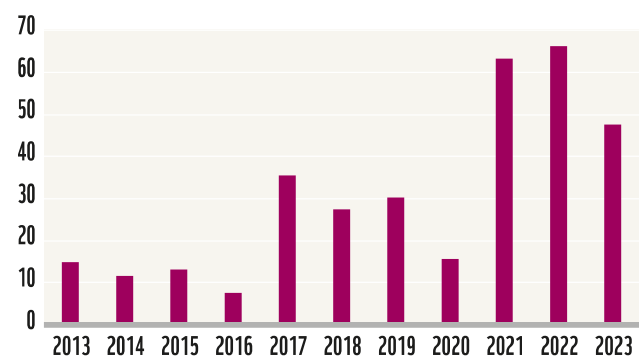
In US\$ billion in 2024 prices



Source: Swiss Re. (2025). U.S. Protection Gap from Natural Catastrophes. In *sigma 1/2025: Natural catastrophes: insured losses on trend to USD 145 billion in 2025*.

FIGURE 7: EU-27 PROTECTION GAP FROM WEATHER & CLIMATE EVENTS

In EUR billion in 2023 prices



Source: European Environment Agency. (2025). Total and insured losses by year from weather- and climate-related events EU-27.

FIGURE 8: WHERE INSURERS ARE LOSING MONEY

American states where homeowners insurance was unprofitable

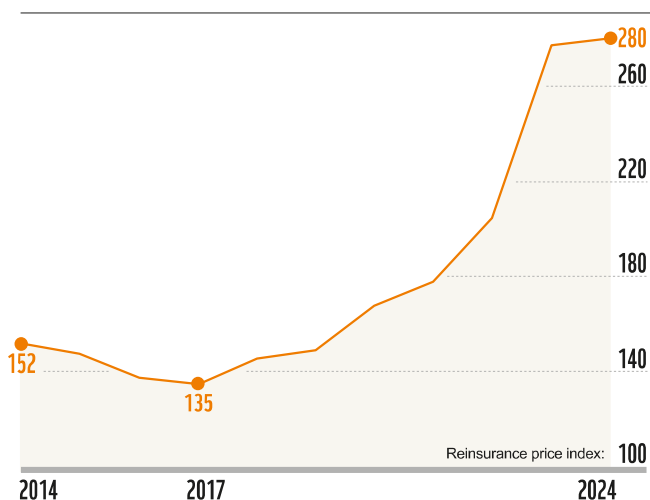
2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
COLO.	COLO.	MASS.	COLO.	CALIF.	CALIF.	COLO.	ALA.	COLO.	ARK.	ARK.
GA.	IOWA	R.I.	MONT.	COLO.	COLO.	FLA.	ARK.	IOWA	ARIZ.	COLO.
ILL.	ILL.	S.D.	N.D.	FLA.	CONN.	ILL.	DEL.	IDAHO	FLA.	GA.
MISS.	MICH.		NEB.	GA.	DC	MINN.	FLA.	KY.	GA.	HAWAII
MONT.	MONT.		N.M.	IOWA	FLA.	MONT.	GA.	LA.	IOWA	IOWA
NEB.	NEB.		TEXAS	IDAHO	GA.	N.D.	IOWA	MICH.	MD.	ILL.
OKLA.	S.D.		WYO.	ILL.	IDAHO	NEB.	ILL.	MINN.	MINN.	IND.
S.D.	VT.			MINN.	MD.	WYO.	LA.	TEXAS	MONT.	KY.
				NEB.	NC.		MINN.		NEB.	MICH.
				N.M.	S.D.		MISS.		N.M.	MINN.
				S.D.	VA.		ORE.		OHIO	MO.
				TEXAS	WYO.		S.D.		WASH.	MISS.
							TENN.		WASH.	OHIO
							UTAH		WIS.	OKLA.
							WYO.			TENN.
										UTAH
										WASH.
										WIS.

Source: Flavelle, C., & Rojanasakul, M. (2024). Where Insurers are loosing money. In *As insurers around the US bleed cash from climate shocks, homeowners lose*. *The New York Times*. From The New York Times Date © Year The New York Times. All rights reserved. Used by permission and protected by the Copyright Laws of the United States. The printing, copying, redistribution, or retransmission of this Content without express written permission is prohibited.

Escalating climate losses are straining the ability of the insurance sector to provide affordable coverage. Increasing frequency and damages from extreme weather events to some properties and assets leads to premiums that many customers are increasingly unable (or sometimes unwilling) to pay. This affordability issue is compounded by rising costs of repeated repairs, which is also driven by increases in the value of buildings and by inflation. Conversely, if insurers set premiums lower than the actuarial price to keep them affordable, this would prevent them from making a profit. This would lead them to withdraw coverage rather than sell at a loss.⁸⁸ For instance, the growing number of US states where homeowner insurance is unprofitable⁸⁹ is creating concerns over the future availability and affordability of insurance against climate risks across the country.

Reinsurance dynamics are also shaping the cost and availability of climate risk coverage. Primary insurers with substantial exposures to climate- and nature-related disasters need to transfer an increasing amount of this risk to reinsurers. However, reinsurance companies are also under increasing strain due to losses from extreme weather events. The data shows insurers ceding a greater share of their premiums to reinsurers to secure coverage, while reinsurers are retreating from some natural catastrophe markets:⁹⁰ over the last decade, the top 19 global reinsurers have more than halved their exposure to insured catastrophe losses.⁹¹ As climate risks rise and more countries are considering making disaster insurance mandatory, regional insurers may find it increasingly hard to find reinsurers willing to assume such risks at affordable rates. This reinsurance protection gap, which has been analyzed in a recent report from the Bank for International Settlements,⁹² further widens the protection gap. The reinsurance challenge has notably prompted joint proposals from the ECB and EIOPA for a European public-private reinsurance scheme (as well as an EU public disaster fund) to help maintain the insurability of climate-related risks.⁹³

FIGURE 9: REINSURANCE PRICES IN THE UNITED STATES HAVE DOUBLED OVER EIGHT YEARS⁹⁴



Source: Brown, C., & Rojanasakul, M. (2025). Reinsurance prices in the United States have doubled over eight years. In *A climate 'shock' is eroding some home values*. New data shows how much. *The New York Times*.

Beyond affordability, other demand-side challenges are compounding supply-side issues. Demand-side barriers in procuring insurance have been documented in a 2024 report from EIOPA.⁹⁵ In practice, many individuals and businesses have limited awareness of the risks they face. They may mistakenly assume that they are either not exposed to climate risks (as has been documented for instance by the British Red Cross⁹⁶) or that their existing coverage adequately protects them against natural catastrophes. A lack of trust in the insurance industry (where some people have experience with claims not being honoured or payments minimized) can also deter adequate insurance uptake. Another contributing factor is what is sometimes referred to as 'charity hazard' or the 'Samaritan's dilemma' – i.e., the expectation that the government will intervene and provide ad hoc disaster relief in the event of widespread climate damage. This creates additional moral hazard and reduces the incentives for individuals and businesses to secure comprehensive private insurance coverage. Finally, there is also the issue of adverse selection, i.e., people living in high-risk areas proportionally seek more insurance coverage than those in low-risk areas, thereby burdening insurance pools with higher risks and driving up premiums for everyone.

3.1.3 WHY PRIVATE INSURANCE MARKETS CANNOT CLOSE THE GAP ALONE

Microeconomic constraints prevent insurers from pursuing collective climate risk mitigation and prevention strategies. Most insurers, reinsurers and insurance intermediaries are aware of the mounting challenges posed by climate change, and the insurance industry has been one of the most vocal business groups raising concerns regarding climate risk over recent decades. However, insurers' individual financial incentives are often misaligned with the need for long-term collective solutions. Annual contract renewals and financial reporting cycles encourage them to focus on short-term risk and profitability management. This is reinforced by the microprudential lens used by most insurance supervisors, who primarily focus on making sure that insurers have enough capital to minimize their probability of going bankrupt over the next year.⁹⁷

In addition, the misuse and political weaponization of antitrust laws by those seeking to impede climate action discourages coordinated voluntary action from the sector. This has led to the dissolution of the UN-sponsored Net Zero Insurance Alliance and the gradual exodus from other net-zero alliances and the Science Based Target initiative.⁹⁸ As a result, individual insurers are generally reacting to escalating losses by increasing premiums and limiting coverage rather than coming together to create and implement long-term solutions to the problem of the protection gap. They typically raise annual premiums, reduce coverage (for instance by introducing higher deductibles or lower caps on the maximum sums insured),⁹⁹ impose new exclusions in insurance contracts (such as in France for subsidence-related damages to buildings),¹⁰⁰ increase their rates of non-renewal, or sometimes withdraw entirely from high-risk regions. This trend is only partially counterbalanced by the expansion of insurance coverage through product innovations such as parametric insurance.

The dilemma of public goods is further discouraging investment in nature for disaster risk reduction. Many of the benefits provided by nature, such as clean air and water or the protection that ecosystems can provide against floods, are public goods, meaning they are non-exclusive and available to everyone. This 'public good problem' makes it difficult to incentivize private investment in nature-based solutions because private actors cannot easily capture sufficient return on investment to justify the costs, while the benefits of climate action and adaptation finance are shared. This is also true for individual insurers, who have little incentive to pay for the implementation of nature-based solutions at the landscape level, given that all companies active in that area profit from the risk mitigation and prevention the nature-based solutions provide. The result is that the implementation of effective, large-scale, robust and sustainably financed nature-based solutions is often lagging, especially where local communities are fiscally constrained.

Market incentives encourage the insurance industry to take a siloed approach to resilience. Individual lines of insurance business often underwrite activities that may be detrimental to other activities. For example, most insurers still insure and finance the fossil fuel industry, to various extents. Its emissions are a major driver of climate change, with material impacts on insurers' underwriting businesses: a holistic approach to their businesses might encourage insurers to view their fossil fuel underwriting differently. To take another example, insurance companies might extend



Logging trucks on forest road. Image: Adobe Stock

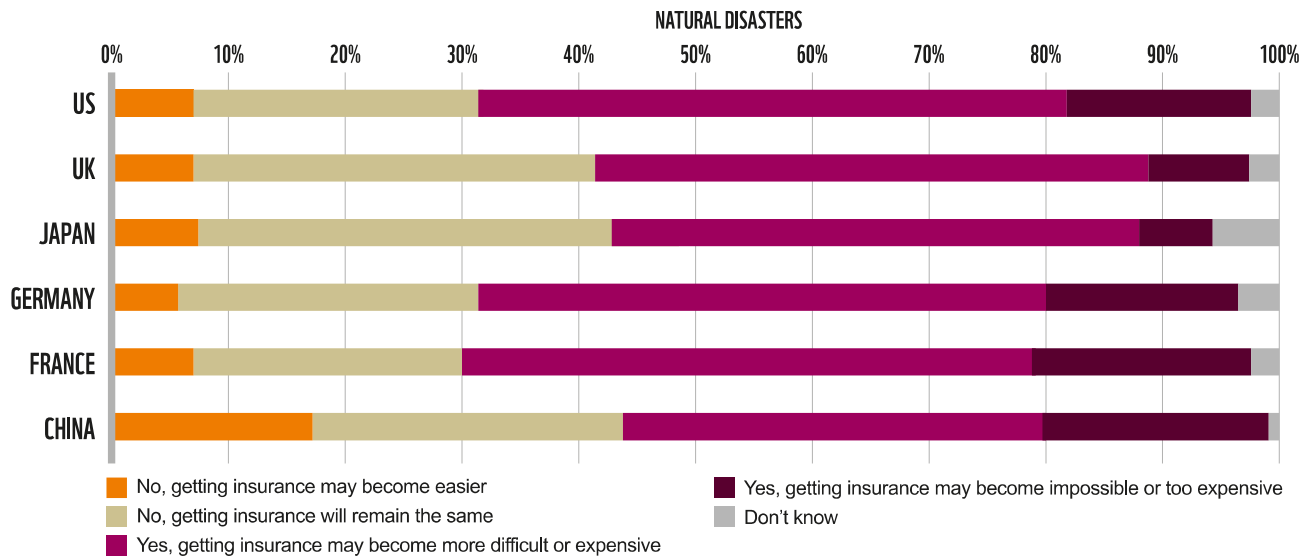
coverage to tree plantations without considering if the kind of forestry damages ecosystem services: monocultural plantations and logging can contribute to rising claims from real estate portfolios due to flooding. A new publication by the Forum for Insurance Transition therefore proposes a total balance sheet approach to climate-related risks and opportunities.¹⁰¹

Higher premiums and withdrawals from markets protect insurers' capital but leave communities and economies more vulnerable. Insurers send correct price signals when they charge risk-based premiums, or when they withdraw from regional markets where climate risks become too severe. However, when most or all individual insurers act on this logic, the cumulative effect is not an efficient insurance market but a macro-level weakening of society's overall financial capacity to withstand extreme climate events, leaving communities more vulnerable and eroding the social foundations of insurance itself. Such a reactive, microeconomic approach from insurers shifts the burden of the risk back from insurers to households, businesses and to governments, who end up bearing an increasing share of the costs. Ultimately, it also threatens insurers' own long-term business model and the stability of private insurance markets.

In highly exposed areas, many policyholders are concerned about losing access to affordable insurance but are powerless to act. The increasing frequency and severity of extreme weather events makes it progressively harder for customers to maintain sufficient and affordable insurance coverage. It is a trend that people are increasingly aware of and worried about, as illustrated in a global survey by the Geneva Association in 2023.¹⁰² However, they can do little to influence the underwriting strategies of insurance and reinsurance companies. Compared with large companies, many households and small businesses also lack the financial means to invest upfront in expensive climate adaptation measures for their assets.

FIGURE 10: CONCERNS ABOUT THE FUTURE INSURABILITY OF RISKS (RETAIL CUSTOMERS)

Are you concerned going forward that it may become more difficult or even impossible to get insurance for some of these risks?



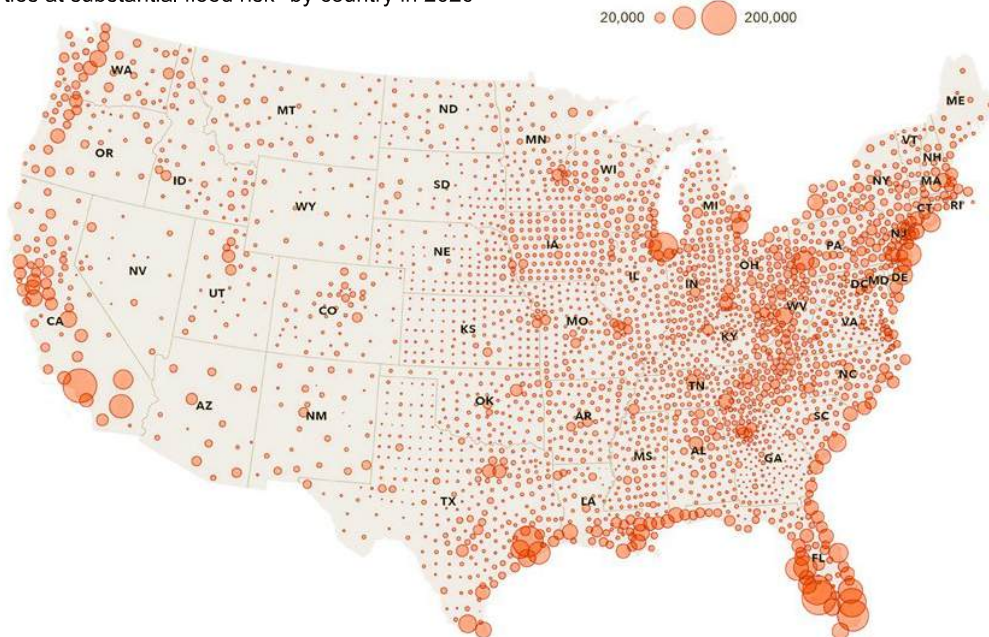
Source: Schanz, K.-U., Braun, A., Eling, M., & Jaenicke, C. (2023). Concerns about the future insurability of risks (retail customers). In *The value of insurance in a changing risk landscape*.

In new climate risk hotspots, customers lack preparedness and awareness of the need to buy insurance. Insurance is becoming critical in a growing number of places. In these emerging climate risk hotspots, many individuals and businesses remain unaware of their heightened vulnerability and of the corresponding necessity for adequate insurance protection. In the United States, a comprehensive national analysis by the First Street Foundation found in 2020 that 14.6 million properties across the country are at substantial

risk of flooding, a figure significantly higher than previous official estimates. Almost 6 million of these are not within a designated Federal Emergency Management Agency (FEMA) floodplain, meaning that their owners may be unaware of or underestimate their true flood risk from riverine, rainfall, storm surge and tidal flooding – and not appreciate their need to seek insurance against these events.¹⁰³ The deadly summer 2025 floods in Texas also illustrate this: owners of some flooded properties had lobbied to be removed from the flood risk map.¹⁰⁴

FIGURE 11: PROPERTIES WITH SUBSTANTIAL FLOOD RISK – UNITED STATES

Number of properties at substantial flood risk* by country in 2020



Source: First Street. From *The First National Flood Risk Assessment: Defining America's Growing Risk* report 2020, authored by First Street listed on firststreet.org. Reprinted with permission.
 *Substantial risk is calculated as inundation 1 cm or more to the building in the 100-year return period (1% annual risk). See methodology for full model details.

The insurance industry is starting to speak up about protection gaps. Some business leaders within the insurance industry have recently sounded the alarm about the widening protection gap and the challenges to insurability amid escalating climate and nature risks. For example:

- Günther Thallinger, one of Allianz’s executive board members, has warned that, as temperatures continue to rise, many risks may soon become uninsurable, potentially triggering systemic market failures and destabilizing the economy.¹⁰⁵ He has also noted that biodiversity is key to supporting resilience.¹⁰⁶

“Once we reach 3°C of warming, the situation locks in [...] risk cannot be transferred (no insurance), risk cannot be absorbed (no public capacity), and risk cannot be adapted to (physical limits exceeded) [...] and with it, capitalism as we know it ceases to be viable.”

GÜNTHER THALLINGER,
MEMBER OF BOARD OF MANAGEMENT OF ALLIANZ.¹⁰⁵

- Allianz has also published a transition plan which states that increasing risk and the growing insurance gap threaten the foundations of economic stability.¹⁰⁷
- Zurich Insurance has emphasized in a recent strategy report the dual imperative of decarbonization and resilience building, stressing that insurers alone cannot bridge the protection gap without coordinated support from governments and policymakers.¹⁰⁸
- Howden has published a report, called *The insurability imperative*, stressing that “we don’t have the luxury of delay. Risks are compounding, consequences escalating, and the cost of inaction is clear. So this is the moment of reckoning and now is the time for insurers, businesses, and governments to act collaboratively.”¹⁰⁹
- In the Netherlands, a.s.r. has repeatedly emphasized that public-private solutions are vital to close the Dutch primary flood insurance protection gap.¹¹⁰

These emerging voices reflect the growing realization that traditional market reactions are no longer sufficient. They are calling for innovative approaches and long-term collaborative strategies that safeguard insurability and preserve financial stability in a rapidly evolving climate risk landscape.

3.2 THE IMPACT OF ESCALATING CLIMATE RISKS ON PROPERTY INSURANCE

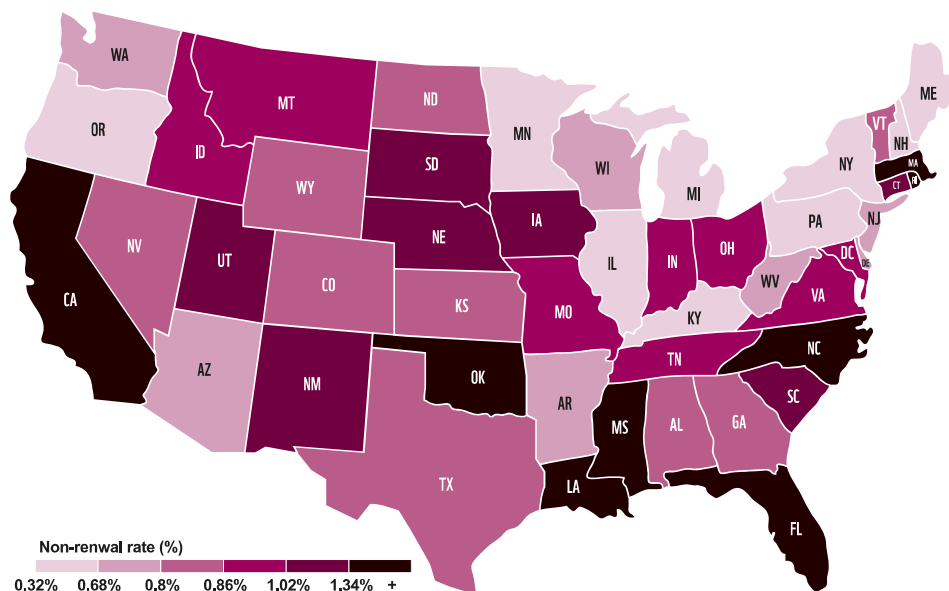


3.2.1 HIGHER PREMIUMS AND REDUCED COVERAGE

Extreme weather is upending US home insurance markets, leaving millions with pricier options, or none at all.

US insurers are increasingly retreating from markets where losses from extreme events are becoming too frequent and severe to bear economically.¹¹¹ Since 2018, more than 1.9 million home insurance contracts nationwide have not been renewed¹¹² (see Figure 12). While some of the affected homeowners were able to find insurance from other providers, often at higher prices, others have been forced to layer multiple insurance contracts, providing only partial coverage, to rely on state-created insurance pools (which are becoming the fastest growing insurers in many states), or to forego insurance altogether.

FIGURE 12: MAP OF AVERAGE NON-RENEWAL RATES BY STATE (2019-2023)



Source: First Street. (2025). Map of Average Non-Renewal Rates by State (2019-2023). In *The 13th National Risk Assessment Climate, The 6th “C” of Credit*.

States like California, Florida and Louisiana are particularly adversely affected. The highest rates of non-renewal and exits from insurance companies are found in states suffering from frequent and devastating hurricanes, wildfires or floods. These states combine large exposures of people and assets with high vulnerabilities to extreme weather events due to insufficient climate adaptation efforts. In California:

- Increasing wildfire losses have prompted insurance companies to change underwriting strategies and to reduce their exposure to properties, leading to a growth in the state-created FAIR insurance plan.
- Some major companies have stopped writing new policies, while others have increased their non-renewals of existing policies.¹¹³
- LendingTree estimates that nearly 10 per cent of properties are uninsured in Los Angeles.¹¹⁴

Regulatory reforms to allow premiums to increase in line with the rising risk of wildfires are seen as a critical factor to addressing the protection gap in California, pointing to a trade-off between affordability and availability of insurance.¹¹⁵

In Florida:

- Seven insurance companies were liquidated in 2021 and 2022 alone, cancelling policies and leaving homeowners scrambling to find new coverage.¹¹⁶
- Many national, out-of-state companies have withdrawn due to intensifying climate risks, leaving predominantly smaller, in-state insurers with fewer resources to manage catastrophic events.¹¹⁷
- As a consequence, the nonprofit, public Citizens Property Insurance Corporation has emerged as the fastest-growing insurance company in Florida.¹¹⁸

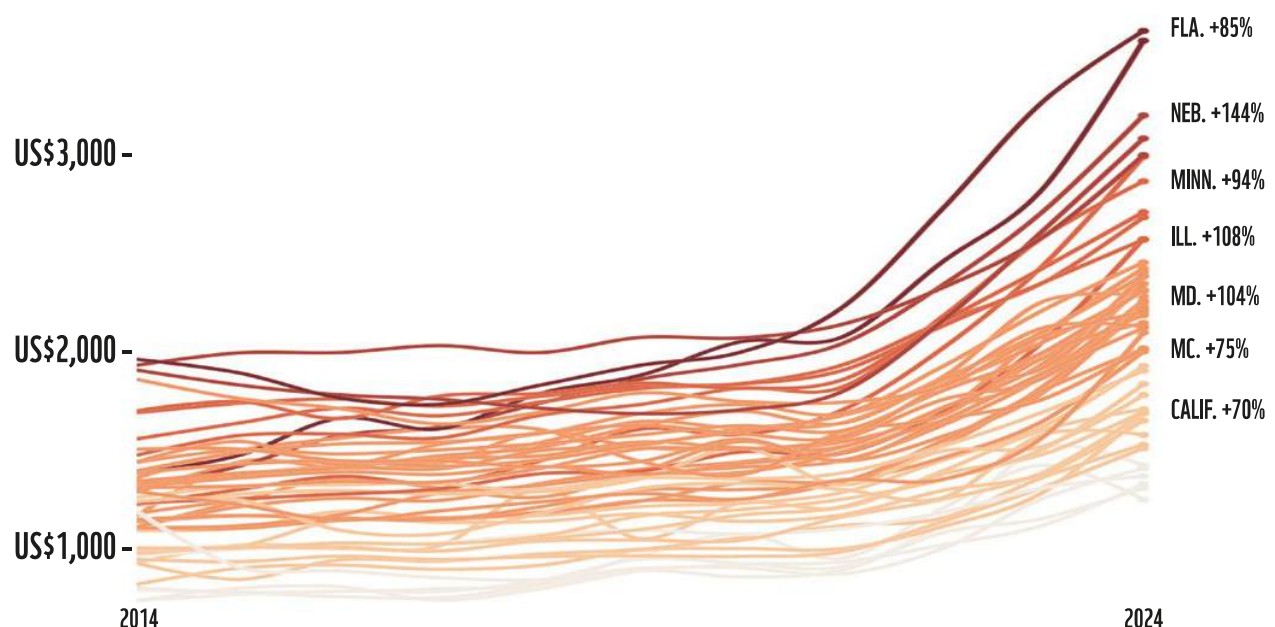
In Louisiana:

- Twelve insurers writing homeowners' coverage were declared insolvent between July 2021 and February 2023, following intense hurricane activity in 2020 and 2021.¹¹⁹

The home insurance crisis is happening to varying degrees across the whole United States, driving up premiums. Severe convective storms are causing substantial insurer losses in the Mid-West, the interior south and New England. In Iowa, four insurers left the market entirely in 2023 due to climate-driven losses.¹²⁰ Insurers are imposing major rate increases in many states.¹²¹ Overall, American homeowners experienced a 38 per cent increase in insurance premiums between 2019 and 2024,¹²² which is almost twice as fast as inflation during the same period. Figure 13 shows the extent of increases in average annual home insurance premiums in various US states between 2014 and 2024.¹²³

Bloomberg estimates that rising home insurance premiums could divert up to 4.6 per cent of spending nationally away from non-discretionary items and services.¹²⁴ Another analysis from 2024 shows that Florida retirees spend 34 per cent of their retirement income on home insurance, which is more than four times the national average for retirees of 8 per cent.¹²⁵ In Louisiana's Orleans Parish, insurance represents nearly 30 per cent of the average homeowner's total housing payments, which include mortgage costs and property taxes.¹²⁶ It is estimated that American households faced approximately US\$21 billion in additional insurance costs over 2021-24.¹²⁷ In addition, US homeowners facing flood risk are contending with increased prices for flood insurance provided by the National Flood Insurance Program,¹²⁸ where premiums for households are subsidized but which are potentially actuarially unsustainable.¹²⁹

FIGURE 13: AVERAGE ANNUAL HOME INSURANCE PREMIUMS



Continental Europe faces similar challenges. European data on insurance pricing is generally not available with the same level of granularity as in the US. However, research by EIOPA shows that private insurance against natural catastrophes risks becoming increasingly unaffordable or unavailable in several countries.¹³⁰ In France, for example, the latest climate scenario exercise undertaken by the central bank highlights concerns about the future availability and affordability of insurance.¹³¹ Most French insurers responding to the survey indicated that they are either already implementing or considering higher premiums, as well as potential new exclusions based on geography to better manage their exposures. Similarly, one of Austria's leading insurers is now considering no longer covering certain regions or adjusting its products following Storm Boris in September 2024, because of the significant increase in claims linked to climate- and nature-related disasters.¹³²

The climate crisis is also affecting home insurance in Britain and Ireland. The United Kingdom traditionally has a high property insurance penetration rate, but increasingly frequent and severe storms and rainfall have led to higher claim costs in recent years.¹³³ The average cost of home insurance in the UK rose by 19 per cent between 2023 and 2024.¹³⁴ Despite the stabilizing effect provided by the public-private partnership Flood Re,¹³⁵ the country faces a rising risk of long-term uninsurability due to climate change, with flood risk being the main concern; in Worcestershire, for example, some town centres may become uninsurable, forcing residents and businesses to relocate.¹³⁶ Flood Re covers residential UK properties which have been built before 2009 but does not extend to businesses or to recent residential properties. It is mandated to end in 2039, but 20 per cent growth in the properties ceded to the scheme between 2024 and 2025 show how reliance on the programme is growing rapidly at a time when it should be starting to taper off. Meanwhile, in Ireland, homeowners in County Cork are facing a flood insurance crisis following severe flooding from Storm Babet in 2023, with insufficient insurance coverage leaving many vulnerable to financial loss and potential homelessness if another major storm occurs.¹³⁷

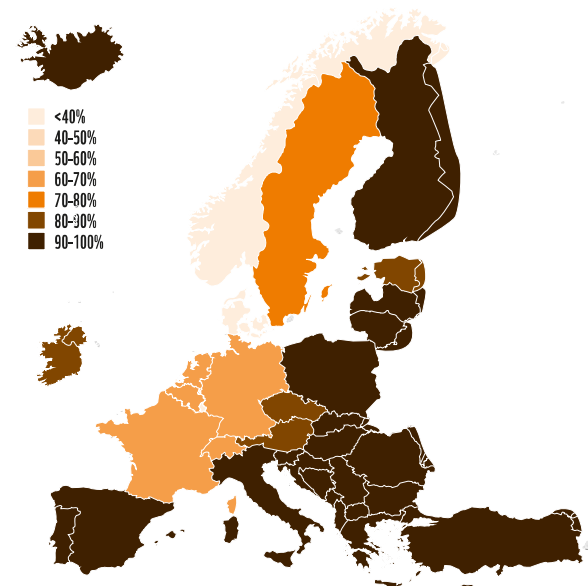
Other regions and commercial properties are also experiencing climate-related property insurance pressures. Australia stands out as another striking example of a climate risk hotspot where policyholders are feeling the strain. Reports indicate that more than 15 per cent of Australian homeowners now allocate the equivalent of at least one month of their gross household income to annual insurance premiums.¹³⁸ With extreme weather events such as bushfires, floods and storms becoming more destructive, the cost of insurance is rising sharply, leaving many Australians at risk of being priced out of adequate coverage.¹³⁹ Beyond insurance for residential properties (i.e., home insurance), reliable data on property insurance premiums is much more difficult to capture, but the limited available evidence indicates that commercial buildings and industrial property also face higher premiums. For example, the Deloitte Center for Financial Services forecasts that the average cost of insurance for a commercial building in the United States could double by 2030 in the states most affected by extreme weather.¹⁴⁰

3.2.2 THE RESULTING CLIMATE INSURANCE PROTECTION GAP

Most climate-related disaster losses worldwide remain uninsured. The climate insurance protection gap measures the extent to which people, businesses and economies are exposed to financial risk from climate disasters without adequate insurance to help them recover. Gallagher Re, an international reinsurance broker, estimates that the global protection gap for natural catastrophes (which include earthquakes and volcanic activity as well as extreme weather events) amounted to 63 per cent for 2024 – i.e., only around a third of the economic losses were insured.¹⁴¹

Global headline protection gap numbers mask wide regional and peril-specific trends. Global averages for the protection gap are primarily influenced by developed countries with high insurance penetration and high real estate prices and asset values, and especially by trends in North America, which accounted for almost 80 per cent of global insured losses in 2024. The aggregated protection gap hides major differences between geographies, perils, types of assets and lines of insurance business, with the protection gap in some developed countries (such as Italy or Portugal) exceeding 90 per cent.¹⁴²

FIGURE 14: INSURANCE PROTECTION GAP IN EUROPE (1980-2023)¹⁴³



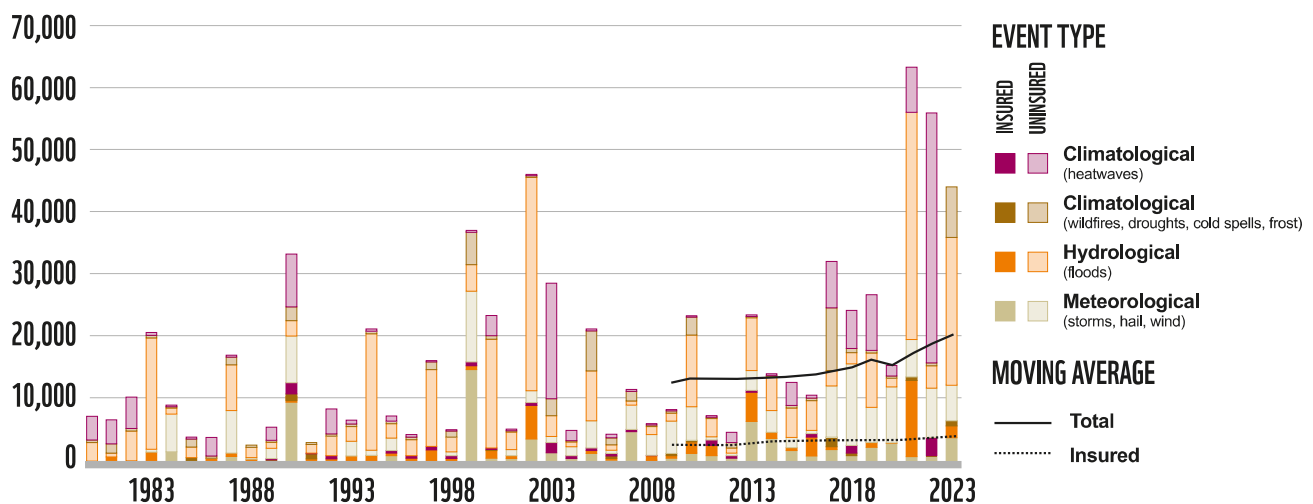
Source: European Environment Agency. (2025). Economic losses and insurance protection gap in the period 1980-2023. In Economic losses and fatalities from weather- and climate-related extremes.

The relative size of the global protection gap has been stable, but absolute uninsured losses are rising. Globally, the percentage of economic losses from natural catastrophes that are not covered by insurance has remained stable in relative terms over the last decade.¹⁴⁴ However, it is not the relative gap but the absolute economic value which matters most to the households, businesses and governments that must pay for uninsured losses. Based on numbers reported by Swiss Re,¹⁴⁵ we calculated that global uninsured losses have increased on average between 6 per cent and 10 per cent annually in real terms between 2015 and 2024.

The US protection gap is deepening both in size and geographical reach. According to data from the Census Bureau, 13.4 per cent of homeowners across the US did not have homeowner insurance in 2024,¹⁴⁶ compared with 7.4 per cent in 2021.¹⁴⁷ There are also growing protection gaps in areas previously considered at lower risk from extreme weather events. For example, parts of Massachusetts, particularly Cape Cod,¹⁴⁸ are emerging as new hotspots where rising climate hazards and severe weather events are undermining the availability and affordability of home insurance. The situation is equally alarming in the Mountain West region, where states like Idaho are now experiencing increased claims and premium hikes.¹⁴⁹ In Hawaii, the insurance crisis has also evolved into a significant local issue, with drastic premium increases and coverage concerns.¹⁵⁰

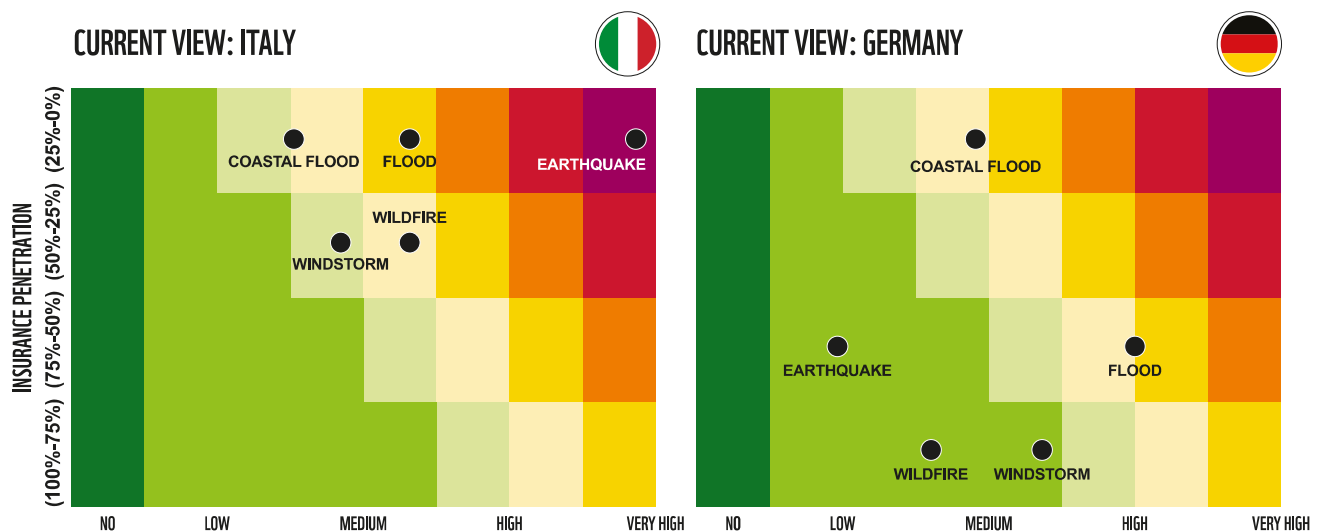
The protection gap in Europe is also large, growing and heterogeneous. Analysis from the European Environment Agency (EEA) shows that, over the period 1980-2024, only around 20 per cent of economic losses from extreme weather and climate-related events were covered by insurance. The EEA analysis also shows a trend towards a widening of the protection gap in absolute terms in recent years, as illustrated by Figure 15 below.¹⁵¹ At the country level, the EIOPA protection gap dashboard highlights that a substantial proportion of economic losses often remain uninsured. For example, customers in Germany (for floods) and Italy (for most perils) face significant risk exposure and material gaps in insurance coverage, as illustrated below.¹⁵² Europe is also warming faster than the global average:¹⁵³ for example, France foresees a temperature rise of up to +4°C (7.2°F) by 2100.¹⁵⁴ This rapid warming is changing risk profiles by exposing regions once considered to be at relatively low risk, and it will continue to push the insurance crisis into new areas.

FIGURE 15: EU-27 COUNTRIES: TOTAL AND INSURED LOSSES BY YEAR FROM WEATHER- AND CLIMATE-RELATED EVENTS



Source: European Environment Agency, (2025), EU-27 Countries. In Total and insured losses by year from weather- and climate-related events.

FIGURE 16: CURRENT INSURANCE PENETRATION VS. RISK ESTIMATION IN ITALY AND GERMANY ACROSS HAZARD TYPE



Source: EIOPA, (2025), Dashboard on insurance protection gap for natural catastrophes.

3.3 HOW CLIMATE CHANGE AND NATURE LOSS AFFECT ALL INSURANCE SECTORS

Climate change is reshaping risk across all insurance lines, not just property insurance. The current public discussion about the protection gap focuses mostly on property insurance and on how homeowners (as well as some businesses) face increasing challenges in obtaining adequate and affordable cover against extreme weather events. However, as highlighted in a 2021 Geneva Association report,¹⁵⁵ climate change affects a broad range of economic sectors and insurance lines. For example, consultancy Public First has pointed out that the continued rise of flood risk in the United Kingdom will not only affect properties, but also critical infrastructure, workplace absences and economic output.¹⁵⁶ In the rest of this chapter, we explore further examples of climate impacts on liability insurance, business interruption insurance, insurance for critical infrastructure, agricultural insurance and health insurance.

3.3.1 CLIMATE LITIGATION AND LIABILITY INSURANCE



Climate litigation is on the rise and is increasing liability risks. Climate change can affect liability insurance through claims for economic damage arising from environmental and climate-related harm, as companies, governments and other organizations face lawsuits over their role in contributing to or failing to mitigate climate impacts.¹⁵⁷ The potential for a further rise in climate-related litigation has been reinforced by the July 2025 landmark opinion from the International Court of Justice, which affirmed that states have legally binding obligations under international law to prevent significant harm to the climate system and to protect human rights from the impacts of climate change.¹⁵⁸

Legal pressures are cascading into liability insurance and the wider insurance system. The financial sector, including insurance providers, reinsurers and intermediaries, is increasingly exposed to the consequences of climate-related litigation.¹⁵⁹ For example, when insurers' corporate clients are targeted in climate-focused lawsuits, they may face substantial legal costs and indemnity payments under directors and officers (D&O) liability policies. Such claims can stem from inadequate climate risk disclosure, failure to adapt business practices or direct contributions to environmental harm. In addition, insurers may face legal disputes over climate damage payments, for example around the question of whether pollution exclusions extend to climate change claims.¹⁶⁰

3.3.2 SUPPLY CHAIN DISRUPTION AND BUSINESS INTERRUPTION INSURANCE



Climate change is a growing threat to supply chains and global trade. Extreme weather events can disrupt production and transportation networks and threaten critical supplier sites, particularly in industries such as technology, automotives and consumer goods.¹⁶¹ The 2024 floods in Valais, Switzerland are a good example of such climate-related disruptions to supply chains. Flooding led to the shutdown of the Novelis factory in Sierre, a key supplier of aluminium alloys used in car manufacturing. As a result, carmaker Porsche faced production delays and financial losses estimated between €1 billion and €2 billion.¹⁶² Prolonged droughts can also affect inland waterways, such as in the case of low water levels in the Rhine river disrupting trade by forcing ships to reduce cargo loads, increasing transportation costs and creating bottlenecks in Germany's industrial production.¹⁶³ In the United States, 52 per cent of the indirect economic losses caused by the 2018 California wildfires occurred outside of the state, due to supply-chain linkages.¹⁶⁴

FIGURE 17: NUMBER OF CLIMATE LITIGATION CASES IN AND OUTSIDE THE US (1986-2025)

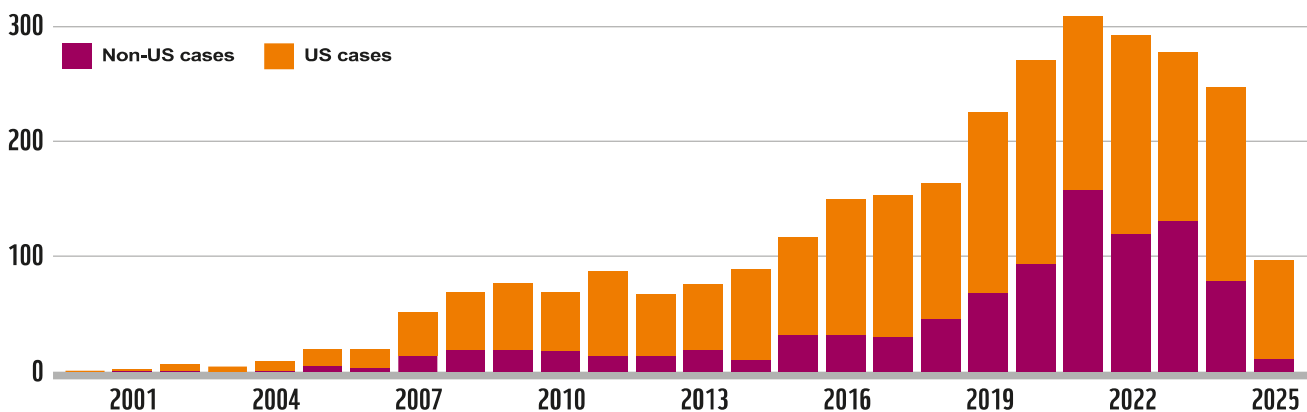
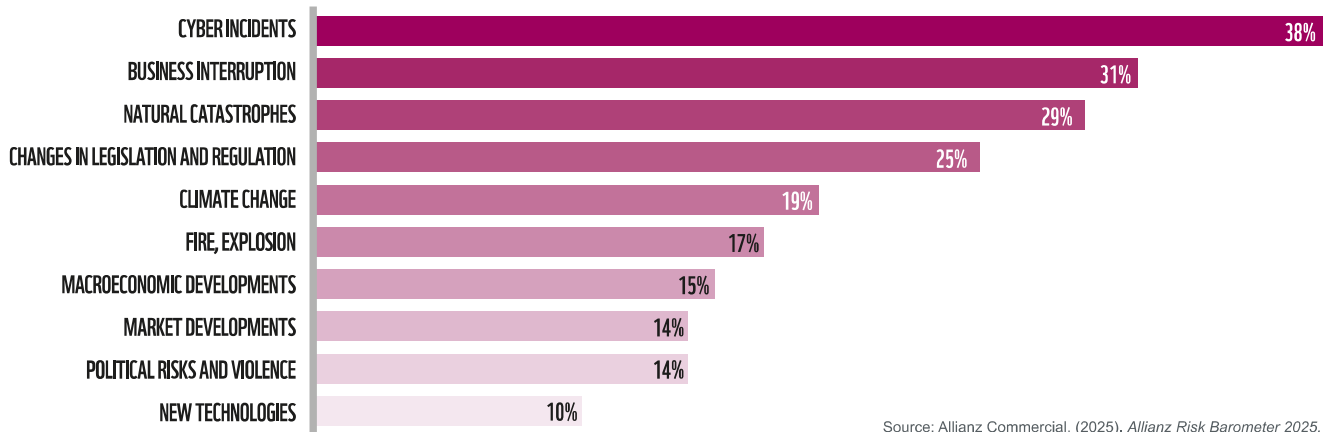


FIGURE 18: ALLIANZ RISK BAROMETER 2025

Figures represent the number of risks selected as a percentage of all survey responses from 3,778 respondents. All respondents could select up to three risks per industry, which is why the figures do not add up to 100%.



As extreme weather intensifies, the demand for and the cost of business interruption insurance are rising.

Several signs point to material impacts from climate change on this line of business. Demand has increased due to the rising frequency and severity of climate- and nature-related disasters,¹⁶⁵ and business interruption is consistently ranked among the top risk concerns in Allianz's Risk Barometer.¹⁶⁶ At the same time, the size of the average business interruption claim is rising in line with the cost of rebuilds, repairs and labour, together with potential shortages of materials and longer delivery times and waiting periods.¹⁶⁷

There is no widely agreed-upon number for the business interruption protection gap, but the problem is real.

This gap is complex to quantify due to the diversity of business types, the varying levels of insurance coverage and the different ways in which business interruptions can occur (e.g., climate- and nature-related disasters, cyber-attacks, pandemics). Standard business interruption insurance often requires direct physical damage to the insured's property, such from as floods or fires, to trigger a claim. Many climate-induced supply chain disruptions, such as transport network failures or upstream supplier failures, are not covered, or only to a limited extent.¹⁶⁸ Insurers can also require detailed disclosure of supply chain dependencies and may only cover specific, named suppliers, leaving coverage gaps if the chain is more complex or changes over time. As a result, many businesses are underinsured against climate-driven supply chain disruption, increasing their exposure to crippling financial losses when disaster strikes. Large companies are more able to access and afford comprehensive supply chain coverage, while SMEs may find premiums prohibitive or coverage insufficient for their needs.

3.3.3 INSURANCE FOR INFRASTRUCTURE AND NATURAL ASSETS



Climate change is disrupting a whole range of energy, transportation and technology systems. In California¹⁶⁹ and Texas,¹⁷⁰ extreme heat and wildfires are repeatedly straining power grids, causing surging energy demands from air conditioning and blackouts. In Puerto Rico, Hurricane Maria in 2017 caused one of the longest blackouts in US history.¹⁷¹ Ports and shipping infrastructure are also increasingly exposed to climate hazards. Major ports like Rotterdam, New York, Shanghai and Singapore already face risks from storm surges and coastal flooding, as exemplified by Hurricane Sandy's impact on New York in 2012. More recently, the 2024 floods in Valencia, Spain, sharply reduced local port activity.¹⁷² Technology systems are also impacted by climate change. In major hubs such as California and India, water shortages are becoming more frequent while extreme heat drives up the need for cooling in data centres. In California, data centres now consume up to 10 per cent of the state's electricity, with about 40 per cent used solely for cooling.¹⁷³

Infrastructure insurance varies widely, leaving critical assets underinsured or dependent on public insurance.

For infrastructure such as power grids, transportation networks or water systems, the degree of private insurance coverage varies significantly, depending on the type of asset, local policies and available financial resources. Public infrastructure is usually not formally insured, and many governments choose to self-insure, relying on public budgets to fund repairs after disasters. In New York City for instance, the Port Authority of New York and New Jersey has tripled the level of damages that it self-insures in recent years because the cost of coverage provided by private insurers has become too high.¹⁷⁴ In many instances, such public insurance can be efficient, yet governments need to make sure that the required funds are readily available and easily deployable, including to underrepresented communities.

Gaps in insurance coverage leave infrastructure vulnerable to costly, drawn-out disruption. Without sufficient private or public insurance, the economic consequences of extreme weather on critical infrastructure can extend beyond temporary outages and spiral into prolonged economic hardship. The burden of financial recovery shifts on to local businesses or governments, draining reserves, forcing austerity measures and potentially triggering closures or public service reductions. For example, after Hurricane Ian hit Florida in 2022, some localities faced extended delays in rebuilding public utilities and road access as they struggled to bridge funding gaps, often relying on overstretched public budgets or emergency federal aid.¹⁷⁵ Conversely, swift insurance payouts (whether from private or public insurance) can accelerate restoration efforts, allowing businesses to resume operations, supply chains to recover and essential services to normalize.

The protection gap for nature is nearly 100 per cent. Nature as a public good shares similarities with public infrastructure. Like man-made infrastructure, it can be destroyed by extreme weather and faces costs for its restoration. However, there is only very limited private insurance coverage for natural assets and ecological restoration.¹⁷⁶ See Textbox 4 for more information.

3.3.4 AGRICULTURAL INSURANCE



Climate change negatively impacts crop yields and livestock production in most regions. A warmer climate and more volatile weather will reduce global agricultural output even when farmers adapt.¹⁷⁷ Fertile agricultural regions like the American Midwest are facing potentially severe future declines, while some areas in northern countries such as Canada and Russia might benefit from improved conditions. The poorest farmers will be hurt the most, as they have fewer resources to enable them to adapt and can be vulnerable to even small declines in productivity.¹⁷⁸ Data on the effects of climate and nature risks on agricultural insurance premiums is lacking, especially since their effects are very difficult to isolate as commodity prices, farmers' adaptation practices and other factors also influence claims.



Cows grazing in field during drought. Image: Freepik

Large protection gaps leave many European farmers financially exposed to climate-driven disasters. While around 90 per cent of US corn, soybean and cotton farmland and more than 85 per cent of wheat farmland is covered by the taxpayer-subsidized federal crop insurance programme,¹⁷⁹ the protection gap is much larger in Europe, with on average only 20 to 30 per cent of farmers' losses being insured against climate events such as droughts and floods.¹⁸⁰ Most European farmers are left financially vulnerable and are reliant on government support to recover from major climate-related disasters. Drought is the primary peril for agriculture across Europe, and is responsible for the largest share of both agricultural insurance claims and uninsured losses. The global effects of droughts on crop yields, as well as the need for agricultural insurance to incentivize resilient farming practices, are further explored below in a case study from Allianz (see page 31).

Insufficient and expensive insurance compels governments to step in with subsidies. Taxpayers often subsidize agricultural insurance as, for example, is the case with the United States Federal Crop Insurance Program,¹⁸¹ in France,¹⁸² and in Austria with hail insurance.¹⁸³ In the Netherlands, the Bredeweersverzekering government programme offers comprehensive weather insurance subsidies; it was initially meant to be temporary, with a view to it generating sufficient participation for the private agricultural insurance market to step in and replace the scheme. Subsidies have increased participation, but net premiums are still so high that many farmers choose not to purchase insurance, and the market would likely shrink without government support.

Governments also provide direct disaster relief after extreme weather events to compensate for the lack of insurance. In Spain, for example, the government responded to the devastating 2023 drought with an unprecedented €2.2 billion emergency package.¹⁸⁴ In the UK, floods in 2024 prompted targeted recovery payments to 13,000 farm businesses.¹⁸⁵ Such emergency interventions strain public finances and risk fostering long-term dependency on government bailouts. In addition, emergency public aid may not be efficiently allocated. In the United States, some aid packages from the US Department of Agriculture have been criticized for not reaching the most vulnerable producers.¹⁸⁶

Current agricultural insurance policies often encourage practices that further harm the environment. A key consideration regarding the protection gap in agriculture is not only the overall availability of insurance, but also which types of agricultural practice benefit from this financial safety net. As noted in WWF's 2023 *Underwriting Our Planet* report,¹⁸⁷ insurance coverage and government subsidies have historically favoured farmers engaged in intensive, large-scale agriculture. This was also highlighted in the case of the US farming and insurance system in a report from the Rockefeller Foundation.¹⁸⁸ Moreover, in the United States, the federal crop insurance programme does not recognize in its rates the risk reduction benefits of regenerative agriculture practices, thus disincentivizing nature-based approaches to agriculture. By underwriting and effectively incentivizing intensive and non-nature-based farming methods, governments and insurers indirectly contribute to further nature loss and climate change, since such practices are closely linked to land conversion, biodiversity loss and increased GHG emissions. Conversely, by aligning agriculture insurance offerings with global climate and biodiversity goals, the insurance sector could help reverse harmful trends and promote more resilient, nature-positive food systems.



Wheat field during drought Image: Shutterstock

CASE STUDY 1: DROUGHT AND CROP YIELDS: WHEN CROPS FAIL, INSURANCE MATTERS

Author: **Hazem Krichene**, Senior Climate Economist, Allianz

Agriculture is increasingly affected by extreme weather, which can reduce farm productivity, yields and incomes. Its effects are felt not only by farmers but also by wider local economies.¹⁸⁹ In Europe, the United States, Australia or Brazil, farmers face rising volatility in crop yields as climate shocks turn from occasional crises into structural risks.^{190,191,192} Climate variability already affects almost 80 per cent of wheat-producing regions worldwide,¹⁹³ underlining the scale of the risk. Looking ahead and considering tipping points, an OECD study concludes that, under a 2.5°C average temperature increase, combined with the collapse of the Atlantic Meridional Overturning Circulation (AMOC), half of suitable land for maize and rice could be lost.¹⁹⁴

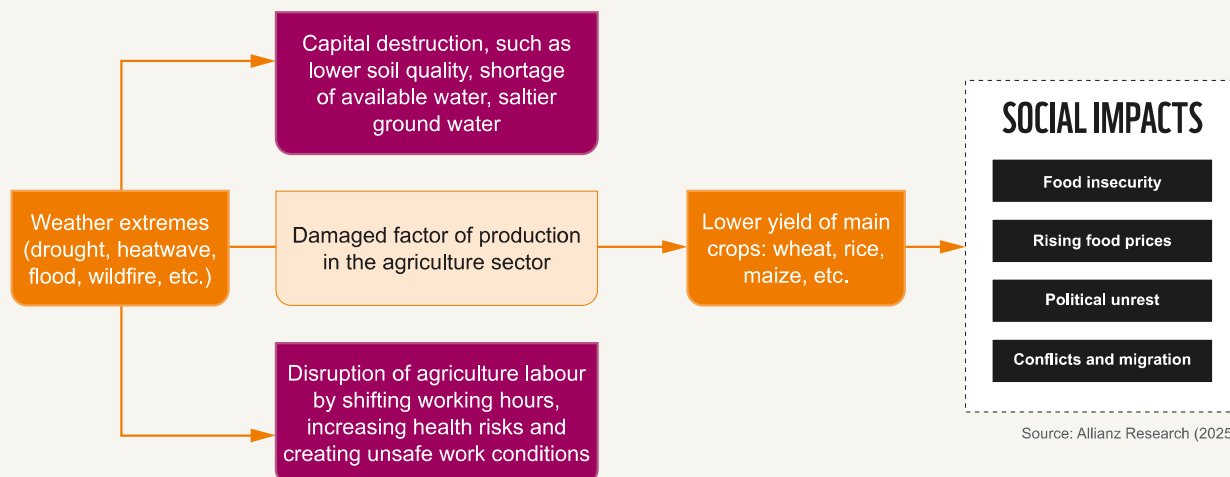
Excess rainfall, flooding, frost and hail cause substantial and increasing damages, yet heat and drought are the most damaging hazards for crop harvest. Droughts in particular heighten food insecurity and can be financially devastating when they occur during critical growth stages, i.e., after sowing, when seedlings establish, during booting and ear emergence, and just before grain fill. In France, the dry summer of 2003 caused losses to the agricultural sector of €4 billion,¹⁹⁵ while in Germany, the 2018/19 drought resulted in damages to agriculture of about of €7.8 billion.¹⁹⁶

Farmers in other regions confirm the severity of this risk: in Australia, 81 per cent reported rainfall deficits and drought as their most significant challenge.¹⁹⁷

The evidence is consistent across studies and regions: drought is the most damaging climate extreme for agriculture, and its frequency and intensity are projected to rise, particularly in southern Europe. In 2022 and 2023, Spain experienced prolonged periods of water scarcity. The drought is estimated to have reduced wheat and barley yields by between 20 per cent and 30 per cent, on average.¹⁹⁸

Dry conditions in one region can cause cascading impacts. The 2010-11 drought in China affected most of its wheat-producing regions.¹⁹⁹ As extreme drought conditions threatened domestic wheat production, China responded by purchasing large quantities of wheat from global markets. This move contributed to a doubling of global wheat prices, with profound consequences for importing nations. In Egypt, bread prices tripled, exacerbating economic stress and fueling public unrest during an already volatile political moment. This sequence of events, from drought to food price shocks to civil unrest, highlights the complex and often underappreciated links between climate hazards, agricultural markets and political stability at both local and global scales.

FIGURE 19: CLIMATE SHOCKS, CROP PRODUCTION AND SOCIAL STABILITY



Source: Allianz Research (2025)

Climate change is already putting pressure on the world's major crops (wheat, maize, rice and soybean) and yields are expected to decline further as droughts intensify. To assess the impact, we examined high-resolution global crop yield data from 1980 to 2016,²⁰⁰ analyzing how droughts, measured by the 12-month Standardized Precipitation-Evapotranspiration Index (SPEI),²⁰¹ affected yields at the subnational level.²⁰² Our results are statistically robust and show a clear negative effect of drought on all four crops.ⁱⁱⁱ

Looking ahead, we used projections of drought conditions under the SSP5-8.5 climate change scenario,²⁰³ a pathway marked by high emissions and limited climate action, likely resulting in around 3°C of global warming. Based on this scenario, we estimate how future drought trends will affect crop yields by 2050. Figure 20 shows the global distribution of drought impacts on crop yields, highlighting how climate change, via more frequent and intense droughts, will reshape agricultural productivity.

The maps illustrate the projected deviation in yields for wheat, maize, rice and soybean under the high-emissions SSP5-8.5 scenario, relative to a baseline where drought intensity (as captured by the 12-month SPEI) remains consistent with the historical average. The findings reveal a broad and significant decline in agricultural yields due to drought. Maize, wheat and soybean are especially vulnerable, with projected yield reductions reaching up to -9.2 per cent, -7.1 per cent and -4.1 per cent, respectively. These losses are concentrated in major producing regions, including Australia, Pakistan

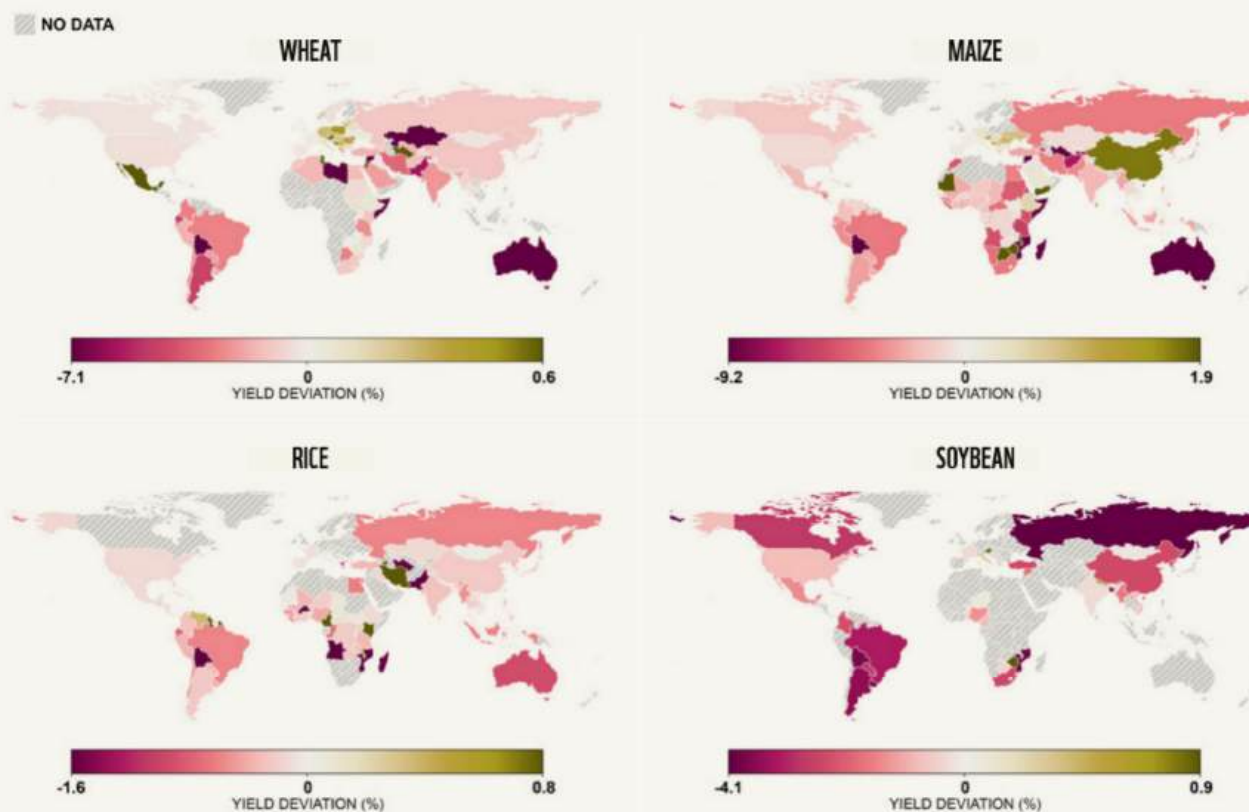
and Kazakhstan for wheat, and across large parts of South America for soybean.

These significant declines in crops harvested are just a part of total expected losses when temperatures increase. Total expected crop losses due to increased temperatures are also affected by the other extreme weather events mentioned above and by chronic risks such as the depletion of aquifers, soil degradation and pollution.

Agricultural insurance is a critical instrument for cushioning the financial impact of extreme weather and limiting debt burdens.²⁰⁴ By providing compensation for weather-related losses, it reduces farm-level economic vulnerability. As climate change drives more frequent and severe extremes, insurance becomes not only a safety net but also an essential component of broader adaptation strategies, supporting farmers in sustaining production and income under growing uncertainty. Therefore, many governments across the US, the EU and other European countries provide subsidies for crop insurance.

However, agricultural insurance alone is not enough. It needs to be combined with resilient and sustainable production. Incentives created by agricultural insurance should be aligned with resilient farming practices as well as with the restoration of ecosystems including soils, forests and wetlands, to help protect local water and nutrient cycles. Otherwise, losses might increase to the point where insurability could be challenged.

FIGURE 20: CROP YIELD DEVIATION UNDER THE SSP5-8.5 SCENARIO



Source: Allianz Research (2025)

iii. We use a three-ways fixed effect panel model with OLS regression with a region-clustered robust covariance

3.3.5 HEALTH INSURANCE



Climate change poses a serious threat to human life and health by causing diseases and injuries and exacerbating existing health problems. The effects of climate change are not limited to the direct impacts of extreme weather events (such as deaths and injuries from hurricanes or wildfires) or to heat stress on the human body,²⁰⁵ but they also include chronic and secondary effects. These include the greater geographical range of vector-borne diseases linked to the spread to new areas of mosquitoes (including dengue fever, malaria, zika virus, chikungunya, yellow fever and West Nile virus) and ticks (which carry Lyme disease and tick-borne encephalitis), as well as respiratory diseases, cancer and allergies (e.g., due to air pollution, exacerbated by rising temperatures and wildfires). In addition, climate change threatens to increase mental health disorders (with heat, climate- and nature-related disasters and environmental changes leading to or exacerbating anxiety and depression, for example). The IPBES Nexus report offers a comprehensive discussion of the climate, biodiversity, water, food and health nexus.²⁰⁶

Extreme heat is of particular concern when it comes to climate-related health costs. The July-August 2003 heatwave in Europe led to an estimated excess mortality of over 70,000 people, mostly among the elderly.²⁰⁸ Heat-related diseases resulting from heat waves alone are projected to place an astonishing US\$7.1 trillion burden on healthcare systems worldwide, according to some estimates.²⁰⁹ One market study conducted by a large health insurer concludes that the rising prevalence of heatwaves alone could increase the health costs per capita in Europe by 4.9 per cent on average by 2035.²¹⁰

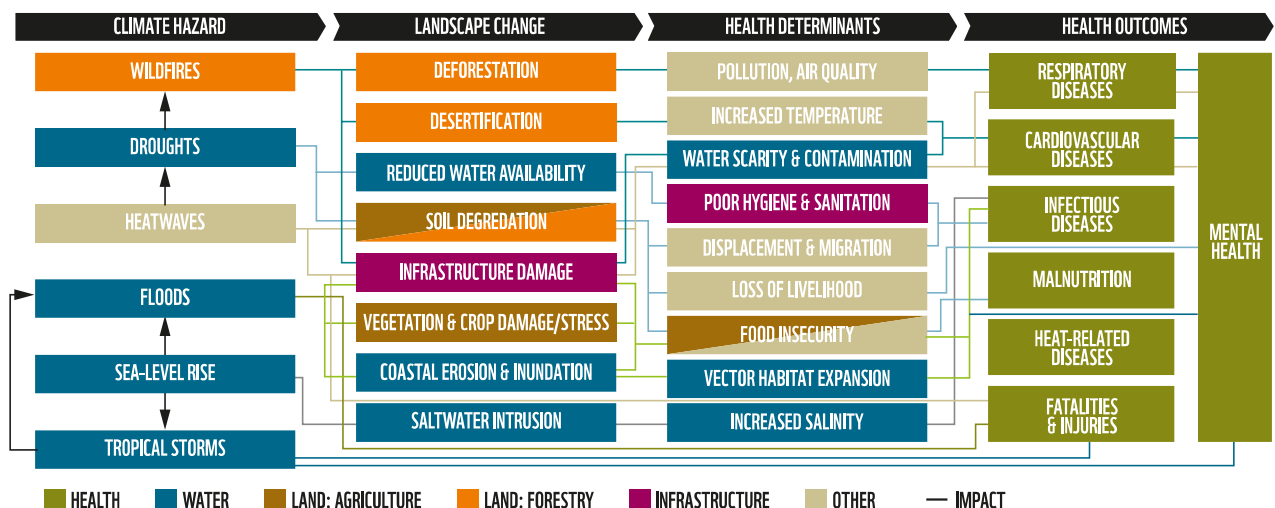
Extreme heat also causes considerable losses in productivity, which are largely uninsured. The International Labour Organization states that at least 2.4 billion workers are exposed to excessive heat, resulting in 22.8 million injuries and 18,970 deaths annually.²¹¹ It estimates the economic costs of heat stress related to health at over US\$361 billion globally.²¹² Outcomes also depend on the measures taken by governments to protect workers. For example, in 2023 Spain introduced a ban on certain outdoor work if the State Meteorological Agency

issues an alert for high temperatures and when employers cannot guarantee workers protection.²¹³ Explicit insurance coverage for productivity losses due to extreme heat is low,²¹⁴ despite the evolving offerings from insurers, for instance through parametric insurance, which offers automatic payouts based on predefined weather conditions.²¹⁵

Climate change will contribute to the reshaping of health insurance costs and coverage. The effects of climate change on health insurance premiums are difficult to quantify and appear to be limited so far.²¹⁶ However, as the health consequences of climate change and biodiversity loss become more pronounced, climate-related increases in health costs could pose significant challenges to public and private insurance schemes, potentially limiting the ability to offer quality care to everyone. For example, wildfire smoke pollution in the US is associated with significantly higher healthcare municipal borrowing costs, putting pressure on hospitals.²¹⁷ As insurers increasingly employ granular data and predictive models, health insurance premiums may also become more differentiated based on vulnerability (such as preexisting conditions made worse by higher temperatures) and geographic exposure to climate risk. In countries where health insurance coverage is low or fragmented, a widening of the insurance protection gap due to climate-related health risks would also lead to greater socio-economic inequality.

Climate and nature considerations must be further integrated in health insurance strategies. Private insurance and reinsurance companies are increasingly recognizing the impact of climate change on human life and health.²¹⁸ In its latest climate stress test for the insurance sector, the French central bank and insurance supervisor incorporated several health-related scenarios, taking into account mortality linked to prolonged heatwaves, air pollution and respiratory illnesses, and the spread of vector-borne diseases such as dengue fever.²¹⁹ Insurance industry leaders have also started to recognize the potential of nature-based solutions to reduce health-related heat stress.²²⁰ However, the role of nature as an ally to protect human life and health remains undervalued, despite having been explicitly recognized by the World Health Organization as a means to reduce health-related climate hazards, for example through urban heat island mitigation.²²¹

FIGURE 21: LINKS BETWEEN CLIMATE AND NATURE RISKS AND HEALTH OUTCOMES²⁰⁷



Source: Oliver Wyman analysis (2024).

04 THE FINANCIAL, ECONOMIC, SOCIAL AND FISCAL CONSEQUENCES OF THE PROTECTION GAP



Effects of Storm Alice in Paiporta, Spain. Image: © Brais Lorenzo

How insurers underwrite and price risks from extreme weather events has systemic consequences. If insurers underestimate or underprice climate risks, whether due to overly optimistic assumptions, limited data and methodologies, or regulatory constraints on setting premiums, they expose themselves to solvency and liquidity risks. Such vulnerabilities can undermine the stability of the insurance sector and lessen its capacity to act as a critical shock absorber for households, businesses, financial institutions and governments. Conversely, when mounting risks make some regions or lines of business unprofitable, and insurers respond by raising premiums or withdrawing coverage, this protects their short-term profitability and solvency by pushing risk back onto other economic actors. This results in a widening protection gap, with consequences extending far beyond the insurance sector.²²²

If the economic system itself becomes increasingly vulnerable and overwhelmed, and its resilience is eroded, initially localized effects can spread. The global insurance company AXA recently warned that extreme weather events “endanger corporates’ bottom lines and translate into systemic risks for financial institutions. They risk peoples’

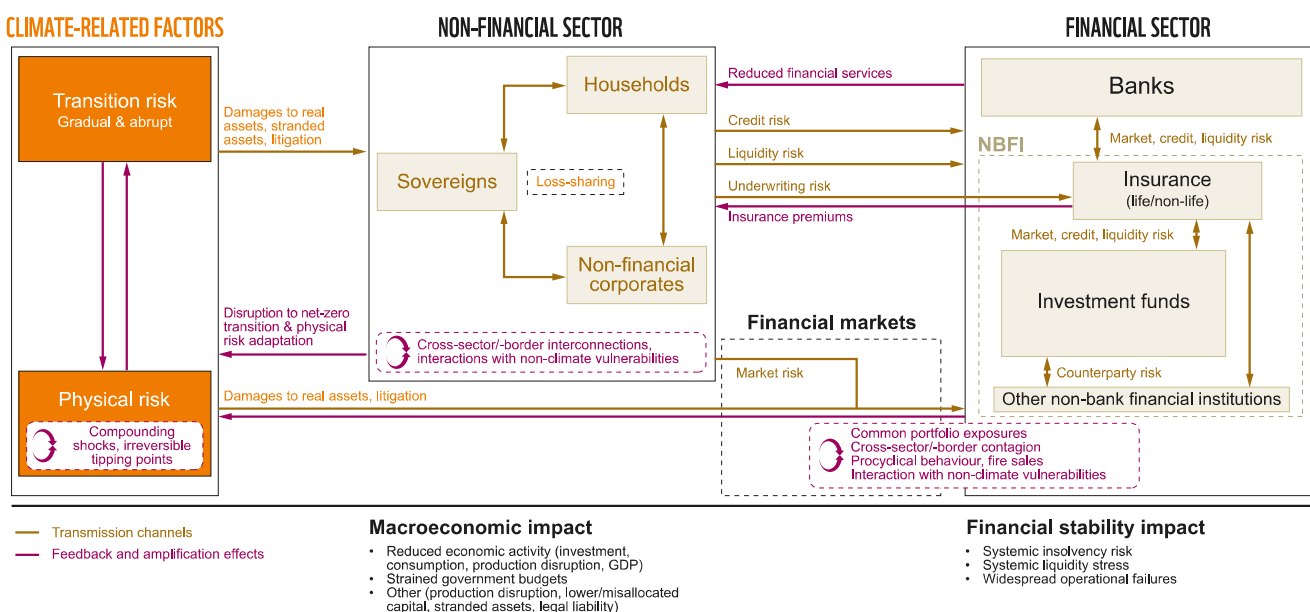
wealth, health and lives, and endanger political stability.”²²³ The Boston Consulting Group has also cautioned about the potential for the ongoing homeowner’s insurance crisis to trigger climate-related tipping points for financial systems.²²⁴

Public finances are increasingly under strain, diverting resources from long-term development to short-term disaster response. Governments are increasingly forced to absorb economic losses and act as insurers of last resort, such as the National Flood Insurance Program in the US. Increasing disaster-related public expenditures, alongside the growing sensitivity of financial markets to climate- and nature-related contingent liabilities, can undermine sovereign credit ratings, increase the cost of borrowing and further erode the fiscal space to invest in adaptation and resilience measures. This is especially true for low- and middle-income countries, but it also applies to advanced economies with heavy public debt burdens and high debt servicing costs. The result is a systemic risk feedback loop in which a lack of insurance amplifies vulnerability, strains government budgets, threatens economic and financial stability, and deepens social inequality.

4.1 RISK TRANSMISSION CHANNELS TO THE FINANCIAL SYSTEM, THE ECONOMY AND PUBLIC FINANCES

The transmission of climate-related risks to financial stability and the real economy occurs through many interconnected channels. According to the Financial Stability Board (FSB), these channels include direct physical impacts on assets and infrastructure, indirect effects through insurance and credit markets, and broader macroeconomic feedback loops, as illustrated in Figure 22 below.²²⁵ Growing insurance underwriting risk – i.e., increasing claims related to extreme weather events and natural catastrophes – is evident and has been discussed above. This section examines the other mechanisms through which a lack of insurance exacerbates market risk, credit risk and macroeconomic impacts.

FIGURE 22: FRAMEWORK FOR THE ASSESSMENT OF CLIMATE-RELATED VULNERABILITIES



Source: Financial Stability Board, (2025). Framework for the assessment of climate-related vulnerabilities. In *Assessment of Climate-related Vulnerabilities Analytical framework and toolkit*.

Market risk is particularly acute for assets with insufficient insurance coverage. While climate- and nature-related risks can trigger write-downs across a whole range of asset classes, this is especially relevant in the real estate sector. Properties in high-climate risk regions can see significant devaluations due to heightened perceptions of the risk of financial losses, in particular when there is a lack of adaptation and of insurance coverage. When homeowners and businesses face large uninsured losses, they may also be forced to liquidate assets to cover costs, creating further downward pressure on prices and eroding market confidence.

Uninsured climate- and nature-related risk transmits to credit risk and the banking sector. When a substantial portion of assets serving as loan collateral lose value due to climate risks (such as uninsurable properties, which usually no longer qualify as acceptable collateral), banks face a deterioration in loan-to-value ratios and can experience a rise in non-performing loans. Inadequate insurance coverage can further exacerbate these losses, as borrowers struggle to recover from disasters. This increases credit risk for banks on existing loans and can restrict access to new credit for homeowners or small enterprises, thereby depressing investment and future growth.²²⁶

The protection gap has macroeconomic impacts. Rising insurance costs and disaster recovery expenditures fuel inflation and reduce disposable incomes for households and businesses, curtailing consumer spending, investment and access to credit. Governments too can face budgetary strains as they are called upon to support uninsured losses or invest in climate adaptation, diverting resources from other priorities. This creates a feedback loop of reduced economic activity, lower

tax revenues and heightened fiscal vulnerability, especially in regions heavily reliant on climate-sensitive sectors.

Climate shocks in one region can trigger cross-border contagion. Due to the interconnectedness of the financial system, even localized climate events can potentially have global repercussions. For instance, the January 2025 Los Angeles wildfires have not only impacted local property values but global reinsurance markets as well, consuming up to 30 per cent of European reinsurers' annual capital budgets for catastrophe insurance, according to one estimate.²²⁷ Beyond the financial system, climate-induced disruptions can also cascade through supply chains and global trade, amplified by a lack of commercial insurance.²²⁸

Irreversible ecosystem tipping points could abruptly amplify risk transmission. Once critical natural thresholds are crossed – whether the dieback of the Amazon rainforest, the collapse of tropical mangroves or mass coral-reef bleaching – ecosystem services providing buffers against climate change can suddenly vanish, sending shockwaves through financial markets and economies. As WWF warned in its *Financial Stability at Risk* report,²²⁹ crossing such tipping points can trigger non-linear, self-reinforcing cascades of asset devaluation, insurance losses and credit defaults, driving systemic risk escalation on timescales too short for traditional adaptation or recovery measures to take effect. EIOPA has also warned that the collapse of important biomes would have systemic impacts, potentially making risk diversification impossible.²³⁰

The following sections highlight some of these transmission channels for which a substantive base of evidence already exists. Other channels are harder to quantify or currently less studied.



Wildfire engulfs Los Angeles 2025. Image: Adobe Stock



The St Maurice river at the Shawinigan Falls Devil's Hole during the spring floods, Quebec, Canada. Image: Adobe Stock

4.2 EFFECTS OF CLIMATE RISK ON MORTGAGES AND REAL ESTATE MARKETS

Affordable housing is a basic human need, property insurance (including homeowner cover) is the largest business line for the insurance sector and the real estate market is central to financial stability. It is therefore important to understand the dynamics between climate- and nature-related risks and the real estate markets, and how they are intermediated by insurance.

Insurance is central to mortgage security but is not systematically demanded by lenders. In most markets, banks and mortgage lenders use the property as collateral and depend on homeowners' insurance as a first line of defense against credit losses in case of extreme weather events. Mortgage lenders therefore usually (although not universally) require insurance coverage as a precondition of mortgage approval and continuation.^{231, iv} This requirement helps reduce the protection gap, but only to a certain degree. First, if the homeowner does not have a mortgage, no insurance is required. Second, lenders often only require insurance coverage up to the amount of the mortgage. If rebuilding costs are rising fast, the mortgage value and hence the insurance limit might be significantly below this cost, leaving the homeowner underinsured. Third, home insurance contracts usually last one year. Banks rarely request updated proof of coverage during the mortgage term, leaving them uncertain about the actual insurance coverage of their mortgage portfolio.

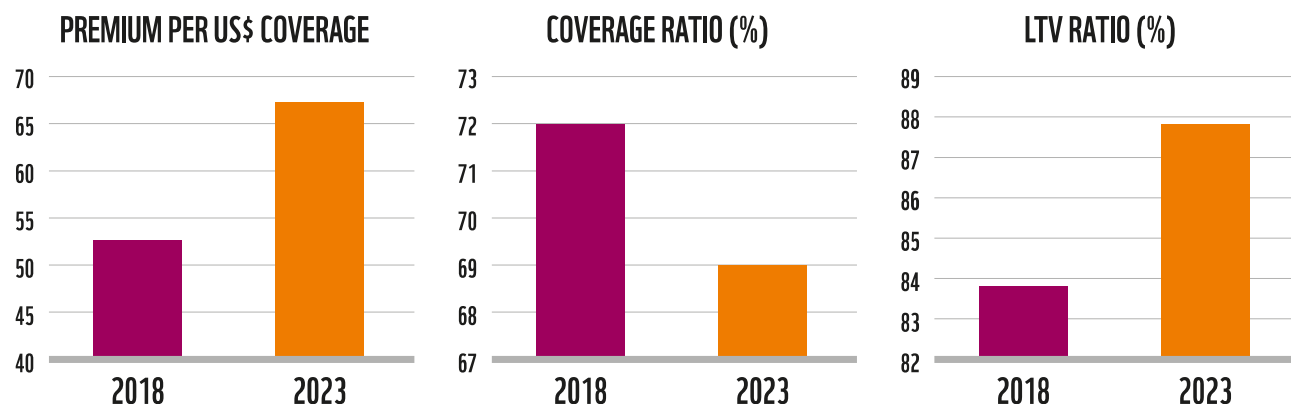
More frequent and more severe extreme weather events are beginning to undermine the foundations of mortgage markets. The interdependence between mortgage risks and insurance coverage means that risks related to extreme weather events have potential consequences not just for property insurance premiums and coverage, but also for mortgage markets. Climate-driven increases in insurance premiums, shrinking coverage availability and mounting deductibles, and declines in property values all combine to drive up housing costs, erode household equity and elevate the risk of missed mortgage payments and defaults.²³² When established insurers exit high-risk markets altogether, the substitute insurance policies available generally offer less

comprehensive coverage and can fail to meet standard loan collateral requirements, depressing home values, amplifying credit risk and constraining new mortgage lending.²³³ The problem is increasingly recognized and publicly discussed by central banks and policymakers. US Federal Reserve Chair Jerome Powell said in February 2025 that "if you fast-forward 10 or 15 years, there are going to be regions of the [United States] where you can't get a mortgage."²³⁴ There is also concern among mortgage lenders in the UK about the uninsurability of certain areas when the state-created Flood Re insurance programme runs off after 2039.²³⁵ In Quebec, the withdrawal of flood insurance has led some banks to stop issuing mortgages in high-risk areas.²³⁶

Rising insurance costs and mortgage rates add to the financial burdens faced by borrowers. This can lead them to reduce insurance coverage even though their risk is increasing – adding to the protection gap. Between 2013 and 2022, insurance costs in the US as a proportion of mortgage payments more than doubled, from 7-8 per cent to over 20 per cent.²³⁷ As banks become more aware of climate risks, they have also started to increase interest rates for mortgages in some high-risk areas, as shown in evidence from the ECB²³⁸ and in academic research.²³⁹ This adds to the financial burden of increasing insurance costs and can force poorer homeowners to opt for less comprehensive coverage or higher deductibles, forego insurance or even relocate. A US study estimates that, if insurance premiums continue to rise in line with historical trends, between 17 and 31 per cent of households will be forced to reduce coverage substantially, meaning insurance markets may shrink even as losses from natural disasters rise.²⁴⁰

There is a direct link between climate risk, lack of insurance and adverse mortgage outcomes. US borrower data shows that abrupt premium increases and insurance policy non-renewals significantly increase mortgage delinquency rates and can trigger prepayments, as financially strained households relocate to less exposed regions.²⁴¹ Another US study found that properties flooded in an extreme weather event face a 57 per cent higher foreclosure rate than nearby unflooded homes.²⁴²

iv. In the US mortgage market, lenders even have and exercise a contractual right to "force" place insurance on the homeowner where the homeowner is unable to find or afford insurance. The "forced placed" insurance usually costs more and its price is rolled into the mortgage payment.

FIGURE 23: AS PREMIUMS INCREASE, INSURANCE COVERAGE DECLINES AND THE LOAN-TO-VALUE (LTV) RATIO RISES

Based on data from Florida between 2018–2023. Source: Sastry, P., Scharlemann, T., Sen, I., & Tenekedjieva, A.-M. (2025). Aggregate Trends have started reflecting these dynamics. In *The Limits of Insurance Demand and the Growing Protection Gap*. Harvard Business School.

A 2025 analysis by First Street also found that, in a severe-weather year, climate-driven foreclosures could result in US\$1.2 billion in direct losses for US banks. That figure is projected to rise to US\$5.4 billion over the next 10 years, highlighting the scale of potential systemic exposure. Overall, the combined loan-to-value ratio is higher in high climate risk regions in the US, suggesting that the mortgages in these areas are not only more exposed to climate hazard but are also more vulnerable to it.²⁴³ This relationship, in the case of Florida, is illustrated in Figure 23.²⁴⁴

The climate and insurance crisis extends beyond individual borrowers and lenders to the stability of the entire housing market. A 2024 US Senate Budget Committee report warned that “property values will eventually fall – just like in 2008 – sending household wealth tumbling. The United States could be looking at a systemic shock to the economy similar to that from the financial crisis of 2008 – if not greater.”²⁴⁵ The threat is especially pronounced in regions facing the greatest climate-related risks. US homes exposed to flood risk are estimated to be currently overvalued by an estimated US\$121 billion–237 billion, signalling a looming correction as the true costs of climate risk are increasingly recognized.²⁴⁶ Property owners in states like California, Florida and Louisiana face estimated reductions in their property values following insurance non-renewal that range from 12 per cent to 48 per cent.²⁴⁷

STATE	ESTIMATED LOSS OF PROPERTY VALUE FOLLOWING INSURANCE NON-RENEWAL
California	12% to 39%
Louisiana	26% to 48%
Florida	19% to 40%

The Colorado insurance commissioner has also warned about the threat from “a situation where the insurance market is effectively decimating the real estate market”.²⁴⁸ Overall, the US property market could see a potential US\$1.47 trillion reduction

in real estate value (equivalent to 3 per cent of the entire market and 5 per cent of US GDP) over the next three decades due to the expected escalating impacts of climate change.²⁴⁹

The available data for European property markets paints a similar picture to the US. One German study found that houses located within designated flood zones face a significant discount in asking prices compared with similar properties outside these zones, even after controlling for other relevant factors.²⁵⁰ In the UK, homes in flood-prone areas generally sell for 8 per cent less on average, with the highest-risk properties experiencing price drops of up to 32 per cent after major flood events.²⁵¹ Flood risk is also generally priced into Dutch property markets, with homes in less protected areas selling at a roughly 5 per cent discount.²⁵² For commercial properties, a survey from January 2025 by the real estate services firm Jones Lang LaSalle estimated that approximately US\$580 billion worth of European commercial real estate is concentrated in Europe’s 10 most climate-vulnerable cities.²⁵³ Of these, Rome, Istanbul, Barcelona and Athens face the greatest weather hazards, while Paris has the greatest total exposure in terms of building value at risk.

Climate-driven property devaluations also threaten insurers’ real estate investment portfolios. The erosion of property values in high climate risk regions also poses an additional threat to insurance companies, many of which are significant investors in real estate globally through direct property holdings, investment funds and real estate debt (with local variations by country in the exact asset allocations).²⁵⁴ By simultaneously underwriting climate hazards through property insurance and holding significant property assets, insurers face a potential contagion channel in which climate risks and falling real estate values can weaken both sides of their balance sheets, strain their solvency ratios and transmit stress across the broader financial system.

Nature can help preserve real estate values. A new study analyzed property sales after hurricanes in Florida. It found that houses with medium flood risk close to mangroves experienced a much lower decline in house prices compared with properties further away from mangroves.²⁵⁵



Destruction caused by Hurricane Katrina, 2005. Image: Adobe Stock

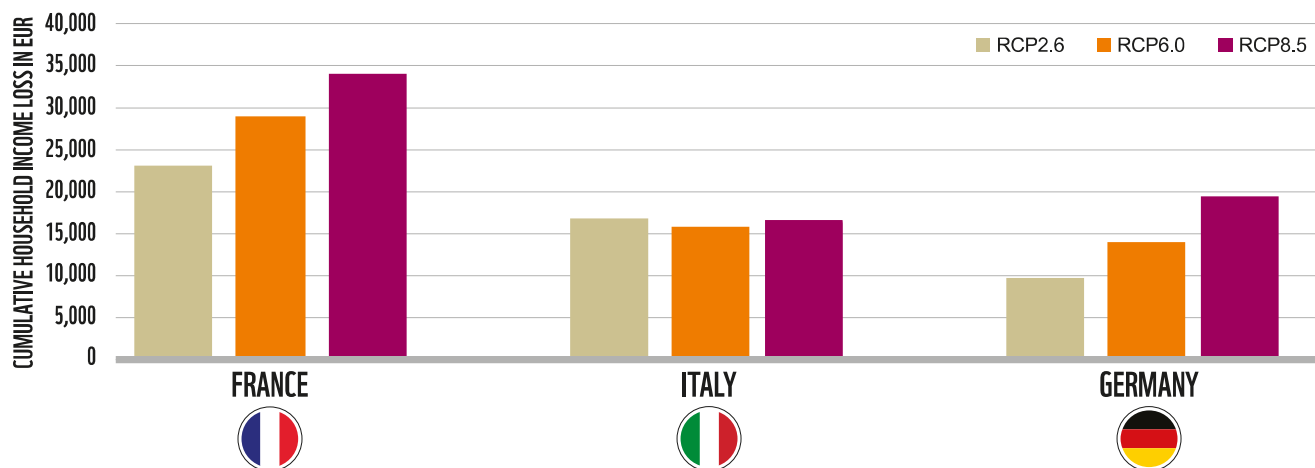
4.3 THE PROTECTION GAP, HOUSEHOLD INCOME AND INTERGENERATIONAL WEALTH

Climate disasters impact household incomes through various mechanisms, especially when losses are not insured. This notably includes direct income loss through the inability to work due to injuries, housing damages, business interruption, disrupted transportation and services, interruptions to education and childcare, increased basic costs and forced relocation. Allianz estimates that, due to floods alone, French and German households could respectively lose around €34,000 and €20,000 in cumulative income over 2025-35 under a high emission scenario (RCP8.5).²⁵⁶

Without insurance, extreme weather events can translate into lasting destruction of inter-generational wealth. In many economies, home equity is the largest component of household net worth, serving both as a financial buffer and a tangible asset to be transferred to heirs. When storms, floods or wildfires destroy properties and insurance

payments fall short of rebuilding costs, families are forced to tap emergency savings or take on heavy debt. One such example is Hurricane Katrina, which flooded most of New Orleans in August 2005 and destroyed more than 200,000 homes. Total property damage neared US\$100 billion, with the National Flood Insurance Program covering only around 10 per cent of losses, with lasting consequences for housing.²⁵⁷ Families in the poorest areas of the city had to pay thousands of dollars out of pocket to complete repairs, even after government help, slowing the recovery process.²⁵⁸ Over time, depleted home equity after extreme weather events undermines parents’ ability to provide financial assistance, education or seed capital to their children, affecting the socio-economic outcome of entire families long after the disaster. Even in the absence of physical damage, steep declines in the value of homes deemed uninsurable or facing prohibitive premiums erode the primary wealth source of middle-class households, hampering intergenerational transfers.

FIGURE 24: TOP 3 CUMULATIVE HOUSEHOLD INCOME LOSS IN EUROPE FOR THE DECADE 2025-2035 ACROSS DIFFERENT EMISSION SCENARIOS (EUR)



Source: Krichene, H., & Kirvaldize, G. (2025). Top 10 Cumulative Household income loss in Europe for the decade 2025-2035 across different emissions scenarios (EUR) In *Rethinking climate adaptation for global resilience*. Allianz Research.

4.4 CLIMATE-DRIVEN INSURANCE PRESSURES ON BUSINESS GROWTH AND COMPETITIVENESS

Gaps in business insurance can undermine loans and investment. Similarly to mortgages, most commercial loans and investment arrangements depend on adequate insurance coverage to protect the underlying assets. Consequently, insufficient insurance coverage for businesses could lead to knock-on impacts on the economy, making credit and financing more difficult to obtain, especially for SMEs and for companies located in the most climate vulnerable areas. Existing loans are also vulnerable, as inadequate insurance coverage can reduce the value of collateral. In extreme cases, entire communities or regions could experience a credit crunch, reflecting banks' reluctance to lend in cases where climate-related losses could make recovery particularly difficult. However, empirical evidence about the impact of climate insurance on commercial lending remains limited and further research is needed.

Rising insurance premiums and investments in resilience put climate-hit regions at a competitive disadvantage. In economic sectors where fixed costs are already tight and competition is high (such as manufacturing²⁵⁹ or retail), rising insurance premiums in climate hotspots and the need to invest in risk prevention can erode companies' profit margins. When insurance costs rise, businesses face higher operational expenses, further straining their financial resources and reducing their ability to invest in growth, innovation or resilience. For instance, risk-exposed tourism facilities in Italy, France and Spain report increased premiums and large investments e.g., into flood defense.²⁶⁰ Rising insurance costs make it harder for businesses to compete with similar companies in less climate-exposed regions. Investments in climate adaptation and resilient infrastructure can lower risks and enhance insurability over the long term. However, this involves short-term costs that businesses must either absorb or pass on to customers, potentially jeopardizing their competitiveness (unless these investments are proactively supported by governments, insurers or banks).



Eight weeks after the devastating floods that hit Bad Münstereifel, Germany, 2021. Image: Shutterstock

4.5 HOW THE PROTECTION GAP BURDENS PUBLIC FINANCES

The protection gap strains public finances through multiple interconnected channels. Extreme weather events affect government budgets not only through the direct costs of public aid for response and recovery, but due to the indirect burden they put on publicly supported insurance schemes and to the need for increased public spending on disaster prevention and infrastructure. Broader economic disruption also slows growth, reduces tax revenues and increases social welfare spending. Over time, repeated climate-related damage can deter investment, increase public debt and undermine sovereign credit ratings at all levels of government. These various mechanisms are illustrated in Figure 25, inspired by Allianz Research and based on Ranger et al. (2021).²⁶¹

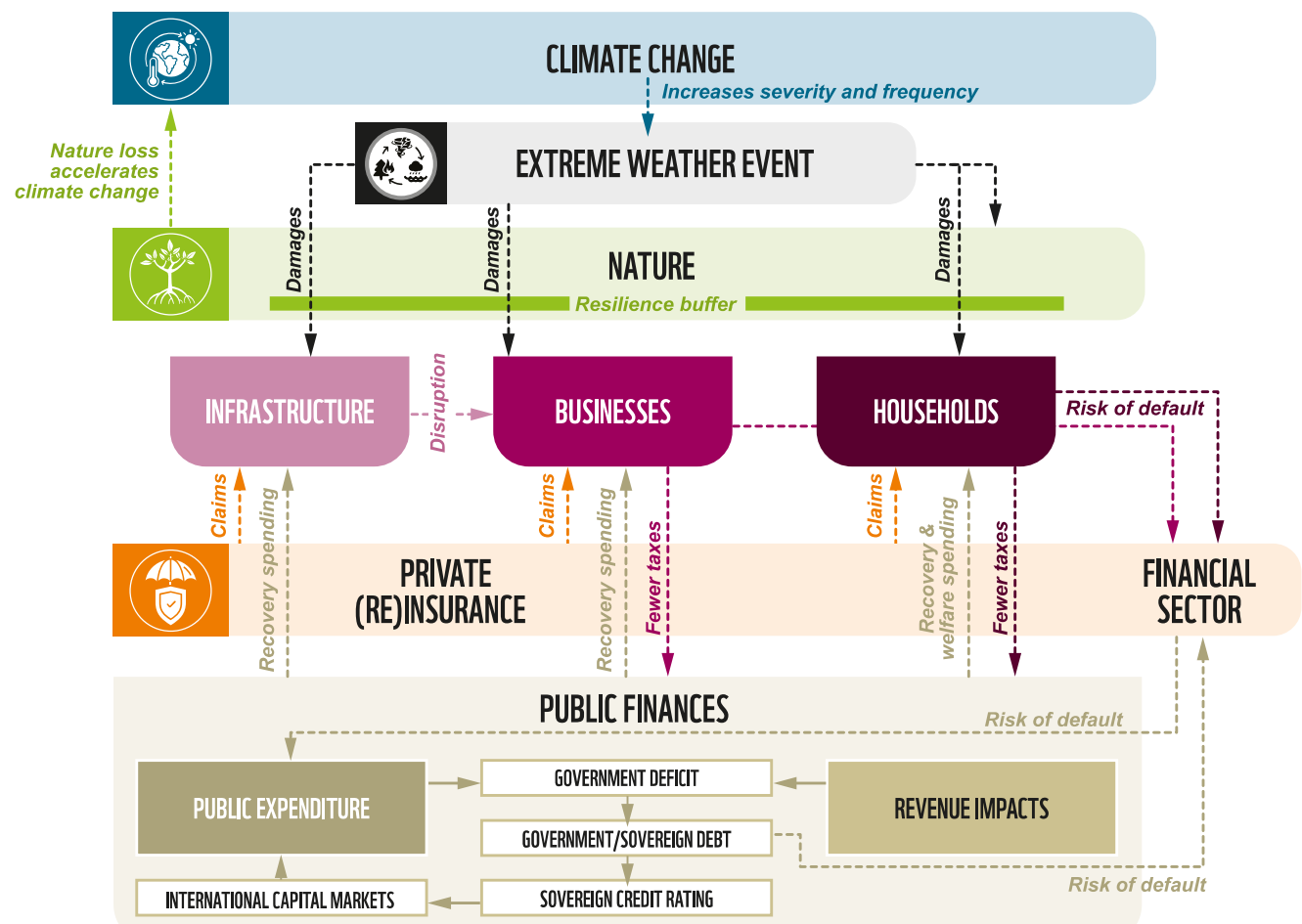
great, governments are called upon to provide direct disaster relief through payments for reconstruction, welfare and ad hoc response measures (such as, for instance, moving people out of disaster zones).²⁶² This shift of climate damage from insurers’ and reinsurers’ balance sheets to government budgets is already happening in numerous countries, increasing fiscal vulnerability and diverting government spending from other critical needs. In addition, governments usually self-insure for damages to infrastructure, including natural assets. As climate losses mount, those losses that the state usually covers also rise, adding to the private losses that are increasingly ending up on public balance sheets.

4.5.1 DIRECT CLIMATE DISASTER RELIEF AND PUBLIC FINANCE

Without adequate insurance, the costs of extreme weather fall on public budgets. When extreme climate events strike people and businesses without sufficient insurance cover, the costs are allocated in a disorderly way between private and public economic actors. When the damage to private actors is too

Even a single climate catastrophe can place immense financial strain on public spending. The 2021 Ahrtal floods in Germany are a stark example. Causing 188 fatalities and the widespread destruction of villages and towns, the event is believed to be the costliest natural disaster in the country’s history, with total losses estimated at €33 billion.²⁶³ In response, the German federal and state governments committed €30 billion in public reconstruction funds, equivalent to about 5 per cent of the combined federal and affected state budgets at the time.²⁶⁴

FIGURE 25: EXPOSURE OF PUBLIC FINANCES TO PHYSICAL CLIMATE AND NATURE RISKS



Based on: Krichene, H., & Kirvalidze, G. (2025). *Rethinking climate adaptation for global resilience*. Allianz Research.

The same catastrophic floods also affected Belgium, where the national insurance system was quickly overwhelmed, necessitating additional public support.²⁶⁵ Similarly, Spain committed a total of €14.3 billion in public aid to support victims of the devastating floods in and around Valencia in 2024.²⁶⁶ This amounted to 7.5 per cent of government spending planned for that year. These extraordinary amounts of public funds highlight the fiscal shock that major climate disasters can inflict, even on advanced economies, forcing governments to rapidly mobilize resources for both immediate relief and long-term rebuilding.

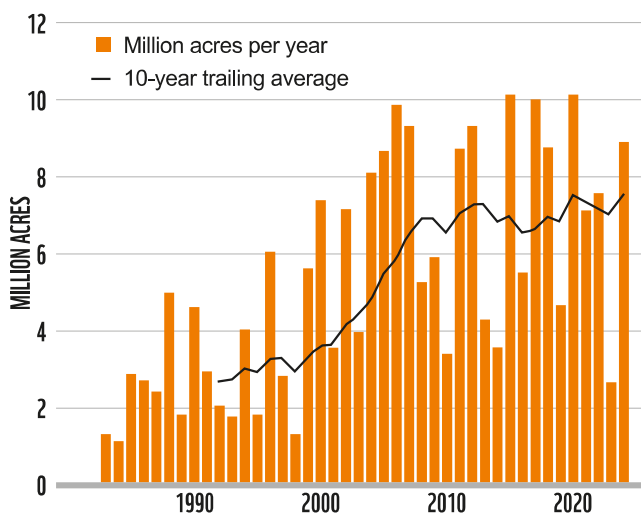
Repeated flood disasters are testing the fiscal resilience of European countries.

Austria's public flood fund is also struggling to keep up with rising costs. In 2024, record floods in Lower Austria caused €1.3 billion in damage, with most homeowners and businesses lacking private flood insurance.²⁶⁷ To plug the gap, the federal government put 1.1 per cent of tax revenues into a disaster relief fund that local states could use for rebuilding.²⁶⁸ However, the costs from the 2024 floods exceeded those reserves and Austria's parliament had to increase funding to €1 billion.²⁶⁹ Another striking example is the devastating flooding that hit Slovenia in 2023, affecting 85 per cent of its municipalities.²⁷⁰ The total damages are estimated at €9.9 billion or the equivalent of 16 per cent of Slovenia's GDP,²⁷¹ of which only €350 million was insured.²⁷² Both the Slovenian government and the European Union Solidarity Fund had to step in with recovery programmes totaling several billions of euros.²⁷³

In the United States, the cost of public climate disaster relief is similarly immense.

Hurricane Maria, which devastated Puerto Rico in 2017, resulted in federal disaster spending of approximately US\$35 billion through FEMA's Public Assistance, Hazard Mitigation and Individual Assistance programmes, amounting to about 1 per cent of the entire US federal budget for that year. Even with this massive federal expenditure on public infrastructure, there was little assistance for private homeowners or businesses without insurance to rebuild. In 2024, the US government granted a total of US\$110 billion, or 1.6 per cent of the federal budget, for relief efforts in states hit by events such as hurricanes or wildfires.²⁷⁴ Over the past 20 years, many rural counties have received government aid exceeding 100 per cent of GDP.

FIGURE 26: AVERAGE US ACREAGE BURNED ANNUALLY BY WILDFIRES HAS ALMOST TRIPLED IN THREE DECADES²⁷⁵



Source: National Interagency Fire Center. (2021). Wildfires and Acres / Total Wildland Fires and Acres (1983-2024).



Forest fire in Portugal. Image: Shutterstock

4.5.2 NATURE LOSS AS A FISCAL BURDEN

Extreme weather events and gradual environmental changes driven by increased temperatures damage nature as well as human-made structures.²⁷⁶ As just one example, in the EU, more than 60,000 forest fires take place each year, burning over 500,000 hectares in an average year;²⁷⁷ in 2025, the burnt area exceeded a record one million hectares.²⁷⁸ In the United States, the average area burned by wildfires has more than doubled over the past three decades,²⁷⁹ indicating a continuing rise in climate-related ecosystem loss. The destruction of mangroves, coral reefs and other natural assets can be added to the list.

Damage to nature is often overlooked and underfunded.

When nature is not restored after damage, the stock of natural capital declines and the economic (as well as environmental and social) value of the ecosystem services it provides is lost, representing a real reduction in public wealth.^{280,281} However, because ecosystem services function as public goods, this value is often unquantified, undervalued and largely absent from standard loss accounting.^{282,283,284} Specifically, damages to nature are not included in calculations of the protection gap.²⁸⁵ Without a clear understanding of the damage, mobilizing appropriate funding is challenging.

Targeted public or private insurance schemes could secure the funding needed to restore nature. Similarly to public infrastructure, governments usually explicitly or implicitly self-insure the public goods provided by nature, using disaster relief efforts. After Hurricane Sandy in 2012, for instance, the entire restoration of Delaware's Prime Hook Marshes – around 4,000 acres of tidal marsh and dunes – was financed with around US\$38 million in public funding.²⁸⁶ Such self-insurance is not necessarily a problem if governments set enough fiscal capacity aside to recover damages to grey and green fiscal infrastructure alike. However, with increasing losses and constrained public budgets, there is a risk that damage to nature is overlooked, eroding critical resilience for the next extreme weather event. Developing appropriate (public or private) insurance mechanisms for nature and ecosystem services could play an important complementary role in reducing the financial burden on governments.²⁸⁷

CASE STUDY 2: CALIFORNIA URBAN FOREST INSURANCE

by *Deborah Halberstadt*, Special Advisor on Biodiversity and Inclusive Insurance at the California Department of Insurance

The California Department of Insurance (CDI) recognizes the essential role healthy ecosystems play in building resilience to climate change and preventing biodiversity loss. As climate change and other human drivers continue to weaken and damage ecosystems, communities are losing benefits from nature and facing heightened risks. Innovations in insurance are being explored as a means to invest in healthy ecosystems and reduce risks to communities.

In particular, the climate risks posed by extreme heat are of increasing concern to California residents and CDI, and urban forests are a powerful nature-based solution to this threat. While targets have been set by the state for increasing tree canopy cover, a combination of tools will be needed to achieve these goals. Parametric insurance of urban forests is being explored as one of them. Unlike conventional insurance, which pays out against actual losses, parametric insurance automatically pays the insured if a specific parameter is exceeded.

In April 2025, CDI and the University of California's Santa Cruz Center for Coastal Climate Resilience convened an expert workshop to explore key feasibility questions for insuring urban forests. Participants included state and local urban foresters, nonprofit and community-based organizations supporting healthy urban forests, and researchers and healthcare professionals studying the benefits of urban green spaces.

There is a potential role for urban forest insurance, since urban forests are important natural assets facing catastrophic risks that could be transferred. Major drivers of catastrophic urban forest loss in California include storms, extreme heat, drought and pests. The workshop explored each of these risks to see if they met feasibility criteria across the state for the type of parametric insurance that has been developed for other natural assets (primarily coral reefs).

Storms were identified as a feasible risk for insurance state-wide because there is a parameter, sustained wind speed, that can act as a trigger that meets common feasibility criteria for insurance. Pests could also be a good candidate for urban forest insurance in some cities, as there is an existing system for identifying and classifying pest risk – it is possible to measure the presence or degree of infestation of the pest to use as a trigger. The other major catastrophic risks would be more difficult to insure at this time because they fail to meet at least one of the feasibility criteria with current data and models.

A diverse set of public and private stakeholders have expressed interest in sustaining urban forests and could be clients for insurance against catastrophic storm losses.

The findings of the workshop and literature suggest that insuring urban forests in California against storm losses is feasible state-wide, and that insuring against pests or other damages may be feasible for some cities or regions. Such insurance warrants further exploration. For more information, see the workshop report.²⁸⁸



Urban forest in Los Angeles. Image: Shutterstock



Flooding from Hurricane Helene in Western North Carolina, in 2024. Image: Adobe Stock

4.5.3 PRESSURES FROM PUBLIC INSURANCE AND PUBLIC-PRIVATE SCHEMES

Public insurance schemes often end up shouldering most of the financial burden from climate catastrophes. When private markets cannot close the protection gap, public or public-private insurance schemes are created to fill the gap. For example:

- In the United States, the National Flood Insurance Program (NFIP), a federal programme and the primary insurance scheme for flood risk, provides roughly US\$1.3 trillion in financial protection annually, financed by a mix of premiums and public funds. According to industry reports, the NFIP is expected to cover the vast majority of insured losses after hurricanes Helene and Milton, which struck the US states of Florida, Georgia and the Carolinas weeks apart in 2024.²⁸⁹
- In Spain, the Compensación de Seguros, which provides direct compensation for losses from specific natural perils, is expected to cover between 90 and 95 per cent of the €3.5 billion in insured losses following the 2024 Valencia floods, leaving only €250 million-350 million to private carriers.²⁹⁰

These cases underscore the critical function of public insurance schemes in absorbing the financial impact of major catastrophes, especially in regions where private insurance coverage is unavailable or unaffordable for many households.

They reflect a broader trend where public insurers act as the primary financial backstop for communities facing extreme weather events, therefore creating both immediate and contingent liabilities for public finances.

Public-private partnerships and other state-sponsored programmes cushion public finances, but they are increasingly vulnerable themselves. As alternatives to purely public solutions, governments are working with the private sector to fill the gap. In 33 US states, state laws require private insurers to join an association with other insurers to cover perils that individual private insurers decline to cover. These ‘residual market’ or FAIR (Fair Access to Insurance Requirements) plans, such as the California FAIR Plan, have been rapidly expanding because of the withdrawal of private insurers increasingly unwilling or unable to cover escalating risks from extreme weather events.²⁹¹ Far from its original intended role of insurer of last resort, the California FAIR Plan is becoming a leading insurance carrier and is often the only option available for homeowners in high-risk areas. Both the NFIP (at the federal level) and state FAIR plans are becoming increasingly financially unsustainable due to a combination of underpriced risk, increasing exposure from climate change and insufficient reserves. As an example, the California FAIR Plan required a US\$1 billion bailout in the wake of the 2025 Los Angeles wildfires, half of which came from private insurers and half from all private home insurance policyholders.²⁹²

For more information on government initiatives to foster insurance supply, see Chapter 5.1.

4.5.4 SPENDING ON DISASTER PREVENTION IS A CRUCIAL SUBSTITUTE AND COMPLEMENT FOR PUBLIC INSURANCE PROGRAMMES

Prevention delivers greater value than post-disaster relief and insurance payments. A 2024 economic study by the US Chamber of Commerce found that every dollar spent on climate resilience and preparedness can save communities up to US\$13 in damages, cleanup costs and economic impact.²⁹³ Similarly, a report from the UK concludes that every £1 invested in flood risk management prevents £8 of damages, including £3 in direct savings to the government.²⁹⁴ In practice, however, government spending on risk prevention competes for limited resources with public financing for post-disaster payouts, as shown in Figure 4 in Section 2.2.

Some countries have prioritized risk mitigation and physical resilience. For example, the Netherlands has historically invested in robust flood defenses and water management infrastructure as a primary means of reducing flood risk, thereby limiting the need for extensive insurance payouts. Since 2012, the Dutch Delta Program²⁹⁵ has benefited from €1.25 billion in dedicated annual funding, sustaining a comprehensive network of dikes, barriers and water management structures to meet an ambitious objective by mid-century of protecting against up to 1-in-100,000-year events. The Wet Tegemoetkoming Schade (WTS), the Dutch government's financial backstop for disaster losses that the market cannot reasonably insure against, then provides an additional layer of financial protection. Similarly, investment in protective forests (see Textbox 1) can deliver risk prevention and mitigation.

The failure to adopt a prevention-first stance undermines both physical resilience and public finances. Existing government budget frameworks rarely capture indirect burdens – such as reduced tax revenues when wealth and incomes fall after disasters – or recognize contingent liabilities from protection gaps, obscuring the true scale of fiscal exposure. By failing to prevent these climate-related costs and the potential losses in their budgets, policymakers blind themselves to mounting risks. Consequently, emergency appropriations continue to crowd out ex ante investments in adaptation, while misaligned land-use rules, building codes and infrastructure standards, as well as the sidelining of nature-based solutions, further increase exposure and vulnerability to extreme weather events. In addition, governments often prioritize rebuilding in the same high-risk places rather than rebuilding strategically to reduce future exposure and vulnerability (also known as 'building back better').

4.5.5 HOW PROTECTION GAPS SLOW RECOVERY AND PERMANENTLY LOWER GROWTH

Losses from climate disasters create lasting economic damage. Like wars or financial crises, extreme weather events can have permanent effects. Reductions in wealth and output are not always fully recovered over time. In a 2024 working paper, the Bank for International Settlements found that major climate- and nature-related disasters reduce growth by 1 to 2 per cent on impact and, over time, they produce an output cost of 2 to 4 per cent of GDP on top of that initial impact, with uninsured losses driving the macroeconomic cost.²⁹⁶

In the UK, a study by Public First also concluded that each year of flood events causes a decade-long downward pressure on the economy worth at least £6.1 billion and which costs 46,000 jobs.²⁹⁷

A lack of insurance significantly slows recovery. A 2020 study by AXA XL and the Centre for Risk Studies at Cambridge University concluded that each percentage point increase in insurance penetration (i.e., non-life insurance premiums divided by a country's GDP) reduces recovery times after natural disasters by almost one year.²⁹⁸ Researchers from the University of Hamburg corroborated this finding by using geosatellite observations to analyze night-light activity in flood-impacted areas in Europe from 2014 to 2023. They found that those areas with mandatory household flood insurance (and therefore a smaller protection gap) recovered to their pre-event level light activity within four months, while other areas recovered much more slowly.²⁹⁹ Another 2025 study, from the European Economic Review, confirmed that higher insurance coverage is associated with less severe macroeconomic consequences from disasters.³⁰⁰

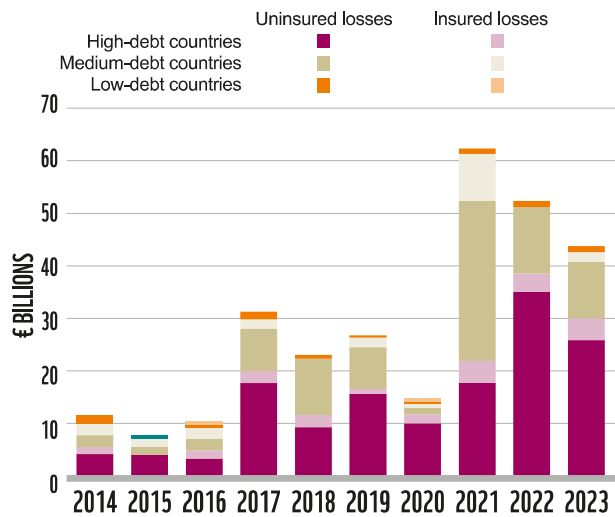
Taken together, slower recovery and growth are a strain on public budgets as less tax can be collected.

4.5.6 PUBLIC DEBT, INFLATION AND POLITICAL RISK STEMMING FROM PROTECTION GAPS

Climate risks and protection gaps affect public debt and sovereign creditworthiness. Research from the International Monetary Fund has found that a country's vulnerability or resilience to climate change can have a direct effect on its creditworthiness, its cost of borrowing and, ultimately, the likelihood it might default on its sovereign debt.³⁰¹ In the absence of adequate insurance coverage and resilience mechanisms, governments can find themselves trapped in a cycle of reactive spending on climate disaster relief, rebuilding or support for public insurance and reinsurance schemes. Unplanned funding for emergency relief and long-term rebuilding often requires supplemental budget appropriations or borrowing, creating fiscal volatility in fiscal projections and widening deficits.

Over time, the accumulation of disaster-related borrowing contributes to long-term debt accumulation and can crowd out essential investments in climate adaptation (including nature-based solutions) and in the transition to low-carbon economies. The ECB specifically warned in 2023 that the vulnerabilities arising from contingent liabilities may increase in countries with high physical risk and a large insurance protection gap.³⁰² If these risks rise alongside concerns about the sustainability of levels of sovereign debt, the impact on financial stability could be amplified by feedback loops that see sovereign credit conditions and ratings deteriorate.

There is mounting evidence of links between protection gaps and sovereign credit ratings, even if rating agencies have yet to reflect it. The influence of protection gaps on sovereign ratings has not been explicitly considered by rating agencies yet, but they were mentioned by Fitch Ratings in a special report in 2017.³⁰³ When the company recently announced that it is considering including climate vulnerability signals in its sovereign ratings, the proposal did not mention insurance.³⁰⁴

FIGURE 27: EURO-AREA ECONOMIC LOSSES FROM CLIMATE- AND NATURE-RELATED CATASTROPHES, BY COUNTRY DEBT LEVEL

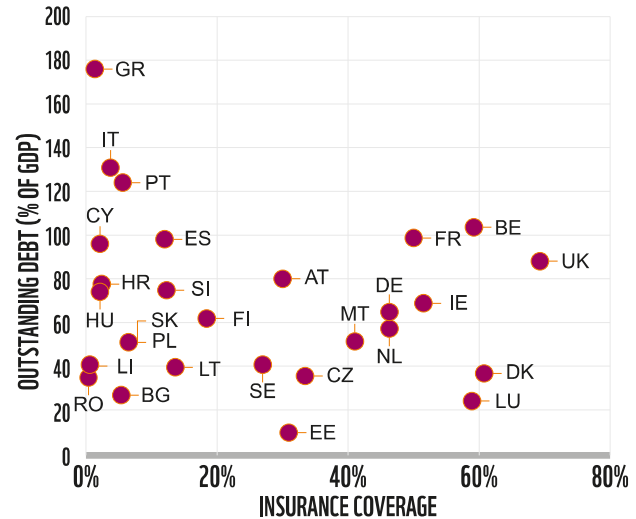
Source: European Central Bank. (2025). Euro Area Economic losses from natural catastrophes, by country debt level. In *Financial Stability Review* 1 May 2025.

However, analysis by EIOPA shows that European countries with the lowest insurance coverage against natural catastrophes are generally those with the highest debt burdens,³⁰⁵ making them doubly exposed to climate shocks. This dynamic is particularly acute in parts of southern and central-eastern Europe, where the protection gap is highest and fiscal space is most constrained.

Emerging economies with large protection gaps have limited financial resources and high levels of sovereign debt. Many low- and middle-income nations lack deep insurance markets or fiscal buffers and are forced to borrow heavily to finance recovery. A World Economic Forum study³⁰⁶ found that, since 2010, countries such as Pakistan and Mozambique have seen public debt ratios spike in the aftermath of floods and cyclones, pushing them into debt-distress negotiations with multilateral creditors and straining domestic budgets already squeezed by development needs. In Jamaica, the use of catastrophe bonds by the World Bank to insure against tropical cyclones has helped strengthen the country's credit standing and attracted international investors,³⁰⁷ but the sums insured were nonetheless dwarfed by the extent of the damage caused by Hurricane Melissa in October 2025.³⁰⁸

Lack of insurance can also erode the creditworthiness of local governments. When a significant share of public assets and infrastructure lies outside insured coverage, municipalities become more vulnerable to revenue shocks and budget volatility in the wake of extreme weather events, weakening their capacity to service debt and invest in critical upgrades. Protection gaps can also depress property values and narrow the local tax base, forcing authorities to delay maintenance, hike taxes or divert funds from long-term resilience projects. While rating agencies have yet to downgrade any municipality explicitly for uninsured climate exposure, Fitch Ratings has warned that persistent underinsurance of physical climate risks will increasingly weigh on real estate market stability and, by extension, on municipal credit assessments.³⁰⁹

Extreme weather events and chronic climate and nature risks can fuel inflation, whereas the effect of the protection gap on inflation is less clear. Climate change and nature loss are often associated with higher

FIGURE 28: NEGATIVE CORRELATION BETWEEN SOVEREIGN DEBT LEVELS AND INSURANCE COVERAGE ACROSS EUROPEAN COUNTRIES

Source: EIOPA. (2019). *EIOPA Staff Discussion Paper Protection gap for natural catastrophes*.

inflation due to the inflationary pressure of supply shocks when harvests fail or properties are destroyed.³¹⁰ For example, recent research in Belgium shows that physical damage from extreme climate events can accelerate inflation for up to four months after the event, indicating that post-disaster price pressures are measurable and non-trivial.³¹¹ How the protection gap intermediates inflation is currently less well understood. While higher insurance penetration could lead to higher short-term inflation in, for example, the construction sector due to increased demand, it could also reduce inflation as supply can more quickly recover.

4.5.7 THE SOCIAL, POLITICAL AND ECONOMIC IMPLICATIONS OF CLIMATE VULNERABILITY

The effects of climate change disproportionately affect vulnerable and marginalized communities, further amplifying existing socio-economic and ethnic inequalities.³¹² Populations with lower incomes, limited education and fewer resources are often more exposed to climate risks because they more often live in hazardous areas due to historical exclusion and systemic inequities. Moreover, climate-related disruptions also disproportionately impact workers in sectors such as agriculture and construction, where minorities are overrepresented. The degradation of ecosystems through deforestation, wetland loss and biodiversity decline also erodes the natural buffers that could protect these communities and further undermines the resilience of those most dependent on healthy environments.

Marginalized and lower-income groups tend to be less insured. Even though lower-income populations with higher exposure to climate risks would disproportionately profit from insurance, they tend to be less insured.³¹³ This 'inclusion gap'³¹⁴ risks broadening wealth inequality and further increasing vulnerabilities.³¹⁵ Low-income households also tend to pay more for insurance³¹⁶ (sometimes referred to as the 'poverty premium'), and homeowners in the US earning less than US\$50,000 a year are twice as likely as the general population to be uninsured.



Community volunteers after Hurricane Katrina. Image: Shutterstock

Homeowners of colour are disproportionately at risk, with an estimated 22 per cent of Native American, 14 per cent of Hispanic and 11 per cent of Black homeowners having no homeowners insurance.³¹⁷ As noted above, the destruction of property and the inability to rebuild due to lack of insurance has negative impacts on maintaining or creating generational wealth for poorer households.³¹⁸

These vulnerabilities are compounded by the insurance industry’s response to climate change. For instance, ‘bluelining’, where insurers withdraw coverage or raise premiums in areas deemed high risk for climate disasters, tends to disproportionately impact communities of colour and lower-income households, as has notably been observed in the US.³¹⁹ These communities, which are already grappling with financial insecurity, simultaneously face heightened exposure to natural hazards as well as the added economic pressures of increasing insurance costs and/or reduced coverage availability. This confluence of factors deepens existing inequalities and amplifies the financial risks borne by the most vulnerable. This highlights the importance of addressing not only the issue of availability (the supply side) but also affordability (related to both the supply and demand sides) of insurance, in conjunction with other means to deal with rising climate-related inequality and vulnerabilities.

Protection gaps can create social and political risks for governments. When affordable insurance is unavailable, the most vulnerable populations are left exposed to climate shocks, deepening existing disparities and fueling social discontent. Governments can also face criticism for a perceived lack of prevention and of failure to manage climate hazards, as was seen in the scrutiny of municipal and state leaders following the January 2025 California wildfires. When disaster relief is insufficient or delayed by bureaucracy (as was reported by victims of the 2021 floods in Germany’s Ahrtal region, for instance),³²⁰ public frustration intensifies and trust in government deteriorates. Unpopular fiscal measures, such as raising taxes or cutting public services, to balance funding for disaster relief can further erode legitimacy, especially when citizens perceive that the cost burden is unfairly distributed.

Affected communities, especially when not insured, need to migrate to safer places. A recent study concluded that current displacement risk is in the order of 30 million annual average displacements, solely due to direct loss of homes from sudden-onset hazards, and not including second-order reasons to migrate, such as job losses. The researchers also state that, under an optimistic scenario, global displacement risk could increase by 75 per cent by 2100 under an optimistic climate scenario, and by 157 per cent under a pessimistic one.³²¹ The Institute of Economics and Peace estimates that the number of people at risk of displacement due to extreme weather events could reach over 1 billion people by 2050.³²²

These dynamics add to already heightened political and geopolitical risks. When extreme weather events and the chronic effects of climate change hit societies without sufficient financial cushioning from insurance, pressure is added to ongoing political challenges. Inequality, political discontent and displacement all contribute to growing political or even geopolitical risks – risks that are rarely privately insured³²³ and that can hit economies and financial markets in systemic ways.

Chapter 4 explored some of the indirect impacts of extreme weather events in conjunction with growing insurance protection gaps. Some of the dynamics, such as the interplay with the mortgage market, are reasonably well understood. Other connections, such as between commercial insurance and lending, or cross-border contagion and the effect of Earth system tipping points, are not. With increasing risks and protection gaps, rising public spending for disaster relief and prevention and growing contingent liabilities will put pressure on public budgets and debt sustainability. Simultaneously, such disasters, especially when uninsured, also add to existing social and political challenges, emphasizing the need for a well-organized and funded government response to maintain the social and political cohesion required for a stable economy and prosperous society.



05 REGULATORY AND POLICY RESPONSES TO THE WIDENING PROTECTION GAP

There is growing recognition among governments in advanced economies of the implications of the expanding protection gap.^v Some governments and public officials recognize both the macroeconomic risks and growing burden on fiscal spending associated with the insurance protection gap as well as the challenges for insurance clients. The European Commission acknowledged the challenge by convening its Climate Resilience Dialogue, bringing together a broad range of stakeholders, including the insurance industry, during 2021 to 2024. This working group was tasked with analyzing ways to narrow the climate protection gap and to propose solutions to increase the resilience of European economies and societies to the effects of climate change. In the US, the Association of Insurance Commissioners adopted a National Climate Resilience Strategy in which it states: “We are at a watershed moment on climate and resiliency. [...] The number and scope of severe disasters that our jurisdictions have faced in recent years have raised questions about the sustainability of insurance availability and the challenges for consumers seeking insurance to be able to find and maintain it.”³²⁴

The Coalition of Finance Ministries for Climate Action³²⁵ has also highlighted the widespread economic impacts of extreme weather and the extent of relevant levers that ministries of finance can pull to reduce such impacts. These include:

- incorporating climate adaptation considerations into long-term economic strategies (e.g., investment decisions with long lifespans)
- allocating funds for resilience spending, including to local government

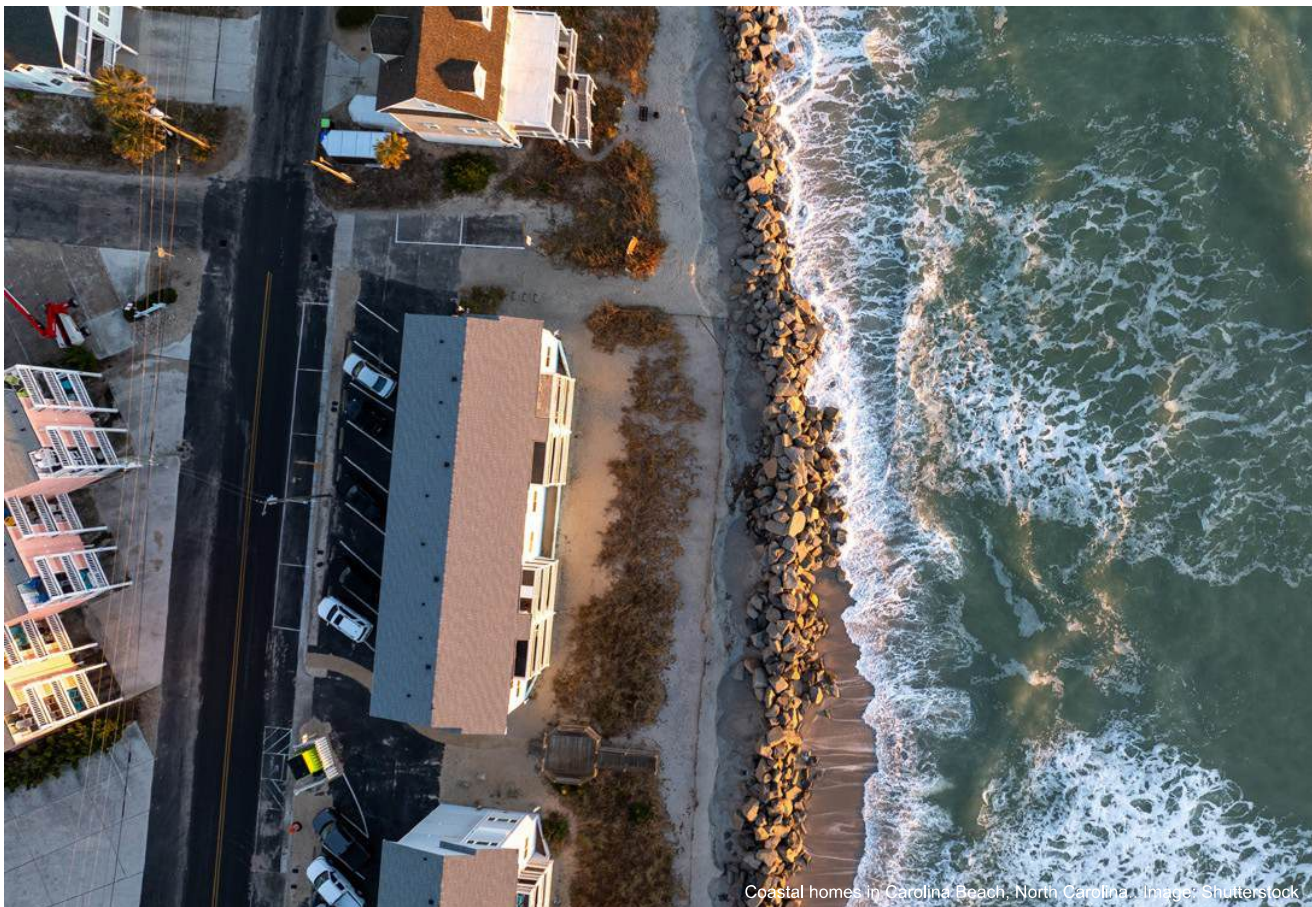
- planning for contingent liabilities
- implementing fiscal policies that incentivize adaptation
- crowding private finance into adaptation
- actively engaging with international climate finance to access additional resources for adaptation.

The Network for Greening Financial Supervision (NGFS) has also elaborated on the protection gap as an important factor for central banks and supervisors to consider regarding its impacts on the wider financial system.³²⁶

Governments and supervisory bodies are stepping up their efforts to address these issues. As summarized in the following sections, the policy and regulatory responses have fallen into the following categories: efforts to increase risk transfer and pooling through insurance supply and demand (5.1); increased risk prevention and resilience measures (5.2); efforts by central banks and financial supervisors to increase monitoring of risks; and microprudential regulation of insurance firms to preserve their solvency (5.3).

However, current responses are as of yet incomplete and, even if implemented fully, they are unlikely to close the protection gap. Concrete action by public authorities is usually focused on increasing insurance coverage and risk prevention measures (by governments), or risk monitoring (by supervisors), but action remains fragmented. A holistic picture of the full extent of risks is missing. Insufficient emphasis is also put on climate mitigation and nature-based solutions for adaptation.

More action within these areas and beyond is necessary and will be discussed in Chapter 6.



Coastal homes in Carolina Beach, North Carolina. Image by Shutterstock

v. Many less-developed and emerging countries have been aware of this challenge for some time, as they are often more exposed to climate- and nature-related risks than advanced economies.

5.1 GOVERNMENT INITIATIVES TO REDUCE THE PROTECTION GAP

5.1.1 PUBLICLY SUPPORTED INSURANCE SCHEMES

Governments in advanced economies have long relied on and now are increasingly adopting public or public–private insurance arrangements to cope with the growing difficulty of insuring extreme weather events.

As climate risks intensify, many countries have moved towards models in which the state supports or supplements private insurance markets, aiming to stabilize coverage availability or prevent market withdrawal. This includes public insurance schemes and reinsurance programmes, as well as state-sponsored private schemes. This reflects a broader trend of greater public involvement in risk sharing for climate-related hazards.³²⁷

In some jurisdictions, governments have responded to gaps in private insurance markets by creating public insurance entities that provide coverage directly to households and businesses. The United States has done so through the National Flood Insurance Program (NFIP), which became the primary insurer for residential flood risk after private insurers withdrew from the market. The NFIP is administered by the Federal Emergency Management Agency (FEMA) and is primarily funded by premiums, with the ability to borrow from the US Treasury when claims from major disasters exceed its reserves. It covers more than 5 million policies and provides roughly US\$1.3 trillion in financial protection. Participating communities need to adopt and enforce specific floodplain management standards. In Spain, the public insurer Consorcio de Compensación de Seguros is funded by a mandatory surcharge on property and motor policies and is responsible for compensating losses from extraordinary perils such as floods and earthquakes. In both cases, the public insurer functions as a centralized mechanism to ensure broad access to adequate protection.

Another model adopted in several countries is the use of public (or public–private) reinsurance systems that support private insurers. Under this approach, private insurers remain responsible for underwriting and claims management, while a publicly backed reinsurer provides additional capacity to ensure that severe or highly concentrated losses do not undermine the insurance sector. These include:

- France’s Caisse Centrale de Réassurance, which operates with an unlimited state guarantee, enabling insurers to cede catastrophic losses.
- A state-backed reinsurance fund in Italy, managed by SACE,³²⁸ the country’s export credit agency, and launched in 2025 with a capitalization of €5 billion. The fund is intended to support coverage for climate- and nature-related disasters affecting businesses, although its effectiveness and financial resilience remain untested in a country exposed to a wide range of natural hazards, including floods, earthquakes and drought.

- Flood Re in the United Kingdom, which is a public–private reinsurance pool that allows insurers to transfer the flood-risk portion of high-risk household policies in return for a capped, subsidized reinsurance premium (based on Council Tax bands). This scheme helps keep coverage accessible and premiums stable, enabling insurers to offer affordable household flood insurance in flood-prone areas.

Another trend, particularly visible in the United States, is the rise of last-resort insurance systems that ensure minimum coverage in regions where private insurers have reduced or withdrawn underwriting capacity.

These Fair Access to Insurance Requirements (FAIR) plans provide basic property insurance to homeowners in areas with high exposure to wildfire, hurricane or urban fire risks. FAIR plans are privately run but mandated and regulated by state governments, funded through policy premiums, assessments on private insurers and, in some cases, state-level financial backing. These plans have been established to provide essential coverage to households that would remain uninsured in regions where market conditions have become untenable.

While there is a general trend toward greater government involvement to maintain insurance coverage, many countries have not yet taken concrete action.

In Austria, for example, discussions about a public–private natural hazard insurance scheme have yet to result in a concrete programme. In Germany, following the catastrophic 2021 floods, discussions are ongoing, but no law has yet been passed. Most recently, the German Insurance Association proposed a system called ‘Elementar Re’ that would also offer an opt-out and hence not be completely compulsory.³²⁹ These examples highlight that, despite broader trends, frameworks for comprehensive risk-sharing remain incomplete.

Public insurance schemes can undermine risk mitigation through misaligned price signals and incentives and therefore need to be carefully designed.

By pooling high- and low-risk properties and subsidizing premiums, such programmes can obscure the true cost of weather hazards, reducing the motivation to invest in preventive measures. Cross-subsidization shifts costs from high-risk to low-risk policyholders – and in some cases from owners to renters, as with the US NFIP – while failing to discourage repeated rebuilding in exposed areas. Reliance on government programmes to cover extraordinary losses might therefore reinforce behavioural risks.

As climate-related hazards intensify, public–private insurance schemes may also struggle with rising costs.

Well-designed programmes can mitigate some of these risks. For example, France’s NatCat regime pools premiums within the state-owned Caisse Centrale de Réassurance, sharing costs evenly with private insurers and rarely requiring government funding: it has even generated a surplus.³³⁰ As discussed in Chapter 4, public insurance schemes serve as critical financial backstops, but extraordinary losses can underline the limits of relying solely on insurance to manage extreme weather risks. Hence, such schemes need to be carefully designed and integrated in a holistic approach, as described in Chapter 6.

5.1.2 SPECIFIC MEASURES TO INCREASE INSURANCE SUPPLY AND DEMAND

Governments and regulators are taking steps to increase insurance supply and demand, and many are applying one or more of the following approaches.

Governments are increasingly making insurance compulsory. France requires natural catastrophe coverage in all property insurance contracts. In Switzerland, most cantons mandate building insurance that includes natural hazard protection,³³¹ and Belgium introduced compulsory natural hazard insurance in 2006, where it is included in fire insurance. Countries such as Italy and Greece³³² have recently strengthened mandatory natural hazard insurance, while in Germany the debate following the 2021 floods is still ongoing, with the German Insurance Association proposing a system called ‘Elementar Re’; this would, however, provide an opt-out, and hence would not be completely compulsory.³³³ Compulsory schemes help increase insurance uptake, address adverse selection and support more stable and affordable premiums. This trend underscores a growing recognition that higher participation is necessary to address the protection gap. However, as the case in Greece shows, if mandates to buy are not carefully designed, and risk reduction is insufficient, companies cannot find insurance even though they are required to.³³⁴

Affordability concerns have prompted governments to intervene more actively in insurance pricing.

In both the United States and Europe, premiums are often subsidized for agricultural insurance, such as through the US Federal Crop Insurance Program, Spain’s Agrosseguro or Austria’s Hagelversicherung, which provides a 55 per cent premium subsidy. In the United Kingdom, Flood Re supports affordability by allowing insurers to transfer the flood-risk portion of high-risk household policies in exchange for a capped premium, enabling insurers to offer affordable household flood insurance in highly exposed areas.

Another shared trend in the US and Europe is the emphasis on improving risk transparency through hazard mapping and disclosure requirements.

Mapping includes initiatives such as the NOAA Climate Mapping for Resilience & Adaptation tool in the US,³³⁵ the UK Met Office’s Climate Projections project and the Environment Agency’s Flood Map for Planning,³³⁶ and the Klimaateffectatlas in the Netherlands.³³⁷

Several US states (e.g., Louisiana, Texas, New York and Pennsylvania) require property sellers to disclose past flood damage, claims and zoning. In California, this obligation also extends to disclosure of past wildfires and earthquakes. In France, both real estate sellers and landlords must provide a risk statement, including past disaster declarations for the property.



Flooding in Tewkesbury, Gloucestershire, February 2022. © PA Images / Alamy Stock Photo

5.2 GOVERNMENT MEASURES TO INCREASE RISK PREVENTION AND RESILIENCE



Governments are updating building codes to strengthen buildings to climate-related hazards, thus reducing vulnerability to extreme weather and the risks that need to be insured. In the US, the International Code Council and the American Society of Civil Engineers (ASCE) are developing consensus-based model codes that include requirements for climate resilience. For example, the latest ASCE 7 code includes a supplement addressing flooding and sea-level rise, and the 2027 update of the International Building Code will introduce criteria for tornado-resistant design. In Florida, the state has already strengthened its building requirements to ensure buildings withstand extreme weather, especially hurricanes, including wind-resistant design features.³³⁸ In the EU, the Eurocodes standards are currently being revised to strengthen the climate-resilience of buildings.

Moreover, governments are updating zoning regulations to prevent new development in high-risk areas. For example, US cities such as Boston are updating coastal flood resilience zoning. In the Netherlands, the Delta Programme for Spatial Adaptation, a national climate-adaptation framework for spatial planning, requires municipalities and provinces to integrate flood, heat and drought risks in zoning. However, it is important to note that updating building and zoning regulations can only mitigate risk for new or renovated buildings; they do not change the location of existing structures in high-risk areas.

Some countries are also developing measures to address risks for existing buildings. For example, some US states, particularly those prone to hurricanes, are implementing

targeted grant programmes and tax credits for homeowners who adopt measures to reduce the risk of hazards like wildfires and hurricanes.³³⁹

Many countries have now adopted some form of national climate adaptation strategy, reflecting the growing urgency of building resilience to climate impacts. In the US, federal agencies have developed Climate Adaptation and Resilience Plans to guide sector-specific action. At the EU level, Article 5 of the European Climate Law, which entered into force in June 2021, makes adaptation to climate change a legal obligation for EU institutions and member states. Moreover, the European Commission is updating the EU's 2021 Adaptation Strategy into an integrated framework for European climate resilience and risk management. The EU is aiming to adopt a policy package in the second half of 2026 which should coordinate efforts across member states.³⁴⁰ As of 2025, the UK and most EU member states have published national adaptation plans, strategies or included climate adaptation in their climate laws.³⁴¹

Despite growing recognition of the need for climate adaptation, public investment remains far below what is required to limit escalating climate-related losses. While other risk sectors – such as residential fire prevention – have demonstrated that proactive measures can potentially reduce damages significantly,³⁴² climate-related damages continue to rise. In Germany, for example, the Environment Agency estimated total federal spending on climate adaptation to be between €2.1 and €3.4 billion in 2022 – less than 1 per cent of the federal budget.³⁴³ With actual climate-related damage totalling at least €80 billion since 2018,³⁴⁴ the €4.5 billion allocated under the German Action Programme for Natural Climate Protection³⁴⁵ (ANK, launched in 2023) appears insufficient to realize the preventive investment needed. Equally, in the US, the Biden government proposed spending US\$23 billion in 2025 on adaptation and resilience (around 0.3 per cent of federal spending).³⁴⁶ This underscores a central challenge identified across national adaptation plans: without adequate and sustained funding, the ambition to build resilience will remain out of step with the scale of the risk.

Adaptation financial planning also suffers from data unavailability and inconsistency. In Austria, for example, adaptation spending is not quantified since it is not specifically classified as such, and there is no national bookkeeping on how much municipalities spend on adaptation-adjacent public goods (such as urban trees against heat, restoring rivers against flooding, etc.).

Efforts to enhance financial resilience and climate adaptation are not matched by adequate reductions in GHG emissions or by sufficient measures to protect and restore natural ecosystems. While governments are intensifying initiatives to expand or maintain insurance coverage and both public and private actors are beginning to invest in disaster risk reduction, both commitments and actions to limit further climate change³⁴⁷ and nature loss remain insufficient.

5.3 HOW CENTRAL BANKS AND FINANCIAL SUPERVISORS ARE STEPPING UP

International insurance supervisors and standard setters are increasingly acknowledging the challenges posed by the widening protection gap. The International Association of Insurance Supervisors (IAIS) has issued a call to action on the role of insurance supervisors in addressing natural catastrophe protection gaps,³⁴⁸ alongside an updated application paper on the supervision of climate-related risks in the insurance sector.³⁴⁹ The paper emphasizes that supervisors should apply more forward-looking climate scenario analysis to better assess, measure and mitigate the protection gap. Likewise, the Bank for International Settlements has examined how a widening reinsurance protection gap could amplify financial instability,³⁵⁰ recommending that supervisory frameworks should capture climate risks and that public-private collaboration and adaptation incentives form part of the toolkit to narrow the gap. In the US, the National Association of Insurance Commissioners, the national insurance regulator, adopted a strategy to close coverage gaps and improve recovery from natural disasters in 2024.³⁵¹

In its most recent *Financial Stability Report*, the ECB cautioned that insurers face mounting exposure to climate-related physical risks, which may evolve into a broader source of systemic vulnerability.³⁵² EIOPA, the European insurance regulator, recently published its first-ever stocktake of biodiversity risks – a report mapping current practices and challenges in the identification, measurement and management of biodiversity risks by insurers and reinsurers as part of Solvency II.³⁵³ Jointly, the ECB and EIOPA have proposed a two-pillar approach to tackle the insurance protection gap: an EU-wide public-private reinsurance scheme and an EU-wide public disaster fund.³⁵⁴

Insurance regulations and supervisory expectations around climate risk are growing, but a holistic picture of risks and a macroprudential view is still lacking, as the WWF SUSREG Tracker update in December 2025 shows.³⁵⁵ Financial supervisors are increasingly introducing measures to understand and address growing risks from extreme weather events and how these risks are absorbed by the insurance sector.³⁵⁶ Several common approaches are emerging:

- Supervisory expectations and regulations on climate risk in underwriting are expanding. Prudential authorities such as the New York Department of Financial Services,³⁵⁷ the Swiss Financial Market Supervisory Authority (FINMA),³⁵⁸ the Financial Market Authority (FMA) in Austria, De Nederlandsche Bank (DNB) in the Netherlands and the UK's Prudential Regulation Authority (PRA)³⁵⁹ have issued climate risk guidance for insurers. However, these actions remain largely microprudential, focused on safeguarding the solvency of individual financial institutions, with limited or no integration of macroprudential perspectives that capture systemic spillovers and financial stability risks.
- Risk indicator monitoring is becoming more sophisticated. DNB, the Dutch central bank, has developed dashboards to track climate and environmental risks for banks and insurers, while EIOPA operates a dashboard quantifying the European insurance protection gap for natural catastrophes. These tools provide early-warning indicators and support evidence-based supervisory action, although they are still limited in coverage of nature-related risks.

- Climate stress tests are being used to explore how climate shocks can be transmitted into the financial system. Several such exercises have been performed, by Autorité de contrôle prudentiel et de résolution (ACPR) in France, DNB in the Netherlands, the PRA in the UK, the ECB and EIOPA in the EU, the New York Department of Financial Services, the California Department of Insurance and the Canadian Office of the Superintendent of Financial Institutions. However, these stress tests typically assume gradual transition pathways, exclude tipping points and nature-related risks, and rarely integrate second-round effects on inflation, fiscal balances or sovereign risk.

Despite this progress, significant gaps remain in the regulatory and supervisory response to climate-related financial risk in the insurance sector. These approaches do not tend to provide a holistic picture about how climate risk and the protection gap ultimately affect macroeconomic variables such as growth, inflation and financial stability.

Implementation is uneven across jurisdictions, methodologies lack harmonization and most supervisory tools focus primarily on microprudential stability rather than systemic risks. Climate stress tests rarely account for non-linear shocks, compound hazards or the exacerbating effects of biodiversity loss, while disclosure regimes remain fragmented. Moreover, supervisory capacity constraints also limit effectiveness.

Critically, few of these initiatives sufficiently account for nature risks or climate adaptation through nature-based solutions, despite the proven ability of the latter to reduce disaster losses. By omitting the role of ecosystems in mitigating extreme weather impacts, supervisory frameworks risk underestimating resilience potential and missing opportunities to reduce protection gaps at their source.

These shortcomings underline the need for more coordinated, forward-looking and macroprudential supervisory approaches to address the systemic implications of widening protection gaps, including by incorporating climate adaptation and the risk-reducing role of nature-based solutions.



Modern apartments alongside naturalized wetland, with water lilies and reeds providing an ecological buffer. Image: Shutterstock

06 WWF RECOMMENDATIONS TO CONTAIN THE PROTECTION GAP FOR THE BENEFIT OF PEOPLE, NATURE, BUSINESSES AND GOVERNMENTS



Danube floodplain forest. Image: Adobe Stock

Public authorities in Europe and the US have already started taking important and relevant action (to varying degrees) to contain the protection gap. However, they are often focused on pooling and transferring risk and/or mitigating it with grey (i.e., man-made) infrastructure or updated building codes. In this section, WWF puts forward further considerations that are crucial for the long-term resilience of the insurance market, and therefore the economy, but that are insufficiently addressed by current policy responses.

Public actors need to tackle the insurance protection gap strategically, with a disaster risk reduction and resilience strategy, addressing the root causes of increasing risks and using the capabilities of the insurance sector.

Closing the protection gap requires a strategic approach to measuring and managing climate and nature risk that embeds insurance mechanisms in a wider strategy. This approach must be based on a more complete understanding and management of risk, including risk prevention and mitigation of extreme weather events through action on climate change, halting and reversing nature loss and mainstreaming nature into climate change adaptation strategies.

As discussed in Chapter 3, current incentives in private insurance markets are insufficient to contain the protection gap. In many cases, risk-based pricing and market withdrawals from high-risk areas protect insurers’ margins and capital but reduce access to affordable coverage where it is most needed. This underscores the enduring need for government intervention in insurance markets, which has been present since their very inception to safeguard societal and economic well-being.³⁶⁰

The resulting political action has often focused on targeted interventions in the insurance market to counter market failures through, e.g., countering adverse selection, assuring affordability or absorbing extreme risks through public-private insurance schemes and risk pools. Such interventions are crucial to reduce the financial vulnerability of affected people, households, businesses and governments and to ensure the swift recovery of affected communities.

However, if not carefully designed, and especially if they distort risk-based pricing, government interventions can also create perverse incentives that lead to long-term maladaptive practices, such as building in areas that are highly vulnerable to extreme weather or planting environmentally unsuitable crops. Moreover, without serious efforts to mitigate climate change, growing physical climate and nature risks render such narrow policy interventions unsustainable, as escalating hazards erode insurability and lead to mounting losses and damages that ripple through the economy and society – ultimately burdening public balance sheets (see Chapter 4).

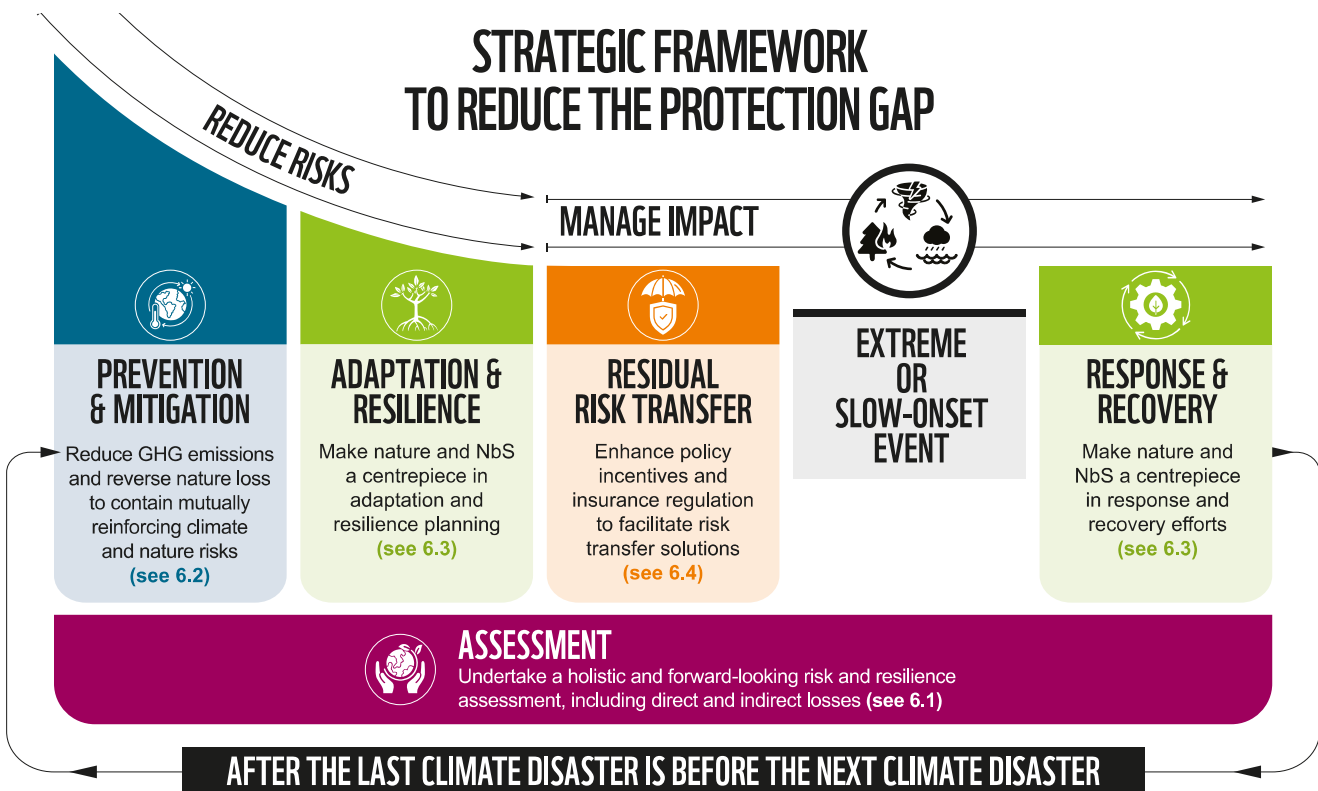
To complement political efforts, WWF recommends, as shown in Figure 29, that governments address residual

risks with a strategic approach based on the disaster risk reduction lifecycle. As a foundation for political support of the appropriate policy reaction, a holistic understanding of the risks and losses is fundamental, while such assessments should not delay the implementation of no-regret actions (6.1).

Building on that, reducing GHG emissions from fossil fuels, deforestation and ecosystem conversion, as well as the restoration of nature to preserve its capability to store GHG emissions, are indispensable for maintaining insurability (6.2). However, climate risk will increase for some time, even under the most optimistic scenarios. Investment in climate change adaptation and building resilience is therefore another key ingredient to address the protection gap. Nature needs to be mainstreamed into each element of such strategies, to increase the physical resilience of affected communities and landscapes. This includes the protection and preservation of nature, the restoration of nature to help people (e.g., through nature-based solutions), and helping nature itself adapt to climate change. (6.3).

Furthermore, any residual risk needs to be managed through insurance or similar mechanisms to transfer, share and decrease the financial vulnerability of affected people, households, businesses and governments and to ensure the swift recovery of affected communities and the restoration of vital ecosystems (6.4). It is crucial that the incentives such mechanisms create contribute to risk reduction efforts. The earlier that governments act decisively, the more likely that risk and losses can be reduced and government budgets and people’s livelihoods protected.

FIGURE 29



Adapted from J. A. Richards, (2022). After the last climate disaster, is before the next climate disaster. The Loss & Damage Collaboration.

6.1 UNDERTAKE HOLISTIC AND FORWARD-LOOKING RISK AND RESILIENCE ASSESSMENTS, INCLUDING INDIRECT LOSSES



As discussed in Chapter 5, governments, central banks and financial supervisors are increasingly seeking to understand and measure climate risks and the implications they have for the insurance sector and beyond. However, significant gaps remain. This section recommends how these actors can address these issues by undertaking risk and resilience assessments, working with the insurance sector.

A focus on the risks to individual firms is not sufficient: such assessments must capture systemic risks and the implications for the economy and society. Central banks, financial supervisors and ministries of finance must work together, across both national silos and international borders, to anticipate and mitigate the systemic risks associated with the climate insurance protection gap.

KEY ACTION AREAS

6.1.1 CONDUCT HOLISTIC AND FORWARD-LOOKING RISK AND RESILIENCE ASSESSMENTS THAT REFLECT CLIMATE CHANGE, NATURE LOSS AND THE INSURANCE GAP



The following aspects should be considered when conducting such assessments:

Supervisory expectations and disclosure requirements and holistic risk and resilience assessments need to align. Insurance supervisors should implement the IAIS's new Insurance Core Principles application guidance on climate-related risks and extend that to nature-related risks. Supervisors need to take steps to ensure that firms have the capabilities to properly understand their risks across an appropriate range of scenarios, and to reflect this in their decision-making.³⁶¹ These steps can be complemented by mandated climate- and nature-risk disclosures for both insurers and the businesses they insure, including the viability of insurance as a risk mitigation strategy for companies. Such assessments and disclosures can give insurers and supervisors a truer sense of total financial and environmental risk exposure.

Holistic assessments must go beyond recording physical destruction caused by extreme weather events to capture indirect impacts. These include social and political consequences, as highlighted in Chapters 3 and 4. Specifically, assessments must consider the economic and financial consequences of physical climate and nature risks, including insurance availability and affordability, household disposable income and wealth, business competitiveness, price and financial stability, and the fiscal position of governments.

Insurance supervisors should perform and publish regular assessments of protection gaps and vulnerability to catastrophe risks. The IAIS recognizes that climate risks can impact financial stability and that supervisors should facilitate the monitoring of climate-related vulnerabilities and macroeconomic instability.³⁶² In addition

to home insurance, supervisors should also consider insurance of public infrastructure, business insurance (including supply chains) and agricultural insurance. A promising example is EIOPA's dashboard on the insurance protection gap for climate-related catastrophes, an analytical tool that tracks how much of the financial losses from climate- and nature-related disasters is covered by insurance in each EU country.³⁶³ This dashboard aggregates data on economic losses and insured claims from floods, storms, wildfires, earthquakes and other perils. (However, it does not yet drill down to the regional or local level.)

Central banks should take a macroprudential approach to insurance and protection gaps. A macroprudential approach to systemic risk was strongly advocated by international supervisory bodies³⁶⁴ and now needs to be amended by including climate and nature considerations.³⁶⁵ Macroprudential supervision is largely focused on the banking sector and is mostly absent from insurance regulation and supervision. Authorities must consider the relationship between the insurance and banking sectors.

Stress-testing exercises should assess the resilience of the financial sector to climate change, nature loss and insurance protection gaps. Regulators must use these stress tests to assess how uninsured losses could transmit shocks through the wider financial system (e.g., through mortgages and property markets). Such stress tests need to be performed and published regularly, not just as one-off exercises. So far, one of the most comprehensive examples is the latest climate stress test from the French supervisor ACPR, which included banks and insurers, asked questions about insurability and addressed effects on life and health insurance.³⁶⁶ Findings on climate- and nature-related risks and the insurance protection gap should be reflected in regular financial stability reports and should inform the further deployment of macroprudential tools.^{vi}

These assessments will face challenges with uncertainty around future climate impacts and with quantification. Authorities should adopt a precautionary policy approach.^{vii} Climate scenario analysis is a key tool to inform macroprudential management of climate risks, but this is constrained by uncertainty over future climate change dynamics and the limitations of modelling.



vi. For more information, see SUSREG 2025

vii. For more information on the precautionary approach, see: https://wwfint.awsassets.panda.org/downloads/wwf_gfri-roadmap.pdf

A 2024 report by the UK Institute and Faculty of Actuaries argues that assessments that only reflect the most probable outcome as suggested by current modelling, rather than the full range of outcomes and significant ‘tail risks’, will be incomplete.³⁶⁷ This is especially relevant as the pace of climate change and nature loss is not fixed, and neither is our scientific understanding. In particular, climate tipping points could irreversibly damage ecosystems and destabilize economies.³⁶⁸ Policymakers must take a precautionary approach, using a diverse portfolio of model types to capture a range of plausible futures, including the potential for escalating climate and environmental risks. Where required and supported by scientific consensus, authorities should encourage the complementary use of qualitative analysis.

6.1.2 INCORPORATE INSURANCE DYNAMICS AND CO-BENEFITS INTO RESILIENCE PLANNING



Public authorities must consider insurance availability, affordability and the protection gap to identify the most important resilience measures. This includes identifying how insurance provision and prices will change in future in response to climate change and nature loss. Understanding the likely future protection gap helps identify where losses are most likely to be uninsured, the potential fiscal liabilities for government and where targeted interventions are needed. Where possible, fiscal risks should also be considered in fiscal outlooks or risk and sustainability reports by ministries of finance or relevant functions (e.g., the Office for Budget Responsibility in the UK). This requires insurers to work with authorities to support this identification process (for example, selecting the criteria to use in determining the insurability of an asset).

Such considerations should also extend to supply chain vulnerabilities, evaluating potential disruptions and identifying measures to improve resilience and insurance coverage. The EU’s Climate Resilience Dialogue between policymakers and insurers offers a platform and template for this.³⁶⁹ For agriculture, the EU’s review of insurance and risk management tools highlights options such as index insurance, mutual funds and public–private partnerships paired with prevention measures to reduce exposure and stabilize incomes.³⁷⁰ In the US, California also offers an example of a holistic government approach to the economic and insurance consequences of the climate crisis.³⁷¹

6.1.3 PROPERLY VALUE AND PRIORITIZE NATURE AND NATURE-BASED SOLUTIONS

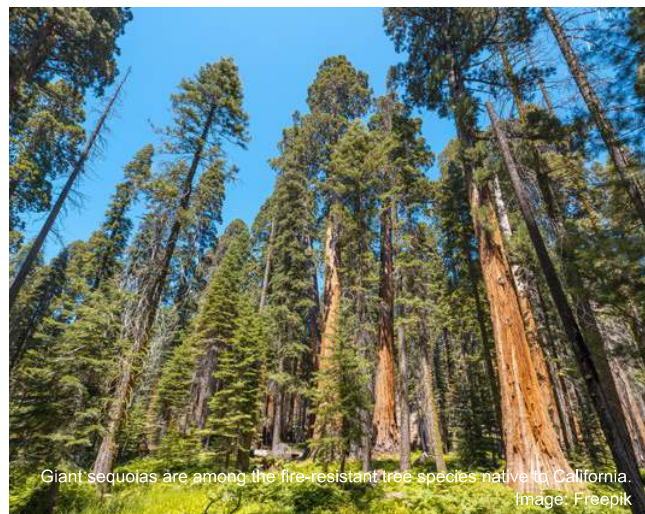


Risk and resilience assessments should incorporate nature. Currently, where nature risk is included in supervisory expectations, nature-specific expectations are high level.³⁷² Recent updates to the IAIS Core Principles only include climate-related risk, rather than nature-related risks.

Scenario analysis must also include the impact of climate change and extreme weather events on ecosystems and natural capital. This reflects the integrated approach to climate- and nature-related risks emphasized by the NGFS.³⁷³

Government intervention and investments must reflect the co-benefits of investment in nature to support resilience. Governments and central banks could look to develop scenarios where risks are mitigated by investment in nature-based solutions. Government decision-making frameworks on resilience measures should recognize interdependencies with other policy areas. This notably means evaluating not only the effect of disaster risk reduction measures on avoided physical damages, but also their indirect benefits, such as improved public health, enhanced ecosystem services and strengthened economic competitiveness. The Dutch government provides guidance to analyse the potential effects of public investments on mitigation and adaptation, as well as on a healthy living environment.³⁷⁴ Given the localized nature of the impacts of extreme weather, municipal authorities need to be included in assessment and decision-making, particularly where these bear significant costs associated with extreme weather events and adaptation measures.

Governments must include both natural ecosystems and built infrastructure assets in post-disaster loss and damage accounting and investment in recovery. Holistic loss and damage assessments should explicitly value both human-made structures and ecosystem services and natural capital, recognizing that ecosystems can reduce hazard exposure, buffer impacts and accelerate recovery when restored. Response and recovery mechanisms and funding should reflect the balance of losses between human-made and natural assets, so that loss and damage inventories and investment pipelines do not systematically neglect natural ecosystems. For example, the EU Solidarity Fund reimburses member states for restoring natural heritage alongside public infrastructure repairs.³⁷⁵ Following the 2020 earthquake in Croatia, the EU Solidarity Fund was used to restore affected natural areas to prevent the immediate effects of soil erosion.³⁷⁶ In California, recovery efforts after wildfires include replanting fire-resistant trees.³⁷⁷



Giant sequoias are among the fire-resistant tree species native to California. Image: Freepik



6.2 REDUCE GHG EMISSIONS AND NATURE DESTRUCTION DOMESTICALLY AND THROUGH INTERNATIONAL COOPERATION TO CONTAIN MUTUALLY REINFORCING CLIMATE AND NATURE RISKS



To keep climate and nature risks insurable, governments must address the root causes of the twin crises by cutting emissions, restoring nature and aligning finance with global sustainability goals. Unless we implement robust mitigation measures, emissions, climate change and nature loss will feed each other, fuelling ever more extreme weather and worsening harm to both humans and the ecosystems we depend on.

KEY ACTION AREAS

6.2.1 DELIVER ON CLIMATE AND NATURE COMMITMENTS



To address the insurance protection gap, national governments must tackle the problem at its roots.

To maintain long-term insurability, governments must urgently enhance and implement their strategies to mitigate climate change and halt and reverse nature loss. For example, parties to the UN conventions on climate and nature should strengthen and deliver on their Nationally Determined Contributions (NDCs) under the Paris Agreement, informed by the outcomes of the Global Stocktake, and implement their National Biodiversity Strategies and Action Plans (NBSAPs) under the GBF.³⁷⁸ This should include setting specific emission mitigation targets for ecosystems, halting and reversing deforestation, forest degradation and land conversion, and the orderly phasing out of fossil fuel and related subsidies. Ending deforestation stands out as a priority at the intersection of climate and nature. Doing so is crucial for combatting climate change because forests absorb vast amounts of carbon dioxide, and their destruction releases significant GHG emissions into the atmosphere.

6.2.2 DEEPEN INTERNATIONAL COORDINATION



International cooperation is crucial for managing global public goods such as climate and nature and must therefore be deepened. Global institutions and forums – including the G20, the FSB, the IAIS and the NGFS – should, within their respective mandates, integrate climate- and nature-related mitigation, adaptation and resilience into global financial stability agendas and initiatives to reduce the protection gap. The Compendium of the Coalition of Finance Ministers for Climate Action on tools and models to support financial decision makers provides an illustrative example.³⁷⁹ Again, the urgent need to halt deforestation and conversion should be

systematically reflected in regulatory and supervisory priorities, given its central role in both climate risk and nature loss.³⁸⁰

Likewise, governments should join and strengthen intergovernmental high-ambition coalitions (e.g., the High Ambition Coalition for Nature and People) to mitigate climate change and halt and reverse nature loss. In addition, joint climate-nature political platforms provide meaningful soft-law frameworks. For example, the COP28 Climate, Nature and People Declaration functions as a political umbrella under which more concrete coalitions and initiatives can emerge,^{viii} with ambitious climate clubs being of particular relevance for high-emitting countries.

6.2.3 DEVELOP NATIONAL TRANSITION PATHWAYS AND REQUIRE PRIVATE SECTOR TRANSITION PLANS TO UNLOCK PRIVATE INVESTMENTS



Governments must mandate integrated climate and nature transition plans to unlock capacity from within the private sector to support an orderly transition.

A transition plan is an aspect of an entity's strategy that lays out its strategic ambition, goals, targets, actions, accountability mechanisms and intended resources for responding and contributing to the transition towards a low-carbon, nature-positive economy. Mandating credible and robust transition plans is a critical way in which governments can align the private economic sector with a sustainable transition.³⁸¹ In addition, evidence suggests that transition planning makes firms more competitive and supports transition finance.³⁸²

Despite the benefits these plans offer, voluntary adoption by private firms remains uneven.³⁸³ This underscores the need for mandated transition plans – as already introduced in some jurisdictions.³⁸⁴ For example Spain, which has experienced severe climate-related floods and fires in recent years, now requires large companies to calculate their carbon footprints and develop GHG emission reduction plans.³⁸⁵



Crucially, these mandated plans must be credible, grounded in science and adhere to stringent minimum requirements, to avoid perpetuating inconsistencies and comparability challenges across different transition strategies.³⁸⁶ As far as transition plan requirements for insurance companies are concerned, they should include their investments as well as their underwriting portfolios.³⁸⁷ Access to state-backed insurance facilities and public reinsurance schemes should be conditional on insurance and reinsurance companies adopting and implementing robust transition plans (see Section 6.4).

Governments should create and support collaborative formats for government officials, the private sector, academia and civil society as well as affected groups to further develop detailed national and sectoral pathways for achieving net-zero and nature-positive outcomes.³⁸⁸

National nature targets remain significantly less advanced than climate targets, with governments yet to commit to mandatory, time-bound commitments comparable to NDCs under the Paris Agreement. Governments must urgently establish legally binding nature targets with clear accountability mechanisms, regular reporting and enforcement provisions, and which are aligned with the GBF's 30x30 goal and integrated into NBSAPs.

Building on those, relevant sector pathways need to be developed, laying out how businesses contribute to national climate and nature targets. National pathways will serve as the basis to address the economic and regulatory hurdles to provide private capital for green (climate) solutions and nature-based solutions at the global scale needed, including the enabling of necessary systematic reforms of tax schemes and subsidies. For example, the UK government is explicitly supporting the development of these pathways for the UK in its recent call for evidence on how to expand the role of the private sector in nature recovery.³⁸⁹ The development of transition plans and national sector transition pathways are mutually reinforcing

when it comes to respective responsibilities regarding individual contributions and an enabling environment. Again, coordinated action is needed by environmental, financial and economic authorities, including governments at national, state and local levels, appropriate to their responsibilities.

6.2.4 MOBILIZE PRIVATE CAPITAL FOR NATURE-BASED AND GREEN SOLUTIONS



Governments should mobilize private capital for nature-based and green solutions and incentivize climate- and nature-friendly investment from insurers as asset owners and managers. Insurers are major institutional investors with the ability to deploy significant capital and with long-term investment horizons. In addition to the necessary environmental regulation and subsidies aligned with climate and nature goals, governments should use (blended) finance instruments – e.g., guarantees and first-loss tranches – to de-risk and catalyze investment in climate and nature projects within a proof-of-concept approach for innovative solutions.

These should include targeted public insurance mechanisms or public-private partnerships for activities that are currently hard to insure, such as transitioning to regenerative agricultural practices,³⁹⁰ or traditional burning for land and ecosystem management,³⁹¹ as well as for public projects, such as local ecosystem protection and restoration, where public self-insurance is often most efficient. Coordinated action among public authorities, investors and insurers can scale green and nature-based solutions globally, unlocking new opportunities for innovation, partnerships and generating resilience dividends.

RESPONSIBLE BODIES



GOVERNMENT



CENTRAL BANKS, FINANCIAL REGULATORS & SUPERVISORS



MARKET



SCIENCE



CIVIL SOCIETY

TEXTBOX 3: BEYOND RISK TRANSFER: HOW INSURERS CAN ACCELERATE THE TRANSITION TO NET-ZERO AND NATURE-POSITIVE ECONOMIES TO MAINTAIN INSURABILITY

In addition to government action, insurers, reinsurers and brokers have an important strategic role to play in maintaining insurability and reducing the insurance protection gap. Their investments and underwriting decisions must not contribute to the growing risks from extreme weather events that they then struggle to cover without government intervention. Instead, they must play a proactive role in integrating climate and nature risks and impacts into their policies and processes, supporting NbS and advocating for science-based policies. Their three main roles are:

- As major long-term institutional investors, where their allocation of capital and the use of ownership rights can influence which industries will develop and which ones contract.
- As risk carriers in their insurance underwriting activities, where they are instrumental in facilitating capital-intensive buildings, infrastructure, companies and projects through the management and transfer of risk. Without insurance, many economic activities cannot be financed

and implemented (or are otherwise riskier and more expensive).

- As risk managers and experts, where they can quantify climate risks and provide invaluable insights into the potential impacts of failing to mitigate climate change and nature loss.

The insurance sector must leverage these roles to enable and scale up the technologies needed in the net-zero and nature-positive transition, while phasing out their support for carbon-intensive activities.³⁹² For example, insurers need to increase the proportion of renewable energy compared with fossil fuels in their underwriting and investment portfolios through capital reallocation and engagement. Estimates from Insuramore show that insurance premium revenues from renewable energy are growing at around 9 per cent a year, or half the pace needed for meeting the growth rates necessary for the International Energy Agency's Net Zero Pathway.³⁹³



Underwriting our Planet cover image. Image: Shutterstock montage

In their 2023 report, *Underwriting our Planet*, WWF and Deloitte set out the multiple levers that insurance companies have in their underwriting business to contribute to climate and nature goals.³⁹⁴ The report also provides examples in each of the levers showing that some insurance companies are making progress, although not at the scale and speed necessary.

Insurance companies determine what is insured through:

- **Developing new products for the transition**, including coverage for practices and technologies that need development and scaling for the transition, such as technology performance insurance for heat pumps, bioenergy, circular economy or solar projects, and parametric insurance to protect wind or solar energy assets against suboptimal amounts of sunshine or wind. Practices such as mass timber construction or the decommissioning of assets also require specialized insurance products.
- **Insuring natural assets and nature-based solutions:** Insurance underwriting can support the construction of nature-based solutions or reduce the financial vulnerability of such assets after extreme weather events (for more details, see Textbox 4).
- **Surety for restoration**, which can play a crucial role by guaranteeing sufficient money for ecological restoration after decommissioning of assets with high negative environmental impacts. To meet their environmental goals, such contracts need to be carefully designed.
- **Exclusion and phase-out policies**, which are crucial to create convergent expectations in the market that are needed for an orderly transition. Insurance companies must also stop supporting new fossil fuel developments that are incompatible with net zero.³⁹⁵ Research for Insure our future shows that, in 2023 “the market share of primary insurers with fossil fuel restrictions has grown from 39.8 per cent to 41.2 per cent in coal and from 15.4 per cent to 19.6 per cent in oil and gas insurance. [...] These increases are positive but don’t meet the urgency of the moment.”³⁹⁶

Insurance companies determine how things are insured – that is, by creating incentives that can:

- **Prevent moral hazard.** For example, an environmental insurance liability product with inadequate terms and conditions could lead to riskier behaviour by the insured company (moral hazard), thus increasing the risk of environmental pollution.
- **Promote green choices and practices.** Insurance companies can provide contractual incentives for green choices, including nature-related risk mitigation practices. For instance, AXA XL offers a reduced deductible on environmental risk policies for French corporate clients if they conduct an independent ecological assessment of nearby natural areas as a baseline and integrate these results into their accident prevention and management plans.³⁹⁷ Also, Zurich, AXA XL and Helvetia are piloting a sustainability-linked reinsurance product for the Swiss federal railways’ insurance captive. Under the insurance contract, SBB Insurance AG’s reinsurance premiums are linked to the group’s sustainability performance targets.^{398, 399}
- **Encourage repair over replace.** Repairing goods increases their lifespan and generally reduces environmental impacts because fewer raw materials are required and less waste is produced. Some insurance companies have therefore introduced repair over replace programmes, mostly in motor insurance.
- **Support build back better and green for old.** Insurance companies need to offer programmes that incentivize replacements after a disaster or incidents that are more resilient, and that ensure that polluting technologies are replaced with green alternatives, such as replacing a damaged oil or gas heating system with a renewable alternative or a combustion engine car with an electric car. Flood Re in the UK, for example, has incorporated since 2022 a ‘build-back-better’ policy,⁴⁰⁰ allowing claimants to access additional funds for more climate-informed repairs, such as self-closing air bricks, flood barriers and raised electrical fittings.

FIGURE 30: LEVERS OF INSURANCE UNDERWRITING TO SUPPORT GLOBAL CLIMATE & BIODIVERSITY GOALS



Source: WWF Switzerland, (2023). *Underwriting Our Planet: How Insurers can help address the crises in climate and biodiversity.*

In addition, insurance companies are important stakeholders for companies and public authorities. They can leverage that position for engagement and advocacy to accelerate a green, fast and fair transition. For example, they can:

- **Engage** with their clients (companies, cedents and brokers) and peers to establish industry coordination. For example, insurance companies and banks should work together to engage and support their clients as they transition, as well as conduct public advocacy.
- **Share research and data** to help other stakeholders (including public authorities) to understand current and future risks.
- **Finance projects for nature and people.** How companies can contribute to climate, nature and people beyond their value chain is discussed in the 2025 WWF guidance *Climate contributions for people and nature*.⁴⁰¹

Political advocacy and the defence of science-based policies are especially important in the current political environment. Through public advocacy and policy engagement, insurers can effectively advocate for systemic change that aligns policy frameworks, financial markets and industry practices with urgent climate and nature goals. Laurence Tubiana, one of the key architects of the Paris Agreement, highlighted the important role of insurance companies for the adoption of the Paris Agreement, and she urged the industry to find its voice again at COP30, for which she was the Special Envoy for Europe.⁴⁰²

Insurance companies should especially leverage their understanding of climate- and nature-related physical risks to advocate for the policies and measures laid out in this report to close the protection gap. For example, as insurance

companies have lobbied for building codes to limit fire hazards, they should lobby for nature-based disaster risk reduction measures, discuss the resilience implications of current farming practice and call for measures to preserve fertile soils and a healthy water cycle. The COP30 FIT Communiqué⁴⁰³ provides an example of a group of insurance companies and regulators addressing world leaders about increasing climate risks.

In addition, in a time when science is increasingly under attack, insurance companies, as fact-based organizations, should point to their data and stand up for science-based targets and measures to reach the goals of the Paris Agreement and the GBF. Recent examples of such advocacy include the Reinsurance Association of America defending the NOAA budget through a letter to Congress.⁴⁰⁴

Recent industry-related initiatives have provided additional specific guidance for insurance companies regarding their own transition plans. For example:

- The reports of the Forum on Insurance Transition provide in-depth guidance and examples of best practices to insurance companies on how to develop climate transition plans.⁴⁰⁵
- The Principles for Sustainable Insurance has published detailed guidance for insurance companies regarding priority actions for nature⁴⁰⁶ and nature-related assessments.⁴⁰⁷
- The Science Based Target initiative's recent net-zero standard includes a standard for insurance underwriting.⁴⁰⁸

These frameworks and guidance can help the insurance sector play its part in the transition to a net-zero, nature-positive global economy.

6.3 MAKE NATURE AND NATURE-BASED SOLUTIONS A CENTREPIECE IN ADAPTATION AND RESILIENCE PLANNING AND IN RESPONSE AND RECOVERY EFFORTS



Nature must be positioned at the core not just of climate mitigation (i.e., the reduction of GHG emissions), but also of climate adaptation, disaster risk reduction and resilience. Doing so offers a cost-effective, systemic pathway to prevent and mitigate disaster losses, enhance social and ecological stability and maintain the insurability of climate risks in the decades ahead.⁴⁰⁹

KEY ACTION AREAS

6.3.1 INTEGRATE NATURE INTO ZONING CODES AND LAND-USE PLANNING



Zoning codes need to reflect the latest insights into future climate and nature physical risks to reduce the exposure faced by structures and people. Land-use planning should restrict land conversion, create buffers against floods or wildfires⁴¹⁰ and preserve green spaces for cooling and water retention. Governments can use property acquisition – so-called buy-outs – to keep (high-risk) areas as open space. It would be especially useful if such space could be restored or replanted to provide valuable regulating services for water cycles or fresh air. In the US, Norfolk, Virginia developed one of the most climate-resilient zoning codes in the country, establishing resilience overlays that encourage building on higher ground, require elevated foundations in vulnerable areas, and provide incentives for relinquishing land in flood-prone zones to conservation easements.⁴¹¹ In Europe, the city of Amsterdam is developing a comprehensive approach to prevent losses from increased temperatures, drought, extreme rainfall and flooding.⁴¹²

6.3.2 UPDATE BUILDING CODES TO INCORPORATE NEW CLIMATE REALITIES AND INTEGRATE NATURE-BASED SOLUTIONS



For existing buildings that cannot be relocated from risky areas, building codes must incorporate the latest insights into climate- and nature-related physical risks to ensure standards reduce vulnerability to future extreme weather events. Building codes should also incorporate green solutions such as green roofs, vertical greenery and rain gardens to mitigate flooding and help cool urban areas for better health outcomes. Cities like Stuttgart started greening roofs as early as 1986.⁴¹³ Today, cities around the world including Berlin,⁴¹⁴ Hamburg,⁴¹⁵ Toronto,⁴¹⁶ Singapore,^{417,418} Paris,⁴¹⁹ Portland (Oregon),⁴²⁰ Chicago⁴²¹ and

Warsaw⁴²² have introduced planning and zoning requirements for certain buildings to implement such nature-based solutions. France has even introduced legal requirements for green roofs at the national level.⁴²³ A 2025 study showed that nature-based measures (e.g., green streets, rain gardens and green roofs) and other municipal adaptation measures (such as water storage facilities) in Amsterdam can reduce insured damages from heavy rain.⁴²⁴

6.3.3 ACCELERATE AND COORDINATE NATIONAL ADAPTATION PLANNING AND INTEGRATED LANDSCAPE MANAGEMENT.



Closing the protection gap and achieving climate adaptation and resilience are inherently systemic challenges that need comprehensive collaboration across the public and private sectors, all levels of government, and including civil society and academia. Public authorities should use their convening power to coordinate and facilitate actions among government institutions and by other stakeholders. This should include convening key stakeholders, including the insurance industry, around the development and implementation of National Adaption Plans (NAPs). The UN Framework Convention on Climate Change emphasizes that NAPs should be “country-driven, gender-sensitive, participatory, and fully transparent”.

The Netherlands has a long-term, multi-sectoral strategy called the Delta Programme to protect against flooding and manage the fresh water supply. While not an NAP, it is an example of an institutionalized national adaptation programme that leans heavily on stakeholder consultation to achieve its results.⁴²⁵

NAPs should address the preservation and building of physical infrastructure for risk prevention and mitigation. Nature should be seen as part of this physical infrastructure, and both green and green-grey infrastructure solutions for disaster risk reduction should be considered.⁴²⁶ For instance, Japan’s disaster risk reduction policies now officially favour ‘Eco-DRR’ (ecosystem-based disaster risk reduction), combining engineered structures with nature-based methods.⁴²⁷



Subnational governments, such as California's, have established their own nature-based solutions strategies and have committed billions of dollars to them.⁴²⁸ Also, the European Investment Bank invests in and supports nature-based solutions for climate resilience in both non-OECD countries⁴²⁹ as well as within the EU, as part of a partnership with WWF.⁴³⁰ Initiatives and tools like The Partnership for Ecosystem-based Disaster Risk Reduction and Adaptation and the Economics of Climate Adaptation can support the choice and combination of suitable actions.

At the local or regional level, integrated landscape planning is a useful tool to avoid maladaptation and effectively manage increasing climate and nature-related risks. Integrated landscape management planning is a collaborative, long-term process, where diverse stakeholders work together to manage a specific area to achieve multiple, often competing, goals for society and the environment. For example, the Collaborative Forest Landscape Restoration Program in the US funds large-scale forest restoration projects across the country. It explicitly requires a collaborative, multi-stakeholder approach to the planning, implementation and monitoring of restoration efforts.⁴³¹

6.3.4 ALIGN PUBLIC OR PUBLICLY BACKED INSURANCE SCHEMES WITH RISK REDUCTION INCENTIVES



Public insurance programmes for extreme weather events, as well as publicly backed or sponsored risk pools, should be combined with risk reduction measures or incentives to harness the benefits of nature-based solutions. Community-based catastrophe insurance (CBCI) is emerging as an additional tool at the local level to reduce the protection gap and create incentives for adaptation and resilience. An example of combining public insurance schemes with risk mitigation incentives is the Community Rating System (CRS), a voluntary FEMA programme in the US which incentivizes communities to exceed minimum NFIP requirements by offering flood insurance premium discounts based on their floodplain management practices.⁴³² In France, a levy on mandatory natural catastrophe insurance co-finances investment by communities in risk mitigation and prevention, including through NbS.⁴³³

Moreover, CBCI, often structured as parametric insurance, is being piloted to complement traditional household or business-level indemnity insurance.⁴³⁴ This can be especially beneficial if a community faces challenges in accessing affordable insurance, while community-level investments in effective risk mitigation and prevention strategies could significantly lower risk and make communities insurable. As most NbS or green-grey infrastructure solutions for disaster risk reduction help build resilience at the community level, such CBCI schemes can facilitate investment in these solutions. Such a scheme has been proposed by Munich Re and The Nature Conservancy along the lower Mississippi River.⁴³⁵

6.3.5 EMBED NATURE IN DISASTER RECOVERY FRAMEWORKS FOR THE BENEFIT OF PEOPLE AND NATURE



Disaster recovery should follow an integrated landscape management approach in which nature is mainstreamed in the post-disaster update of building codes, zoning and land-use planning and physical risk prevention and mitigation. Governments must require post-disaster recovery frameworks, such as the US National Disaster Recovery Framework, to mandate the consideration of nature-based solutions. For example, FEMA's Natural and Cultural Resources Recovery Support Function organizes federal support for states after a disaster by considering natural resources and integrating them into recovery planning.

Governments must also adjust funding criteria for post-disaster aid to give priority to projects – where appropriate – that use natural features like forests, wetlands and mangroves for protection, rather than focusing solely on grey infrastructure. Streamlining complex funding systems and regulations that might prevent smaller organizations and communities, including Indigenous groups, from accessing government funds for nature-based projects should also be a priority. Information can be found in the guidance for post-disaster needs assessment regarding the environment from the World Bank and partners.⁴³⁶ As an example, after Hurricane Katrina, the newly formed Coastal Protection and Restoration Authority dug a channel to allow water and sediment from the Mississippi River to flow into part of Maurepas Swamp, a roughly 218-square-mile forested wetland northwest of New Orleans that had been “dying for over a century” because of levees.⁴³⁷ Sediment dredged from elsewhere was pumped into thousands of acres of sinking marshes to nourish them and raise their levels. In the EU, its Solidarity Fund also deployed funding for restoration of natural areas for the prevention of soil erosion after the 2020 earthquake in Croatia.⁴³⁸

6.3.6 INCORPORATE ECOSYSTEM SERVICES INTO INSURANCE MODELS



Governments must support insurance companies to include ecosystem services and nature-based solutions in natural catastrophe models and gradually phase in requiring such modelling when appropriate.⁴³⁹ To give credit to the value of nature for disaster risk reduction, insurance companies should identify and take into account in their natural catastrophe models where areas are less exposed to climate- and weather-related hazards due to intact and resilient ecosystems protecting them.





Bamboo and mangrove coastal flood protection. Image: Adobe Stock

For example, Moody's North Atlantic Hurricane Model Version 25 takes mangroves into account.⁴⁴⁰ Such modelling requires several steps:

- partnering with public data providers and academia to obtain high-resolution layers (wetlands, mangroves, urban green spaces)
- piloting covering high-risk areas as well as discounts or lower deductibles linked to verified local nature-based solutions
- validating impacts through post-event loss analysis and reinsurance model feedback.

As such modelling capacities are at an early stage, public authorities should support their development, for example through national science funding and other project grants. (For examples of these steps, see Textbox 4.) Legislative requirements are another option to incentivize innovation by companies. A pioneering new law in Colorado mandates insurers to incorporate property-specific and community-level wildfire mitigation efforts, including forest management, into their underwriting and pricing models and provide discounts to policyholders where there is landscape-scale mitigation.⁴⁴¹ In 2024, the California Department of Insurance also enforced its first catastrophe modelling regulation that requires models to account for wildfire mitigation efforts.⁴⁴²

6.3.7 STRENGTHEN THE RESILIENCE OF ECOSYSTEMS TO CLIMATE CHANGE



Resilience strategies should not overlook the significant risks that climate change poses to nature, nor assume

that conservation or sustainability efforts alone can build resilience to unprecedented climate shocks and stresses. Nature itself needs to adapt to climate change. Forests can help stop soil erosion, recharge groundwater and store carbon. But these services are lost when forests burn under increasing drought and heat. A new study estimates that, depending on the scenario, 40-56 per cent of mangroves globally face high to severe risk of being destroyed due to cyclones and sea-level rise.⁴⁴³

We must manage ecosystems and natural resources differently. Climate scenarios need to be integrated into protected area and landscape management, and governments should implement policies that prioritize ecosystems' resilience. For example, governments can pass laws explicitly focused on protecting, conserving and restoring wildlife corridors and habitat connectivity between protected areas, as proposed by the US Wildlife Corridors and Habitat Connectivity Conservation Act of 2024.⁴⁴⁴ Governments should also promote the sharing of knowledge and adaptive management best practices between jurisdictions, communities and natural resource managers, to help implement locally adapted, climate-smart, resource-efficient and systemic interventions for climate adaptation. It is vitally important to implement consistent systems for monitoring, evaluating and adjusting the effectiveness of adaptation strategies and actions for protected area and ecosystem management to address challenges and improve outcomes. Understanding, monitoring and managing slow-changing factors like soil organic matter or water tables, as well as the feedback loops that can amplify or dampen changes, can help manage landscapes, waterscapes and seascapes for change, not just persistence.

TEXTBOX 4: HOW INSURANCE COMPANIES CAN ACCELERATE THE INTEGRATION OF NATURE IN THE RESILIENCE AND ADAPTATION AGENDA

Alongside governments, insurance can also contribute to the restoration of nature and the implementation of NbS.

Insurers need to recognize the significance of nature’s influence on their financial performance, especially when it comes to mitigating risks and the sustainability of their business models. In addition to phasing out activities that destroy nature from their underwriting and investment activities and supporting the transition (as explained in Textbox 3), insurance companies should make use of nature to mitigate risks and reduce claims. The benefits of NbS require insurers to take a long-term, holistic perspective that considers how management strategies will need to adapt over time in response to climate change and other stressors.

Insurance companies can play crucial roles developing successful NbS, but government actors need to lead and coordinate efforts for landscape resilience. This report recognizes that insurance companies face expectations to conserve and restore nature that are often unrealistic given their nature as private, mostly for-profit companies.

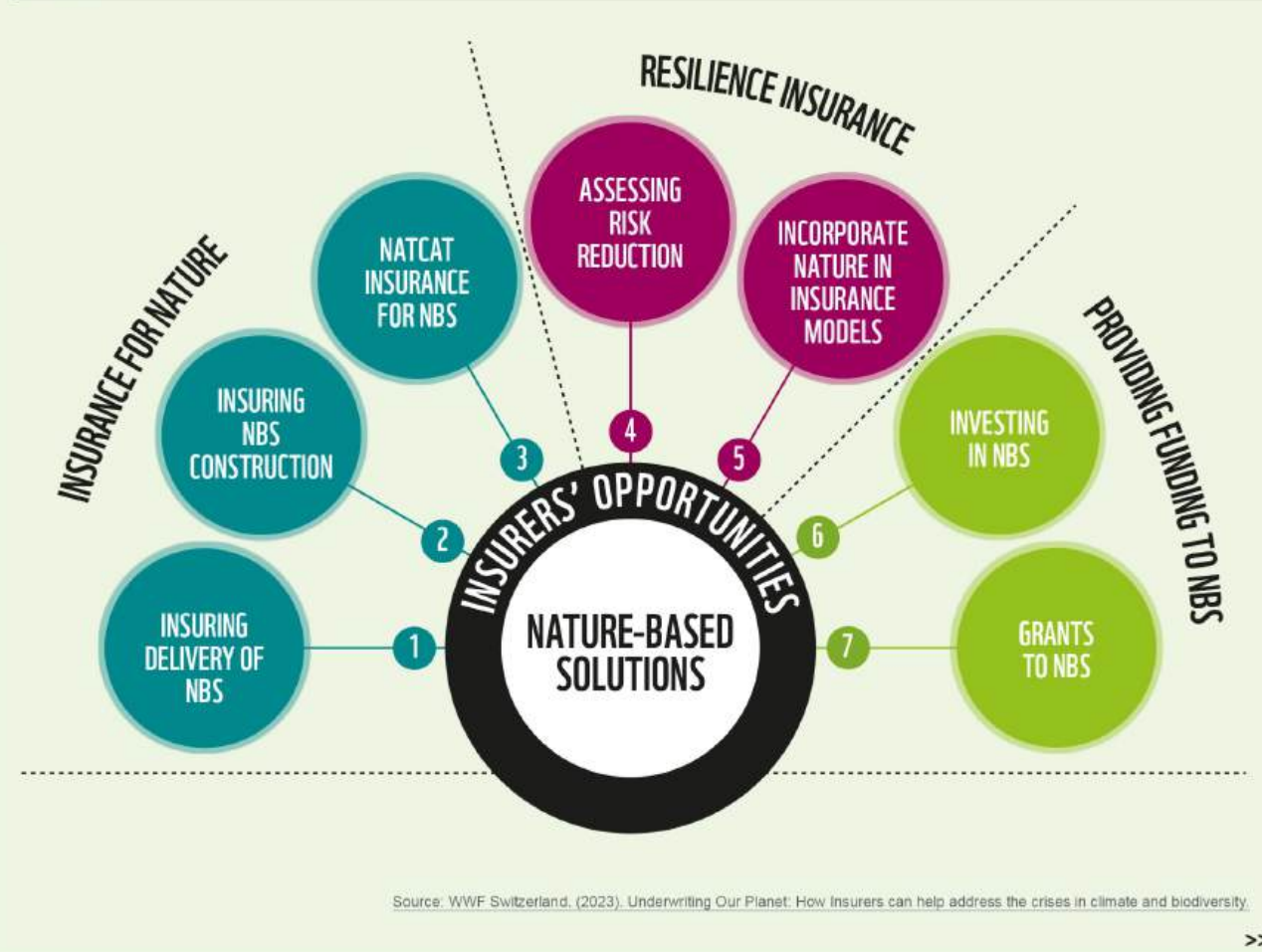
However, it argues that insurance companies have unique resources that they can contribute to the successful design and implementation of NbS. It urges insurance companies to deploy these resources, but it also recognizes that leadership for coordinated action for nature protection and restoration at the community level usually needs to come from local, regional or national governments, and that other financial institutions and businesses benefiting from local ecosystem services also need to contribute to their preservation and restoration.

This Textbox provides an overview into that topic, which is more comprehensively discussed in a recent report from the Environmental Defense Fund, *Nature for insurance and insurance for nature*.⁴⁴⁵

Overall, insurance companies interface with nature and NbS in eight different ways that can be clustered in three functions:

1-3: Insurance for nature, 4 and 5: Resilience insurance, 6 and 7: Providing funding to NbS.

FIGURE 31



Source: WWF Switzerland, (2023). Underwriting Our Planet: How Insurers can help address the crises in climate and biodiversity.

INSURANCE FOR NATURE: REDUCING THE PROTECTION GAP FOR NATURE

This concept, related to insurance products for traditional assets such as real estate or public infrastructure, can be extended to natural assets in similar ways (see Section 3.3.3.).

1. INSURING THE DELIVERY OF NATURE-BASED SOLUTIONS

Insurance solutions are emerging for regulated biodiversity offsets, voluntary carbon markets and other restoration projects to ensure that projects genuinely deliver promised environmental gains. In the UK, for example, the Environment Act 2021 requires development projects to achieve at least a 10 per cent net gain in biodiversity,⁴⁴⁶ with insurance products now emerging to cover performance risks or setbacks over the required multi-decade period. These solutions can help safeguard financial commitments, foster greater confidence among regulators and investors and could potentially facilitate the scaling of biodiversity-positive investment by underwriting habitat restoration, conservation and offset projects.^{447,448,449,450} Voluntary carbon credit markets supporting nature-based solutions have faced considerable criticism due to double-counting, a lack of corresponding adjustments, non- or under-delivery of credits, leakage, lack of additionality, reversals, greenwashing and exposure to fraud or counterparty failure. While emerging insurance products could enhance the credibility of project planning, delivery and risk management, thereby strengthening trust in voluntary carbon and nature markets, they cannot solve all these challenges.⁴⁵¹

2. INSURING CONSTRUCTION OF NBS PROJECTS

Insurance can catalyse investment in NbS or green infrastructure because these projects face additional risks, such as technological uncertainties, performance variability (e.g., linked to weather conditions) and evolving regulatory landscapes. By effectively managing risks, insurance not only protects investments but also catalyses confidence in innovative new projects and green technologies that might otherwise seem too risky.

Projects designed to build NbS mostly need insurance to cover operations in the same way as traditional infrastructure projects. Such projects typically require engineering all-risk insurance to protect them against disruptions or delays, or they require dedicated environmental risk insurance. For instance, Swiss Re provided construction all-risk coverage to support the restoration of the Prince Hendrick sand dyke that protects a unique ecosystem on the Island of Texel in the Netherlands – a World Heritage Site. The project aims to prevent a major failure of the dyke due to rising sea levels, while simultaneously improving biodiversity and protecting the local community, which benefits from physical protection afforded by the dyke and income from tourism and fishing.⁴⁵² Another industry example is SCOR's 'Restore and Manage' product that provides parametric insurance coverage for ecological restoration projects against predefined perils like droughts or earthquakes, helping projects recover from setbacks and maintain their trajectory.^{453,454}

3. NATURAL CATASTROPHE INSURANCE FOR NATURAL ASSETS OR NBS

Providing natural catastrophe insurance for natural assets is the most well-known role of insurance companies in this area, with flagship examples like the insurance of coral reefs. These insurance solutions mostly rely on parametric insurance products, which provide predictable pay-outs triggered by pre-defined levels of extreme weather events. Examples include insurance products to protect: wetlands against risks from typhoons and droughts;⁴⁵⁵ mangroves against risks from hurricanes;⁴⁵⁶ and coral against risks from hurricanes and tropical storm damage.⁴⁵⁷

Such products create financial resilience by providing critical funding for natural infrastructure restoration after disasters, protecting a natural asset's value. However, they are not always able to insure the most relevant risks to these natural assets. For example, coral reefs are at acute threat from climate change and mangroves face often pressure from other land-use needs. Hence, it is crucial that insurance companies make sure that they are not simultaneously underwriting or investing in activities that exert non-insured pressures on these assets.

Lastly, insuring public goods privately only makes sense in very specific circumstances.⁴⁵⁸ It is therefore even more crucial to consider damages to nature from extreme weather events in the public planning of recovery funds (see also Section 6.3.5.) and to stop their degradation as a result of economic and human activities.

ACCOUNTING FOR DE-RISKING BENEFITS OF ECOSYSTEM SERVICES

4. ASSESSING RISK REDUCTION FOR ADVOCACY AND ADVICE

Insurers can support local, city, regional and national authorities to understand and quantify the risk reduction potential of certain nature-based solutions. They can also support their implementation with advocacy and design advice for solutions with long-term risk prevention outcomes. To achieve this, insurance companies should engage with local ecologists, environmental groups and community members to understand the local context and share information and identify specific local risks and opportunities for prevention.

Insurance companies can also support the development of resilience or adaptation action plans and interventions that mitigate risk for companies. In fact, insurance companies could ramp up their consulting capacities in that regard. Such plans should consider system dynamics and integrate ecological, social and economic factors, then provide expansive and holistic recommendations for building adaptive capacity and addressing systemic vulnerabilities. Resilience action plans can crowd-in different stakeholders to the planning process and stack capital to fund different interventions. They also offer an opportunity to improve the risk-return characteristics of an investment by pooling expertise, resources and capital with different financial and non-financial return expectations.

5. INCORPORATION OF ECOSYSTEM SERVICES INTO INSURANCE MODELS

Many insurers and reinsurers estimate expected losses based on past data and, when forward-looking models are used, they often neglect the risk reduction benefit of nature, including through NbS. However, the inclusion of nature into natural catastrophe modelling is crucial to make its benefits visible. It helps insurers realize when nature is degrading and therefore risks are increasing, as well as the potential to offer preferential conditions to areas that invest in NbS. Examples show that such modelling is feasible, for example, in the case of ecological forestry as a nature-based approach to reducing wildfire risk.⁴⁵⁹ Insurers should embed nature-related risks across all material risk categories, while acknowledging their interactions with climate risks, rather than treating them in isolation. By unleashing this prevention dividend for NbS, insurance companies can also play a role in incentivizing further public measures to invest into such projects and risk-pooling solutions (e.g. community insurance) or by informing resilience guidelines and property value reports.

To provide a few examples:

- A consortium of organizations has developed the Coastal Risk Index, which calculates coastal flood hazards under various climate change scenarios and the risk reduction benefits which could be provided by coral reefs and mangroves.⁴⁶⁰
- Swiss Re has linked claims data from Florida with its Biodiversity and Ecosystem Services (BES) Index, which shows a reduction in loss frequency caused by lower severity storms of between 42 per cent and 65 per cent in areas with high BES coastal protection.⁴⁶¹
- In 2025, wildfire resilience insurance for a 6,500-home community in the middle of the forest in northern California – a high-risk area which other insurance companies refused to cover – was successfully placed. UC Berkeley CLEE, The Nature Conservancy and Willis Towers Watson designed, structured and placed the insurance on the condition of landscape-scale forest management to reduce fire risks. This project could both close the protection gap for fire insurance and lower premiums by 39 per cent and the deductible by 89 per cent.⁴⁶²

PROVIDING DIRECT FUNDING TO NATURE-BASED SOLUTIONS

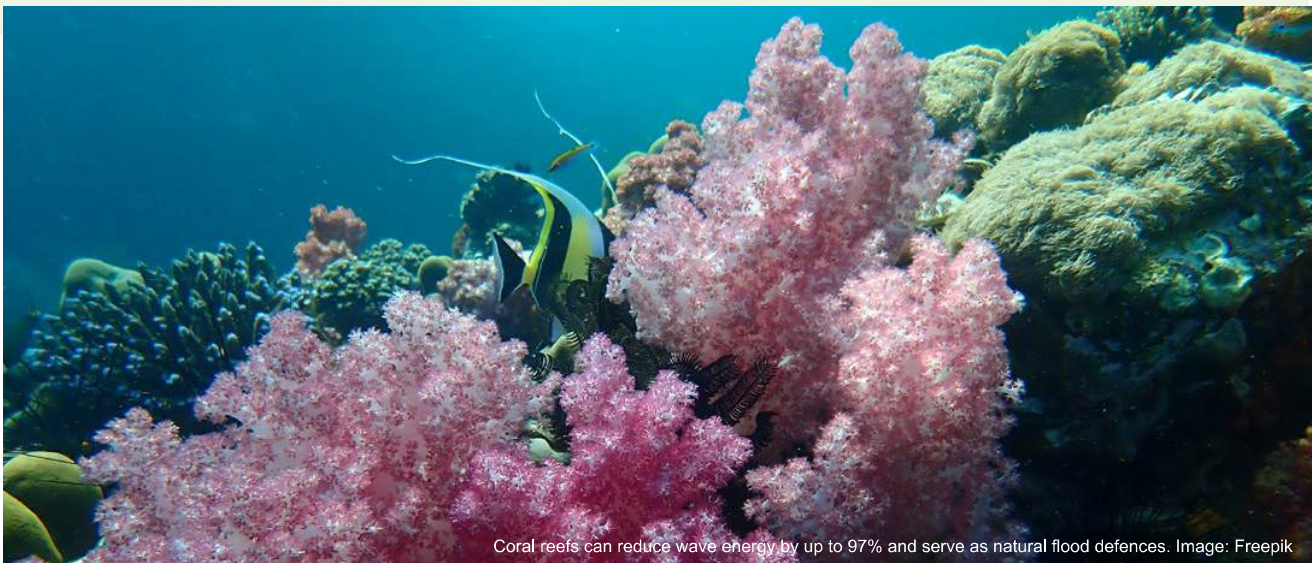
6. INVESTING IN NBS

Insurers, as large institutional investors, can direct capital towards NbS projects, aligning with their long-term investment strategies. However, as nature is usually a public good, generating benefits that can be privatized to only to a limited degree, most NbS are not investable or do not have the financial characteristics to fulfil insurance companies' return and liquidity requirements. However, this should not deter insurance companies from investing where it feasible to do so. A growing body of research shows where these potentials lie.^{463,464,465}

7. GRANTS TO NBS, ESPECIALLY FOR PILOTING

As part of their strategies for beyond-value-chain climate mitigation, insurance companies can also provide grants to NbS, thereby helping to close the financing gap. WWF Switzerland has recently published a discussion paper for credible project design and selection in this case.⁴⁶⁶ A partnership between WWF and Aviva provided a specific example of a grant directed to NbS.⁴⁶⁷ Within that partnership, Aviva provided grants to community-led restoration projects. These projects aim to promote community resilience to climate change, including through natural flood management and restoring coastal ecosystems.

Having outlined the different roles insurance companies can play to catalyze NbS, it can't be stressed enough that these usually require multistakeholder initiatives and public and private partnerships to be implemented and government leadership to drive ambition and create an enabling policy and regulatory enabling environment for investment and scaling.⁴⁶⁸ Such partnerships can leverage local, state and federal as well as private money, and help diversify the risks to both communities and natural assets.



Coral reefs can reduce wave energy by up to 97% and serve as natural flood defences. Image: Freepik

6.4 ENHANCE POLICY INCENTIVES AND INSURANCE REGULATION TO SUPPORT RISK TRANSFER SOLUTIONS AND FINANCIAL RESILIENCE



Even after performing holistic risk assessments, reducing GHG emissions and leveraging the protective role of nature, residual risks from extreme weather events will always remain. These need to be managed through insurance and similar risk transfer mechanisms to decrease the financial vulnerability of people, businesses and governments. Insurance supervision and regulation, as well as targeted public interventions in insurance markets, should therefore be extended to perils and regions where protection gaps are the most acute, with a view to ensuring greater financial resilience.

KEY ACTION AREAS



6.4.1 ADOPT A REGULATORY APPROACH THAT INTEGRATES MACROPRUDENTIAL CONSIDERATIONS AND TOOLS WITH UPDATED SUPERVISORY EXPECTATIONS FOR CLIMATE AND NATURE

Based on comprehensive macroprudential risk assessments (see Section 6.2), financial supervisors and central banks must adopt a macroprudential view. The application of macroprudential tools to insurance should be explored and developed in a holistic manner.⁴⁶⁹ However, while such a macroprudential lens can help ensure that the financial system is more resilient to potential climate-related shocks and tipping points, it will not by itself transfer risk from impacted communities. Supervisors should apply climate-related guidance from the IAIS and application papers across existing Insurance Core Principles,⁴⁷⁰ and set clear incentives for insurers to contribute to the climate and nature adaptation and mitigation efforts that are needed to maintain stable and sufficient coverage in high-risk areas. Nature should also be included in insurers' transition plans, integrating guidance from standard setters such as the Taskforce for Nature-related Financial Disclosures.⁴⁷¹

6.4.2 EXPAND TARGETED PUBLIC INTERVENTIONS IN INSURANCE MARKETS TO CLIMATE PERILS AND REGIONS WHERE PROTECTION GAPS ARE MOST ACUTE

Current microeconomic incentives for private insurance markets are insufficient to close the protection gap. In many cases, premium increases and withdrawals from high-risk areas may protect insurers' margins and capital but they will reduce access to affordable coverage where it is most needed. This underscores the inevitable need for government

intervention in insurance markets, such as insurance mandates, subsidies or public risk backstops, since widespread catastrophe insurance is a public good.⁴⁷² Of course, such public intervention needs to be carefully designed to avoid creating disincentives (such as encouraging development in disaster-prone areas) and instead increase future resilience, as discussed in Section 6.3.4.

6.4.3 MAKE INSURERS' ELIGIBILITY FOR STATE SUPPORT AND PUBLIC BACKSTOPS CONDITIONAL ON MITIGATION AND ADAPTATION REQUIREMENTS

As explained in Chapter 5, typical interventions in insurance markets can take the form of public-private partnerships (PPPs), with governments providing various forms of support or financial guarantees for insuring the most extreme and unpredictable disaster losses. Such schemes are becoming increasingly central to public debates about protection gaps, such as in Italy, where mandatory catastrophe insurance coverage for businesses was recently introduced, or in Germany, where discussion about a new flood insurance law is ongoing.

Some insurance PPPs link public support to limited adaptation or prevention measures (such as France's natural catastrophes regime, Spain's Consorcio de Compensación de Seguros and Switzerland's cantonal monopolies for buildings insurance), but none as yet link it to climate mitigation. Such conditionality must be systematic, whether it is introduced from the start in new PPPs or introduced later in the context of existing schemes. This would leverage governments' role as insurers of last resort, and would consistently tie financial resilience to both climate mitigation and climate adaptation. For example, access to the EU reinsurance PPP proposed by EIOPA and the ECB⁴⁷³ could be conditioned on portfolio decarbonization and investments in prevention, adaptation and nature-based solutions.⁴⁷⁴



6.4.4 INCENTIVIZE INVESTMENTS IN RESILIENCE THROUGH CAREFULLY DESIGNED MULTI-YEAR CONTRACTS

Public support for multi-year catastrophe insurance (instead of annual contracts) could help to align insurers' and policyholders' financial incentives with long-term resilience. This approach would incentivize them to jointly invest in preventive and renovation measures, as they would recognize the long-term mutual financial benefits better than in the context of an annual transaction. Some examples of multi-year contracts – not necessarily for natural catastrophe damages – already exist. For instance, in Japan, multi-year fire insurance contracts also include coverage against extreme weather such as typhoons, lightning strikes, snow and hail,⁴⁷⁵ while in France, the law mandates 10-year builders' liability insurance.⁴⁷⁶ However, such schemes must be carefully designed so that resilience benefits are real and potential consumer limitations to consumer rights are counterbalanced.

6.4.5 SUPPORT MARKET INNOVATION TO EXPAND RISK COVERAGE

Innovative financial instruments, such as parametric insurance and catastrophe bonds, can play a role in broadening protection,

particularly in regions or sectors where traditional indemnity insurance is limited or unavailable. Parametric insurance, which pays out when predefined thresholds (such as rainfall or wind speed) are breached, offers rapid liquidity and can support communities' immediate recovery needs. Similarly, catastrophe bonds allow risk to be transferred to capital markets, thereby increasing the overall capacity of the insurance sector to absorb losses from extreme weather events.

Regulatory support is crucial to ensure these innovative solutions can be widely adopted. For example, parametric contracts are not recognized as insurance products in certain jurisdictions but are rather classified as derivatives. However, the basis risk of such instruments (i.e., the risk that the payout does not match the actual loss experienced) may limit their effectiveness and makes them better suited to governments and large companies than to households and SMEs.

A more in-depth discussion of risk transfer aspects not directly related to climate and nature is outside the scope of this report. Related analyses and proposals can be found elsewhere, including in WWF's own Greening Financial Regulation and Sustainable Financial Regulations and Central Bank Activities initiatives,⁴⁷⁷ and in the work of other organizations, such as the IAIS,⁴⁷⁸ the ECB,⁴⁷⁹ the US National Association of Insurance Commissioners⁴⁸⁰ and the Council on Economic Policies.⁴⁸¹



A sustainable detention pond in Campbell Park, Milton Keynes, UK Image: Shutterstock



07 CONCLUSION

Considering the escalating and reinforcing risks from climate change and nature loss, it is essential that policymakers act now to implement a strategic approach to closing the insurance protection gap, as outlined here.

Complementing WWF's work on this report, an advisory group, comprised of insurance and reinsurance companies, brokers, insurance associations, NGOs, think tanks, an insurance regulator and researchers, contributed to this project. This demonstrates the relevance of this topic and a willingness across sectors and geographies to support solutions. Policymakers are urged to collaborate with these actors to strengthen risk reduction, preserve insurability and better protect communities.

ENDNOTES

- 1 Flavelle, C., & Rojanasakul, M. (2024b). Insurers are deserting homeowners as climate shocks worsen. *The New York Times*. <https://www.nytimes.com/interactive/2024/12/18/climate/insurance-non-renewal-climate-crisis.html>
- 2 Swiss Re Institute. (2025). *sigma 1/2025: Natural catastrophes: insured losses on trend to US\$145 billion in 2025*. <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>
- 3 Khoo, F., & Yong, J. (2023). Too hot to insure – avoiding the insurability tipping point. Bank for International Settlements & Financial Stability Institute. <https://www.bis.org/fsi/publ/insights54.pdf>
- 4 EIOPA, & ECB. (2024). EIOPA and ECB propose European approach to reduce economic impact of natural catastrophes. https://www.eiopa.europa.eu/eiopa-and-ecb-propose-european-approach-reduce-economic-impact-natural-catastrophes-2024-12-18_en
- 5 ABA Banking Journal. (2025). Fed's Powell says some areas of US may be 'uninsurable' in next decade. <https://bankingjournal.aba.com/2025/02/feds-powell-says-some-areas-of-u-s-may-be-uninsurable-in-next-decade/>
- 6 Geneva Association. (2025). Safeguarding Home Insurance: Reducing exposure and vulnerability to extreme weather. https://www.genevaassociation.org/sites/default/files/2025-06/safeguarding_home_insurance_040625.pdf
- 7 World Meteorological Organization. (2025). WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level. <https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level/>
- 8 Copernicus Climate Change Service. (2025). Global Climate Highlights 2024. <https://climate.copernicus.eu/global-climate-highlights-2024>
- 9 WWF International. (2022). Our climate's secret ally: Uncovering the story of nature in the IPCC Sixth Assessment Report. https://www.fint.awsassets.panda.org/downloads/wwf_our_climates_secret_ally_uncovering_the_story_of_nature_in_the_ipcc_ar6.pdf
- 10 Narayan, S., Beck, M. W., & Wilson, P., et al. (2017). The value of coastal wetlands for flood damage reduction in the northeastern USA. *Nature*. <https://doi.org/10.1038/s41598-017-09269-z>
- 11 WWF. (2022). Living Planet Report 2024 – A System in Peril. https://www.worldwildlife.org/documents/614/5gc2qerb1v_2024_living_planet_report_a_system_in_peril.pdf
- 12 IPBES. (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. <https://doi.org/10.5281/zenodo.3831673>
- 13 Kang, T.-H., Sharma, A., Marshall, L., & Kim, Y.-O. (2025). Interception reduction from deforestation and forest fire increases large-scale fluvial flooding risk. *Communications Earth & Environment*. <https://doi.org/10.1038/s43247-025-02748-6>
- 14 Pereira, H. M., Martins, I. S., Rosa, I. M. D., et al. (2024). Global trends and scenarios for terrestrial biodiversity and ecosystem services from 1900 to 2050. *Science*. <https://doi.org/10.1126/science.adn3441>
- 15 Curran, J. C., & Curran, S. A. (2025). Natural sequestration of carbon dioxide is in decline: climate change will accelerate. *Weather*. <https://doi.org/10.1002/wea.7668>
- 16 Jerrett, M., Jina, A. S., & Marlier, M. E. (2022). Up in smoke: California's greenhouse gas reductions could be wiped out by 2020 wildfires. *Environmental Pollution*. <https://doi.org/10.1016/j.envpol.2022.119888>
- 17 Müller J.-D., Gruber N, Schneuwly A. et al. (2025). Unexpected decline of the ocean carbon sink under record-high sea surface temperatures in 2023. *Nature Climate Change*. <https://doi.org/10.1038/s41558-025-02380-4>
- 18 Institute and Faculty of Actuaries, & University of Exeter. (2025). Planetary Solvency - finding our balance with nature Global risk management for human prosperity. <https://actuaries.org.uk/document-library/thought-leadership/thought-leadership-campaigns/climate-papers/planetary-solvency-finding-our-balance-with-nature/>
- 19 Aðalgeirsdóttir G., Bindoff N., Björnsson H., et al. (2024). Open Letter by Climate Scientists to the Nordic Council of Ministers. [Vedur.is. https://www.vedur.is/media/ads_in_header/AMOC-letter_Final.pdf](https://www.vedur.is/media/ads_in_header/AMOC-letter_Final.pdf)
- 20 AMOC Scenarios. (n.d.). AMOC collapse visualisation map. Retrieved 11 December 2025, from https://amocscenarios.org/?lat=53.75&lon=-1&model=cc_RCP45&is_amoc_on=false&is_delta=false&metric=temp_2m
- 21 Baker, K., Kochar, R., Goedicke, R., et al. (2023). Investing with Nature: Exploring investment opportunities across ecosystems. *Unepfi.org*. <https://www.unepfi.org/wordpress/wp-content/uploads/2023/08/Investing-with-Nature-NbS-in-forests-Primer.pdf>
- 22 Bundesministerium Land und Forstwirtschaft, Klima- und Umweltschutz, Regionen und Wasserwirtschaft. (n.d.). Was ist Schutzwald? Retrieved 9 December 2025 from <https://www.schutzwald.at/wissen/was-ist-schutzwald.html>
- 23 Makino, Y. and Rudolf-Miklau, F. (2021). The protective functions of forests in a changing climate – European experience. *FAO and the Austrian Federal Ministry for Agriculture, Regions and Tourism*. <https://doi.org/10.4060/cb4464en>
- 24 Olschweski, R. (n.d.). Insurance value of forest ecosystems. 73 NRP. Retrieved 9 December 2025 from <https://ntp73.ch/en/projects/insurance-value-of-forest-ecosystems>
- 25 Johann, E. (2021). Zur Geschichte der Waldnutzung in Österreich. *Waldgeschichten*. <https://www.waldgeschichten.com/fakten-wissen/die-geschichte-des-waldes/die-geschichte-de-der-waldnutzung-in-oesterreich/>
- 26 Jandehur, J. (1852). Das Forstgesetz für das Königreich Bayern. <https://www.digitale-sammlungen.de/en/view/bsb10482230>
- 27 Office national des forêts. (2024). La grande Histoire des forêts (#Episode 1) : le reboisement des massifs montagneux, sauveur et protecteur. *ONF*. <https://www.onf.fr/vivre-la-foret/%2Bfb4:la-grande-histoire-des-forets-episode-le-reboisement-des-massifs-montagneux-sauveur-et-protecteur.html>
- 28 Waldgesetz. (2020). *Waldbüro*. <https://waldbuero.com/waldgesetz/>
- 29 Bundesamt für Umwelt BAFU. (2025a). Handbuch Programmvereinbarungen im Umweltbereich 2025-2028. <https://www.bafu.admin.ch/de/handbuch-programmvereinbarungen-im-umweltbereich-2025-2028>
- 30 Bundesamt für Umwelt BAFU. (2025a). Handbuch Programmvereinbarungen im Umweltbereich 2025-2028. <https://www.bafu.admin.ch/de/handbuch-programmvereinbarungen-im-umweltbereich-2025-2028>
- 31 SBB. (2024). Naturgefahren und Klimawandel. *SBB CFF FFS*. <https://company.sbb.ch/de/ueber-die-sbb/verantwortung/sicherheit/sicherheit-im-bahnumfeld/naturgefahren.htm>
- 32 Andersen, D. (2021). The impact of subsidies on the operating profit in the Swiss forestry sector. *ETH Zurich*. <https://doi.org/10.3929/ETHZ-B-00509683> and Bundesamt für Umwelt BAFU. (2025a). Handbuch Programmvereinbarungen im Umweltbereich 2025-2028. <https://www.bafu.admin.ch/de/handbuch-programmvereinbarungen-im-umweltbereich-2025-2028>
- 33 LWF aktuell - Magazin der Bayerischen Landesanstalt für Wald und Forstwirtschaft und Mitglie derzeitschrift des Zentrums Wald-Forst-Holz Weihenstephan. (2011). *Bergwaldwirtschaft*. <https://www.lwf.bayern.de/mam/cms04/service/dateien/a84-bergwaldwirtschaft.pdf>
- 34 BFW, LFD, BMLUK, WLW. (2025). Hinweiskarte für Schutzwald in Österreich. *Wildbach- und Lawinenverbauung Forsttechnischer Dienst*. https://www.schutzwald.at/dam/jcr:984ac33e-7c45-494d-8223-497e10ff9e33/Hinweiskarte%20Schutzwald%20in%20C3%96sterreich_2025_Quelle%20BMLUK.pdf
- 35 Schneeberger, P. (2016). Verjüngungen sind angesagt. *Neue Zürcher Zeitung*. <https://www.nzz.ch/schweiz/schutzwald-verjuengungen-sind-angesagt-ld.110761>
- 36 Bund Naturschutz in Bayern e.V. (n.d.). Zahlen und Fakten: Bergwald. Retrieved 9 December 2025 from https://web.archive.org/web/20140831072052/http://www.bund-naturschutz.de/fileadmin/download/alpen/Zahlen_Fakten_Bergwald_Alpen.pdf
- 37 Olschweski, R. (n.d.). Insurance value of forest ecosystems. 73 NRP. Retrieved 9 December 2025 from <https://ntp73.ch/en/projects/insurance-value-of-forest-ecosystems>
- 38 Fachstelle für Gebirgswaldpflege. (n.d.). Risikomanagement - Schutzwald Schweiz. Retrieved 9 December 2025 from <https://www.schutzwald-schweiz.ch/de/risikomanagement.html>
- 39 Helvetia. (n.d.). Helvetia's protection forest campaign. *Helvetia.com*. Retrieved 9 December 2025, from <https://www.helvetia.com/ch/web/en/about-us/sponsoring/protection-forests.html>
- 40 Wald Schweiz-Verband der Waldeigentümer. (2025). *Schutzwald*. <https://www.waldschweiz.ch/de/wissen/waldeleistungen/schutzwald>
- 41 Schneeberger, P. (2016). Verjüngungen sind angesagt. *Neue Zürcher Zeitung*. <https://www.nzz.ch/schweiz/schutzwald-verjuengungen-sind-angesagt-ld.110761>
- 42 Baker, K., Kochar, R., Goedicke, R., et al. (2023). Investing with Nature: Exploring investment opportunities across ecosystems. *Unepfi.org*. <https://www.unepfi.org/wordpress/wp-content/uploads/2023/08/Investing-with-Nature-NbS-in-forests-Primer.pdf>
- 43 Bebi, P., Hanewinkel, M., & Antkowiak P. (n.d.). Forest management as an insurance against natural hazards – a case study of protection forests in Switzerland. Retrieved 9 December 2025, from https://www.dora.lib4ri.ch/wsl/islandora/object/wsl%3A25610/datastream/PDF/Antkowiak-2020-Forest_management_as_an_insurance-%28published_version%29.pdf
- 44 Bundesamt für Umwelt BAFU. (2025b). *Biologische Massnahmen*. <https://www.bafu.admin.ch/de/schutzwald>
- 45 Swiss Re Institute. (2025). *sigma 1/2025: Natural catastrophes: insured losses on trend to US\$145 billion in 2025*. <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>, figure 20
- 46 Swiss Re. (2025). How big is the protection gap from natural catastrophes where you are? <https://www.swissre.com/risk-knowledge/mitigating-climate-risk/natcat-protection-gap-infographic.html?#/region/Latin%20America>
- 47 United Nations University-Institute for Environment, & Human Security (UNU EHS). (n.d.). Uninsurable future. Retrieved 9 December 2025 from <https://interconnectedrisks.org/2023/tipping-points/uninsurable-future>
- 48 Munich Re. (n.d.). Natural disasters worldwide. Retrieved 31 December 2025. <https://www.munichre.com/en/risks/natural-disasters.html>
- 49 United Nations Office for Disaster Risk Reduction. (2025). *Global Assessment Report on Disaster Risk Reduction 2025: Resilience Pays: Financing and Investing for our Future*. <https://www.undrr.org/gar/gar2025#download>
- 50 Frost, R. (2025). Europe faces billions in economic losses from summer heatwaves, droughts and floods, study warns. *Euronews*. <https://www.euronews.com/green/2025/09/15/europe-faces-billions-in-losses-from-summer-heatwaves-droughts-and-floods-study-warns>
- 51 Roston, E. (2025). US spending on climate damage nears \$1 trillion per year. *Bloomberg News*. <https://www.bloomberg.com/news/articles/2025-06-17/us-spending-on-climate-damage-nears-1-trillion-per-year>
- 52 Lutz V., Lafakis C., Rudaviciute K., et al. (2025). Catastrophic events in an uncertain future: A pending \$41 trillion bill for businesses and governments to resolve. *Moodys.com*. <https://www.moodys.com/web/en/us/insights/physical-transition-risk/catastrophic-events-in-an-uncertain-future-a-pending-41-trillion-bill-for-businesses-and-governments-to-resolve.html>
- 53 Jorio, L. (2025). Switzerland spends big on flood protection – but is it enough? *Swissinfo.ch*. <https://www.swissinfo.ch/eng/climate-solutions/switzerland-spends-big-on-flood-protection-is-it-enough/88698922>
- 54 Walkowiak, M. P., Bandurski, K., Walkowiak, J., et al. (2025). Outpacing climate change: adaptation to heatwaves in Europe. *International Journal of Biometeorology*. <https://doi.org/10.1007/s00484-025-02872-0>
- 55 Bloomberg Intelligence. (2025). *The Climate Economy 2025 Outlook*. *Bloomberg Finance L.P.* https://assets.bbbhub.io/promo/sites/16/ClimateEconomyDeep-DiveFINAL_PRINT.pdf, figure 1

- 56 The Nature Conservancy. (n.d.). Coastal Protection. [oceanwealth.org](https://oceanwealth.org/ecosystem-services/coastal-protection). Retrieved 9 December 2025 from <https://oceanwealth.org/ecosystem-services/coastal-protection>
- 57 Watson, L., Straatsma, M. W., Wanders, N., Versteegen, J. A., de Jong, S. M., & Karssenberg, D. (2020). Global ecosystem service values in climate class transitions. *Environmental Research Letters*. <https://doi.org/10.1088/1748-9326/ab5aab>
- 58 Marsden, L. (2024). Ecosystem tipping points: Understanding risks to the economy and financial system. E-Axes Forum. <https://e-axes.org/research/ecosystem-tipping-points-understanding-risks-to-the-economy-and-financial-system/>
- 59 World Bank. (n.d.). The Changing Wealth of Nations – Global Assessment of the Economic Value of Non-Wood Forest Ecosystem Services. World Bank Group. Retrieved 9 December 2025 from <http://documents.worldbank.org/curated/en/099101124145545368>
- 60 Lehnhart-Barnett, H. T. (2022). Peatland restoration on the North York Moors: implications for hydrological functioning and water quality. https://livrepository.liverpool.ac.uk/3166392/1/Hannah%20Lehnhart-Barnett_PhD_THESIS_Corrections_FINAL.pdf
- 61 McClymont, A. F., Hayashi, M., Bentley, L. R., Muir, D., & Ernst, E. (2010). Groundwater flow and storage within an alpine meadow-talus complex. *Hydrology and Earth System Sciences*, 14(6), 859–872. <https://doi.org/10.5194/hess-14-859-2010>
- 62 Swiss Re & LibertyMutual. (2025). Wildfire risk reduction in a changing climate. <https://www.libertymutualgroup.com/documents/wildfire-risk-reduction-changing-climate-final>
- 63 WWF. (2025). Fighting forest fires with cork in Portugal. Panda.org. https://wwf.panda.org/wwf_news/?20933%2FFighting-forest-fires-with-cork-in-Portugal
- 64 Resilient Forests. (2022). A step forward in EU forest policy: the Mediterranean perspective. Policy position paper. <https://www.resilientforest.eu/about/>
- 65 Urban Greening Company. (2024). How urban greening initiatives help UK cities reduce the impact of climate change. TUGC. <https://tugc.co.uk/2024/12/how-urban-greening-initiatives-help-uk-cities-reduce-the-impact-of-climate-change/>
- 66 Àrea d'Ecologia Urbana. Ajuntament de Barcelona. (2017). TREES FOR LIFE Master Plan for Barcelona's Trees 2017-2037. Barcelona.Cat. <https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/Pla-director-arbrat-barcelona-ENG.pdf>
- 67 New York State, Division of Lands and Forests. (2024). 25 Million Trees by 2033. Department of Environmental Conservation. <https://dec.ny.gov/nature/forests-trees/climate-change/25-million-trees>
- 68 Senatsverwaltung für Stadtentwicklung, Bauen und Wohnen. (2023). 6. Änderungsgesetz der Bauordnung für Berlin beschlossen. Berlin.de. <https://www.berlin.de/rbmskz/aktuelles/pressemitteilungen/2023/pressemitteilung.1369717.php>
- 69 City of Chicago, Illinois. (2015). 2015 Chicago ordinance 1741015 providing zoning incentives for green roofs. <https://progov21.org/Home/Document/T3P452>
- 70 Directorate of Legal and Administrative Information (Prime Minister). (2025). Obligation to produce renewable energy or green roofs. <https://entreprenure.service-public.gouv.fr/vosdroits/F38107?lang=en>
- 71 Naumann, S. et al. (2020). Addressing climate change in cities – Policy instruments to promote urban nature-based solutions. Ecologic Institute, the Sendzimir Foundation: Berlin, Krakow. <https://www.ecologic.eu/sites/default/files/publication/2020/3205-Addressing-climate-change-in-cities-2.pdf>
- 72 Council of the City of Toronto. (2021). City of Toronto Green Roof Bylaw. <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/>
- 73 Bundesministerium Land- und Forstwirtschaft, Klima- und Umweltschutz, Regionen und Wasserwirtschaft. (n.d.). Was ist Schutzwald? [Schutzwald.at](https://www.schutzwald.at/wissen/was-ist-schutzwald.html). Retrieved 20 October 2025, from <https://www.schutzwald.at/wissen/was-ist-schutzwald.html>
- 74 WWF International. (2016). Danube-Carpathian Programme I Lower Danube green corridor: floodplain restoration for flood protection case study. Climate-ADAPT. <https://climate-adapt.eea.europa.eu/en/metadata/case-studies/lower-danube-green-corridor-floodplain-restoration-for-flood-protection>
- 75 Clark, K. et al. (2025). The multiple benefits delivered by hedgerows: Where is the evidence and does it meet current knowledge needs? *People and Nature* (Hoboken, N.J.), 7(10), 2437–2450. <https://doi.org/10.1002/pan3.70114>
- 76 Natural Water Retention Measures. (2011). Case Study Elbe Dyke Relocation (Lenzen). https://www.nwrm.eu/sites/default/files/case_studies_research/cs-de-01-elbe-final_version.pdf
- 77 Federal Office for the Environment. (2025). A Protection Forest Does More Than You Might Think. in *Natural resources in the Switzerland environment*. https://climate-adapt.eea.europa.eu/en/metadata/case-studies/nature-based-measures-against-rock-falls-over-forests-in-the-engadin-region-switzerland/magazine_environment22015-livingwithnaturalhazards.pdf
- 78 Narayan, S., Beck, M.W., Wilson, P. et al. (2017) The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA. *Sci Rep* 7, 9463. <https://doi.org/10.1038/s41598-017-09269-z>
- 79 EPA United States Environmental Protection Agency. (2012). Coastal Wetlands Initiative: North Atlantic Review. <https://www.epa.gov/sites/default/files/2015-05/documents/north-atlantic-review.pdf>
- 80 Wetlands International. (2018). The restoration of the former saltworks in the Camargue: a Nature-Based Solution to adapt to sea-level rise. <https://tourduvalat.org/en/newsletter-articles/the-restoration-of-the-former-saltworks-in-the-camargue-a-nature-based-solution-to-adapt-to-sea-level-rise/>
- 81 The Nature Conservancy. (2024). The Importance of Mangroves. <https://www.nature.org/en-us/about-us/where-we-work/united-states/florida/stories-in-florida/why-mangroves-important/>
- 82 Geneva Association. (2018). Understanding and addressing the global insurance protection gaps. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/research-brief_-_global_insurance_protection_gaps.pdf
- 83 Berliner, B. (1982). Limits of insurability of risks. Prentice-Hall.
- 84 The Geneva Association. (2020). An Investigation into the Insurability of Pandemic Risk. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/insurability_report_web.pdf
- 85 Crugnola-Humbert, J. (2025). From Risk to Resilience. Closing the Climate Insurance Protection Gap. Council on Economic Policies. <https://www.cepweb.org/from-risk-to-resilience-closing-the-climate-insurance-protection-gap/>
- 86 Environment Agency. (2024). National assessment of flood and coastal erosion risk in England 2024. <https://www.gov.uk/government/publications/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024>
- 87 Deloitte. (2024). Underwriting earth I The restorative potential of nature-positive insurance. <https://www.deloitte.com/content/dam/assets-zone3/us/en/docs/industries/financial-services/2025/us-ins-nature-risk-pov.pdf>
- 88 Sastry, P., Scharlemann, T., Sen, I., & Tenekedjjeva, A.-M. (2025). The Limits of Insurance Demand and the Growing Protection Gap. Harvard Business School. https://www.hbs.edu/ris/Publication%20Files/25-054_8068f2c0-0bac-4200-aa22-a18a2aef9c49.pdf
- 89 Flavelle, C., & Rojanasakul, M. (2024). As insurers around the U.S. bleed cash from climate shocks, homeowners lose. *The New York Times*. <https://www.nytimes.com/interactive/2024/05/13/climate/insurance-homes-climate-change-weather.html>
- 90 Fitch Wire. (2023). Global Reinsurers Pull Back from Natural Catastrophe Cover. <https://www.fitchratings.com/research/insurance/global-reinsurers-pull-back-from-natural-catastrophe-cover-24-08-2023> and Christoph Möhr, Yong J. & Zweimueller M. (2025). FSI Insights on policy implementation (No 65) Mind the climate-related protection gap – reinsurance pricing and underwriting considerations. IAIS, Financial Stability Institute, BIS. <https://www.bis.org/fsi/publ/insights65.pdf>
- 91 Kaufman, L., & Millan, L. (2025). Reinsurers in Monaco place their climate bets. [Bloomberg News](https://www.bloomberg.com/news/newsletters/2025-09-10/reinsurers-in-monaco-place-their-climate-bets). <https://www.bloomberg.com/news/newsletters/2025-09-10/reinsurers-in-monaco-place-their-climate-bets>
- 92 Möhr, C., Yong, J., & Zweimueller, M. (2025). Mind the climate-related protection gap – reinsurance pricing and underwriting considerations. *Bis.org*. <https://www.bis.org/fsi/publ/insights65.htm>
- 93 EIOPA. (2024b). Towards a European system for natural catastrophe risk management. https://www.eiopa.europa.eu/document/download/d8c87070-f602-4bf7-b8d8-726ec0b5c173_en?filename=eiopa-ecb-climate-insurance-protection-gap.pdf
- 94 Brown, C., & Rojanasakul, M. (2025). A climate 'shock' is eroding some home values. *New data shows how much*. *The New York Times*. <https://www.nytimes.com/interactive/2025/11/19/climate/home-insurance-costs-real-estate-market.html>
- 95 EIOPA. (2024). Measures To Address Demand Side Aspects Of The Natcat Protection Gap. https://www.eiopa.europa.eu/document/download/be654e97-0428-4702-bd75-fb5d217e1960_en
- 96 British Red Cross. (2022). Every time it rains: British Red Cross research on flooding in the UK. <https://www.redcross.org.uk/about-us/what-we-do/we-speak-up-for-change/every-time-it-rains-british-red-cross-report-on-flooding>
- 97 Mack, S. (2025). Better green than sorry – Why the prudential framework for insurers should integrate systemic climate risks. Hertie School - Jacques Delors Centre. <https://www.delorscentre.eu/en/publications/detail/publication/better-green-than-sorry>
- 98 Khan, Y. (2025). Republican Attorneys General Accuse Net-Zero Standards Setters of Running Climate Cartel. *The Wall Street Journal*. <https://www.wsj.com/articles/republican-attorneys-general-accuse-net-zero-standards-setters-of-running-climate-cartel-5893d34e>
- 99 Brown, C., & Rojanasakul, M. (2025). A climate 'shock' is eroding some home values. *New data shows how much*. *The New York Times*. <https://www.nytimes.com/interactive/2025/11/19/climate/home-insurance-costs-real-estate-market.html>
- 100 Lavarde, C. (2023). Rapport d'information (...) sur le financement du risque de retrait gonflement des argiles et de ses conséquences sur le bâti. *Vie Publique*. <https://www.vie-publique.fr/rapport/288710-le-risque-de-retrait-gonflement-des-argiles-consequences-sur-le-bati>
- 101 United Nations Environment Programme (2025). A Total Balance Sheet Transition: A holistic transition plan guide linking the underwriting and investment portfolios of insurers and reinsurers. <https://www.unepfi.org/wordpress/wp-content/uploads/2025/11/A-Total-Balance-Sheet-Transition.pdf>
- 102 Schanz, K.-U., Braun, A., Eling, M., & Jaenicke, C. (n.d.). The value of insurance in a changing risk landscape. *The Geneva Association*. Retrieved 9 December 2025 from https://www.genevaassociation.org/sites/default/files/2023-11/value_of_insurance_web.pdf
- 103 First Street. (2020). The First National Flood Risk Assessment: Defining America's Growing Risk. https://assets.firststreet.org/uploads/2020/06/first_street_foundation_first_national_flood_risk_assessment.pdf
- 104 Cobler, P., Birenbaum, G., Langford, T., & et al. (2025). FEMA removed dozens of Camp Mystic buildings from 100-year flood map before expansion, records show. *The Texas Tribune*. <https://www.texas-tribune.org/2025/07/12/camp-mystic-flood-plain-FEMA/>
- 105 Thallinger, G. (2025). Climate, risk, insurance: The future of capitalism. <https://www.linkedin.com/pulse/climate-risk-insurance-future-capitalism-g%C3%BCnther-thallinger-smw5f/>
- 106 Thallinger, G. (2025a). Warum Biodiversität unverzichtbar für unsere Zukunft ist. [Table Briefings](https://table.media/forum/tableforum-biodiversity/warum-biodiversitaet-unverzichtbar-fuer-unsere-zukunft-ist). <https://table.media/forum/tableforum-biodiversity/warum-biodiversitaet-unverzichtbar-fuer-unsere-zukunft-ist>
- 107 Allianz SE. (2025). Climate change: Our responsibility to act. <https://www.allianz.com/en/mediacenter/news/reports/250724-climate-change-our-responsibility-to-act.html>
- 108 Zurich Insurance Group. (2025). Climate Risks: Strategies for Building Resilience in a More Volatile World. <https://edge.sitecorecloud.io/zurich-insur6934-zwpcorp-prod-ae5e/media/project/zurich/dotcom/industry-knowledge/climate-change/docs/strategies-for-building-resilience.pdf>
- 109 Howden. (2025). The insurability imperative. <https://www.howdengroup.com/uk-en/insurability-climate-report-2025>

- 110 Risk & Business. (2024). asr roept kabinet op alsnog werk te maken van publiek-private verzekeringsooplossing overstroming grote rivieren. Risk & Business. <https://riskenbusiness.nl/nieuws/claims/asr-roept-kabinet-op-alsnog-werk-te-maken-van-publiek-private-verzekeringsooplossing-overstroming-grote-rivieren/>
- 111 Flavelle, C., & Rojanasakul, M. (2024b). Insurers are deserting homeowners as climate shocks worsen. The New York Times. <https://www.nytimes.com/interactive/2024/12/18/climate/insurance-non-renewal-climate-crisis.html>
- 112 Bradstock, F. (2025). US insurers are refusing to cover climate change risk zones. Oilprice.com. <https://oilprice.com/Energy/Energy-General/US-Insurers-Are-Refusing-to-Cover-Climate-Change-Risk-Zones.html>
- 113 First Street. (2022). The insurance issue. <https://pitch.com/v/Insurance-Bubble-ciHncu/9e1b145d-6722-4a33-81b3-01129c44a0c0>
- 114 Davis, M. (2024). Wildfire risk highest in California, Florida, Texas. LendingTree. <https://www.lendingtree.com/insurance/wildfire-risks-study/>
- 115 First Street. (2022). The insurance issue. <https://pitch.com/v/Insurance-Bubble-ciHncu/9e1b145d-6722-4a33-81b3-01129c44a0c0>
- 116 Kaufman, L. (2024). Florida's Home Insurance Industry May Be Worse Than Anyone Realizes. Claims Journal. <https://www.claimsjournal.com/news/national/2024/04/24/323210.htm>
- 117 Liao, P. (2024). Home insurance in crisis. Milken Institute Review. <https://www.milkenreview.org/articles/home-insurance-in-crisis>
- 118 Eaglesham, J. (2023). Homeowners Flock to Last-Resort Insurance Policies. The Wall Street Journal. News Corp. <https://www.wsj.com/finance/homeowners-flock-to-last-resort-insurance-policies-a7ae9439>
- 119 Insurance Information Institute. (2023). Trends and Insights: Louisiana Insurance Crisis. https://www.iii.org/sites/default/files/docs/pdf/triple-i_trends_and_insights_louisiana_03282023.pdf
- 120 Barton, T. (2024). Climate disasters have made Iowa a losing proposition for some insurance companies. Here's how Iowans are being affected. Gazette. <https://www.thegazette.com/state-government/climate-disasters-have-made-iowa-a-losing-proposition-for-some-insurance-companies-heres-how-iowan/>
- 121 Adu-Wadied, B. (2025). State Farm's Insurance Rate Increase Sparks Backlash From Advocates, Lawmakers. Wttw.com. <https://news.wttw.com/2025/07/24/state-farm-s-insurance-rate-increase-sparks-backlash-advocates-lawmakers>
- 122 McCartney, R. (2024). Arizona leads the nation with 62% surge in home insurance rates over 5 years. Greater Phoenix In Business Magazine; In Business Magazine. <https://inbusinessphx.com/economy-trends/arizona-leads-the-nation-with-62-surge-in-home-insurance-rates-over-5-years>
- 123 Brown, C., & Rojanasakul, M. (2025). A climate 'shock' is eroding some home values. New data shows how much. The New York Times. <https://www.nytimes.com/interactive/2025/11/19/climate/home-insurance-costs-real-estate-market.html>
- 124 Bloomberg Intelligence. (2025). The Climate Economy 2025 Outlook. Bloomberg Finance L.P. https://assets.bhub.io/promo/sites/16/ClimateEconomyDeepDiveFINAL_PRINT.pdf
- 125 Sheets, C. (2024). 'Everything Has Gone Up': Retirees Feel Burdened by Inflation as Home Insurance Costs Surge. Insurify.com. <https://insurify.com/homeowners-insurance/insights/retirees-burdened-by-home-insurance-inflation/>
- 126 Brown, C., & Rojanasakul, M. (2025). A climate 'shock' is eroding some home values. New data shows how much. The New York Times. <https://www.nytimes.com/interactive/2025/11/19/climate/home-insurance-costs-real-estate-market.html>
- 127 Araullo, K. (2025). Insurance crisis deepens in Gulf states. Insurance Business. <https://www.insurance-businessmag.com/us/news/property/insurance-crisis-deepens-in-gulf-states-537234.aspx>
- 128 First Street. (2022). The insurance issue. <https://pitch.com/v/Insurance-Bubble-ciHncu/9e1b145d-6722-4a33-81b3-01129c44a0c0>
- 129 Fellowes-Granda, L., Jarsulic, M., & Thornton, A. (2025). Managing the Climate Change-Fueled Property Insurance Crisis. Center for American Progress. <https://www.americanprogress.org/article/managing-the-climate-change-fueled-property-insurance-crisis/>
- 130 EIOPA. (2025). Dashboard on insurance protection gap for natural catastrophes. https://www.eiopa.europa.eu/tools-and-data/dashboard-insurance-protection-gap-natural-catastrophes_en
- 131 ACPR. (2024). Main results of the climate exercise for the insurance sector. Banque de France. https://acpr.banque-france.fr/system/files/2025-03/20240527_main_results_of_the_climate_exercise_insurance_sector_2024_en.pdf
- 132 Shah, A., Amara, A., Vettori, N. B. S., et al. (2025). Milliman Annual Report Extreme weather in Europe 2024: The Year Of The Flood. https://edge.sitecorecloud.io/millimaninc5660-milliman6442-prod27d55-0001/media/Milliman/PDFs/2025-Articles/5-21-25_Extreme-weather-in-europe-in-2024.pdf
- 133 The ABI. (2025). Property insurance payouts underscore continued support for homes and businesses. <https://www.abi.org.uk/news/news-articles/2025/7/1.6-billion-paid-in-property-claims-in-q2-2025/>
- 134 Fisher, R. (2024). How the Climate Crisis is Impacting the UK Property Insurance Market. Property Insurance Centre. <https://www.propertyinsurancecentre.co.uk/how-the-climate-crisis-is-impacting-the-uk-property-insurance-market/>
- 135 Flood Re. (2025). Flood Re completes successful debut ILS catastrophe bond placement. <https://www.floodre.co.uk/flood-re-completes-successful-debut-ils-catastrophe-bond-placement/>
- 136 Murray, J. (2024). Could Tenbury Wells be the first UK town centre abandoned over climate change? The Guardian. <https://www.theguardian.com/environment/2024/dec/01/could-tenbury-wells-be-the-first-uk-town-centre-abandoned-due-to-climate-change>
- 137 Middleton, L. C. (2025). 'If we flood again, we're homeless': Middleton homeowners in crisis without flood insurance after storms. Irish Times. <https://www.irishtimes.com/environment/climate-crisis/2025/03/30/if-we-flood-again-were-homeless-middleton-homeowners-in-crisis-without-flood-insurance-after-storms/>
- 138 The Geneva Association. (2025). Safeguarding Home Insurance: Reducing exposure and vulnerability to extreme weather. https://www.genevaassociation.org/sites/default/files/2025-05/safeguarding_home_insurance_140525.pdf
- 139 WorldD, D. (2025). How insurers tackle Australia's protection gap. Accelerated Innovation. <https://acceleratedinnovation.com.au/2025/01/28/how-insurers-tackle-australias-protection-gap/>
- 140 Williams, N., Coy, T., & Burns, R. (2024). Climate change impacts elevate US commercial real estate insurance costs. Deloitte. <https://www.deloitte.com/us/en/insights/industry/financial-services/impact-of-climate-change-on-commercial-real-estate-insurance-costs.html>
- 141 Gallagher Re (2025). Natural Catastrophe and Climate Report: 2024. <https://www.aig.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2025/natural-catastrophe-and-climate-report-2025.pdf>
- 142 European Central Bank. (2024). The climate insurance protection gap. <https://www.ecb.europa.eu/ecb/climate/climate/html/index.en.html>
- 143 European Environment Agency. (2025). Economic losses and fatalities from weather- and climate-related extremes. <https://www.eea.europa.eu/en/analysis/publications/economic-losses-from-climate-extremes>, figure 1
- 144 Swiss Re Institute. (2025a). Sigma Report I Natural catastrophes: insured losses on trend to US\$145 billion in 2025. <https://www.swissre.com/dam/jcr:46617c8b-98a4-4d54-b259-4bdcbaab0b8/sri-sigma-natural-catastrophes-1-2025.pdf>, figure 1
- 145 Swiss Re Institute. (2025b). sigma 1/2025: Natural catastrophes: insured losses on trend to US\$145 billion in 2025. <https://www.swissre.com/institute/research/sigma-research/sigma-2025-01-natural-catastrophes-trend.html>, figure 2
- 146 NBC News. (2024). 1 in 8 U.S. homeowners aren't protected by homeowners insurance. <https://www.nbcnews.com/data-graphics/map-new-data-shows-many-americans-are-without-homeowners-insurance-rcna169974>
- 147 Consumer Federation of America. (2024). EXPOSED: A Report on 1.6 Trillion Dollars of Uninsured American Homes. <https://consumersfed.org/wp-content/uploads/2024/03/Exposed-UninsuredHomes-1.pdf>
- 148 J.P. Morgan. (2025). Insurance: Weathering the storm of inflation, climate change and market-distorting state regulation. https://www.jpmorgan.com/content/dam/jpm/cib/documents/Weathering_the_storm.pdf
- 149 Woodhouse, M., & Cohen, R. (2025). A home insurance crisis is building in the Mountain West. State leaders are struggling to respond. Boise State Public Radio. <https://www.boisestatepublicradio.org/politics-government/2025-05-20/homeowners-insurance-wildfires-climate-change-insurance-premiums>
- 150 Green, J. (2024). Office of the Governor – News Release – Gov. Green Signs Emergency Proclamation to Address Condo Insurance Crisis. Hawaii.gov. <https://governor.hawaii.gov/newsroom/office-of-the-governor-news-release-gov-green-signs-emergency-proclamation-to-address-condo-insurance-crisis/>
- 151 European Environment Agency. (2025). Economic losses and fatalities from weather- and climate-related extremes. <https://www.eea.europa.eu/en/analysis/publications/economic-losses-from-climate-extremes>, figure 2
- 152 EIOPA. (2025). Dashboard on insurance protection gap for natural catastrophes. https://www.eiopa.europa.eu/tools-and-data/dashboard-insurance-protection-gap-natural-catastrophes_en; select '2024' and 'Germany' or 'Italy'
- 153 European Environment Agency. (2024). Global and European temperatures. <https://www.eea.europa.eu/en/analysis/indicators/global-and-european-temperatures>
- 154 Ministère de la Transition écologique; Aménagement du territoire; Transports; Ville et du Logement. (2025). Presentation document PNACC 3. https://www.ecologie.gouv.fr/sites/default/files/documents/PNACC_EN_VF_2.pdf
- 155 The Geneva Association. (2021). Climate Change Risk Assessment for the Insurance Industry A holistic decision-making framework and key considerations for both sides of the balance sheet. https://www.genevaassociation.org/sites/default/files/research-topics-document-type/pdf_public/climate_risk_web_final_250221.pdf
- 156 Norman, A. (2025). From risk to resilience: The case for flood-resilient communities, economy and growth. Public First. <https://www.publicfirst.co.uk/from-risk-to-resilience-the-case-for-flood-resilient-communities-economy-and-growth.html>
- 157 Igini, M. (2025). Climate Litigation No Longer a 'Niche Concern', 226 New Cases Filed in 2024: Report. Earth.org. <https://earth.org/climate-litigation-no-longer-a-niche-concern-as-impacts-become-increasingly-visible-report-says/>
- 158 International Court of Justice. (2025). Obligations of States in respect of Climate Change. <https://www.icj-cij.org/case/187>
- 159 Crugnola-Humbert, J., & Bänziger, A. (2024). Climate Litigation and the Financial Sector A perspective on recent developments. Deloitte. https://www.deloitte.com/ch/en/services/risk-advisory/perspectives/climate-litigation-and-the-financial-sector.html?trk=feed-detail_main-feed-card_reshare_feed-article-content
- 160 Sabin Center for Climate Change Law. (2024). Aloha petroleum ltd. v. National union fire insurance co. Of Pittsburgh. https://www.climatecasechart.com/collections/aloha-petroleum-ltd-v-national-union-fire-insurance-co-of-pittsburgh_ddcfd
- 161 Sandor Boyson, Michael D. Gerst, Laharish Guntuka, et al. (2022). How exposed is your supply chain to climate risks? Harvard Business Review. <https://hbr.org/2022/05/how-exposed-is-your-supply-chain-to-climate-risks>
- 162 RTS. (2024). L' "effet papillon" des inondations en Valais: Porsche annonce 1 à 2 milliards de pertes. <https://www.rts.ch/info/regions/valais/2024/article/l-effet-papillon-des-inondations-en-valais-porsche-annonce-1-a-2-milliards-de-pertes-28582422.html>
- 163 Reuters. (2022). Why low water levels on the Rhine river hurt Germany's economy. <https://www.reuters.com/business/environment/why-low-water-levels-rhine-river-hurt-germanys-economy-2022-08-15/>
- 164 Wang, D., Guan, D., Zhu S. et al. (2020). Economic footprint of California wildfires in 2018. Nature Sustainability. <https://doi.org/10.1038/s41893-020-00646-7>

- 165 Data Horizon Research. (2025). Business Interruption Insurance Market By Policy Type, By Coverage Type, By Distribution Channel and By End-User Industry, Global Market Size, Share, Growth, Trends, Statistics Analysis Report, By Region, and Segment Forecasts 2025 – 2033 (data set). In Datahorizon-research.com. <https://datahorizonresearch.com/business-interruption-insurance-market-43524>
- 166 Allianz Commercial. (2025). Allianz Risk Barometer 2025. <https://commercial.allianz.com/news-and-insights/reports/allianz-risk-barometer.html>
- 167 Allianz Global Corporate & Specialty. (2022). Business interruption loss trends. <https://commercial.allianz.com/news-and-insights/expert-risk-articles/business-interruption-trends.html>
- 168 Marsh McLennan. (2023). Climate resilience: Five steps to strengthen supply chains. <https://www.marshmclennan.com/insights/publications/2023/august/climate-resilience-5-steps-to-strengthen-supply-chains.html>
- 169 Deliso, M. (2022). Why California has blackouts: A look at the power grid. ABC News. <https://abcnews.go.com/US/california-blackouts-power-grid/story?id=89460998>
- 170 Musto, J. (2024). Texas gripped by deadly heat wave raising drought concerns and straining power grid. Independent. <https://www.independent.co.uk/climate-change/texas-heat-wave-deadly-record-breaking-drought-b2600257.html>
- 171 US Department of Energy. (n.d.). Puerto Rico Grid Recovery and Modernization. Retrieved 9 December 2025, from <https://www.energy.gov/gdo/puerto-rico-grid-recovery-and-modernization>
- 172 Garriga, J. M. (2024). Economic impact of the floods in the Valencia province. CaixabankResearch. <https://www.caixabankresearch.com/en/economics-markets/activity-growth/economic-impact-floods-valencia-province>
- 173 Branton, S., Greenberg, S., Earni, S., & et al. (2024). Energy Research and Development Division Final Project Report: Demonstration of Low-Cost Data Center Liquid Cooling. California Energy Commission. <https://www.energy.ca.gov/sites/default/files/2024-06/CEC-500-2024-061.pdf>
- 174 Jacob, K., Deodatis, G., Whitcomb, M., et al. (n.d.). ClimAID-Transportation. Retrieved 9 December 2025, from <https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Environmental/EMEP/climaid/ClimAID-Transportation.pdf>
- 175 Moran, D., Querolo, N. (2022). Florida Cities Crushed by Ian Face Highest Borrowing Costs in Decade. Insurance Journal. <https://www.insurancejournal.com/news/national/2022/10/04/688163.html>
- 176 See for such an example: SCOR. (2025). SCOR launches its second Ecological Restoration Insurance Solution Product: "Manage". <https://www.scor.com/en/news/scor-launches-its-second-ecological-restoration-insurance-solution-product-manage>
- 177 Hultgren, A., Carleton, T., Delgado, M., et al (2025). Impacts of climate change on global agriculture accounting for adaptation. Nature. <https://doi.org/10.1038/s41586-025-09085-w>
- 178 The Economist. (2025). Climate change will hurt the richest farmers—and the poorest. <https://www.economist.com/science-and-technology/2025/06/18/climate-change-will-hurt-the-richest-farmers-and-the-poorest>
- 179 US Congress (2021). Federal Crop Insurance: A Primer. <https://www.congress.gov/crs-product/R46686>
- 180 European Commission and European Investment Bank. (2025). Insurance and Risk Management Tools for Agriculture in the EU. Fi-Compass EAFRD. <https://www.fi-compass.eu/library/market-analysis/insurance-and-risk-management-tools-agriculture-eu>
- 181 Gustin, G. (2018). US taxpayers on the hook for insuring farmers against growing climate risks. Inside Climate News. <https://insideclimatenews.org/news/31122018/crop-insurance-farm-bureau-taxpayer-subsidies-climate-change-risk-risking/>
- 182 Grislain-Létrémy C., Villeneuve B., Yeterian M. (2024). Don't bet the Farm on Crop Insurance Subsidies: A Marginal Treatment Effect Analysis of French Farms. Banque de France. <https://www.banque-france.fr/en/publications-and-statistics/publications/dont-bet-farm-crop-insurance-subsidies-marginal-treatment-effect-analysis-french-farms>
- 183 Schiretz, V. (2025). Ministerium will Sparstift bei Entschädigung für Bauern ansetzen. <https://www.kleinezeitung.at/politik/innenpolitik/19903506/ministerium-will-sparstift-bei-entschaedigung-fuer-bauern-ansetzen>
- 184 Jones, S. (2023). Unprecedented €2.2bn drought response plan approved in Spain. The Guardian. <https://www.theguardian.com/world/2023/may/11/spain-approves-unprecedented-drought-recovery-plan>
- 185 Newson, N. (2025). Climate change: Supporting farmers and growers. UK Parliament. <https://lordslibrary.parliament.uk/climate-change-supporting-farmers-and-growers/#heading-5>
- 186 Horn-Muller, A. (2025). The \$20B question hanging over America's struggling farmers. <https://grist.org/food-and-agriculture/the-20-billion-question-hanging-over-americas-struggling-farmers/>
- 187 WWF Switzerland. (2023). Underwriting Our Planet: How Insurers can help address the crises in climate and biodiversity. https://wwf.panda.org/wwf_news/?9548441/WWF-urges-insurance-companies-to-take-responsibility-for-their-underwriting-business
- 188 Pollination Group. (2024). Financing for Regenerative Agriculture. Rockefeller Foundation. <https://www.rockefellerfoundation.org/wp-content/uploads/2024/06/Financing-for-Regenerative-Agriculture-Final.pdf>
- 189 Lesk, C., Rowhani, P., & Ramankutty, N. (2016). Influence of extreme weather disasters on global crop production. Nature. <https://doi.org/10.1038/nature16467>
- 190 Lavorato, M. P., & Braga, M. J. (2023). On the risk efficiency of a weather index insurance product for the Brazilian semi-arid region. Weather, climate, and society. <https://doi.org/10.1175/wcas-d-22-0079.1>
- 191 Bucheli, J., Conrad, N., Wimmer, S. et al. (2023). Weather insurance in European crop and horticulture production. Climate Risk Management. <https://doi.org/10.1016/j.crm.2023.100525>
- 192 Barratt, J., Kath, J., Collins, B., et al. (2025). Decile-based index drought insurance to help improve income stability for wheat producers in Australia. Agricultural Water Management. <https://doi.org/10.1016/j.agwat.2025.109726>
- 193 Ray, D., Gerber, J., MacDonald, G. et al. (2015). Climate variation explains a third of global crop yield variability. Nat Commun. <https://doi.org/10.1038/ncomms6989>
- 194 OECD. (2022). Climate tipping points: Insights for effective policy action. https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/12/climate-tipping-points_9994de90/abc5a69e-en.pdf https://www.oecd.org/en/publications/managing-climate-risks-facing-up-to-losses-and-damages_55ea1c9e-en/full-report.html
- 195 van der Velde, M., Tubiello, F. N., Vrieling, A., & Bouraoui, F. (2012). Impacts of extreme weather on wheat and maize in France: evaluating regional crop simulations against observed data. Climatic Change. <https://doi.org/10.1007/s10584-011-0368-2>
- 196 Prognos. (2020). Schäden der Dürre- und Hitzeextreme 2018 und 2019. https://www.prognos.com/sites/default/files/2022-07/Prognos_KlimawandelfolgenDeutschland_Detailuntersuchung%20Hitzesommer%2018_19_AP2_3a.pdf
- 197 National Farmers' Federation. (2020). Financial Risk Management Project. <https://nff.org.au/programs/financial-risk-management/>
- 198 Molina Vileya, I., & Paccé, M. J. (2025). The impact of drought on agricultural production in Spain. Economic Bulletin. <https://doi.org/10.53479/39768>
- <https://www.bde.es/finweb/SES/Secciones/Publicaciones/InformesBoletinesRevistas/BoletinEconomico/25/T2/Files/be2502-art07e.pdf>
- 199 Sternberg, T. (2012). Chinese drought, bread and the Arab Spring. Applied Geography. <https://doi.org/10.1016/j.apgeog.2012.02.004>
- 200 Izumi, T., Sakai, T. (2020). The global dataset of historical yields for major crops 1981–2016. Scientific Data. <https://doi.org/10.1038/s41597-020-0433-7>
- 201 Database: Beguería, S. (2022). sbeguiria/SPEIbase: Version 2.7. Zenodo.
- 202 GADM, ADM1 resolution
- 203 Araujo, D.S.A., Enquist, B.J., Frazier, A.E. et al. (2025). Global Future Drought Layers Based on Downscaled CMIP6 Models and Multiple Socioeconomic Pathways. Sci Data. <https://doi.org/10.1038/s41597-025-04612-w>
- 204 DeLay, N. D., Brewer, B., Featherstone, A., & Boussios, D. (2023). The impact of crop insurance on farm financial outcomes. Applied Economic Perspectives and Policy. <https://doi.org/10.1002/aep.13223> show that while substantial insurance indemnity payments ease farmers' dependence on short-term borrowing in Kansas (USA), they do not significantly alter overall (long-term) debt levels.
- 205 Augustin, J., Hischke, S., Hoffmann, P., et al. (2025). Effects of high thermal stress on health—a nationwide analysis based on statutory health insurance routine data between 2012 and 2021. Bundesgesundheitsblatt, Gesundheitsforschung, Gesundheitsschutz. <https://doi.org/10.1007/s00103-024-03968-5>
- 206 IPBES. (2024). Thematic Assessment Report on the Interlinkages among Biodiversity, Water, Food and Health of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Harrison, P. A., McElwee, P. D., and van Huysen, T. L. (eds.). IPBES secretariat, Bonn, Germany.
- 207 World Economic Forum. (2024). Quantifying the Impact of Climate Change on Human Health. <https://www.weforum.org/publications/quantifying-the-impact-of-climate-change-on-human-health/>
- 208 The Geneva Association. (2024). Climate Change: What does the future hold for health and life insurance? https://www.genevaassociation.org/sites/default/files/2024-02/cch-report_web-270224.pdf
- 209 World Economic Forum. (2024). Quantifying the Impact of Climate Change on Human Health. <https://www.weforum.org/publications/quantifying-the-impact-of-climate-change-on-human-health/>
- 210 Holzhausen, A., Grimm, M., & Zimmer, M. (2024). Climate change and the double impact of aging. Allianz Trade. https://www.allianz-trade.com/en_global/news-insights/economic-insights/climate-change-impact-aging.html
- 211 International Labour Organization. (2024a). Ensuring safety and health at work in a changing climate I Global report. https://www.ilo.org/sites/default/files/2024-07/ILO_SafeDay24_Report_r11.pdf
- 212 International Labour Organization. (2024b). Heat at work: Implications for safety and health A global review of the science, policy and practice. https://www.ilo.org/sites/default/files/2024-07/ILO_OSH_Heat-stress-R16.pdf
- 213 Garrigues. (2023). Spain: High temperatures will mean employers must adopt preventive measures in order to protect employees. https://www.garrigues.com/en_GB/new/spain-high-temperatures-will-mean-employers-must-adopt-preventive-measures-order-protect
- 214 California Department of Insurance. (2024). Impacts of extreme heat to California's people, infrastructure, and economy. <https://www.insurance.ca.gov/01-consumers/180-climate-change/upload/Impacts-of-extreme-heat-to-California-s-people-infrastructure-and-economy-by-California-Department-of-Insurance-June-2024.pdf>
- 215 Climate Resilience For All. (2025). Groundbreaking south-north initiative to bring heat insurance, direct cash support, and resilience to heat-exposed outdoor workers of Los Angeles. <http://www.climate-resilience.org/initiative-to-bring-heat-insurance-direct-cash-support-to-heat-exposed-workers-of-los-angeles>
- 216 The Geneva Association. (2024). Climate Change: What does the future hold for health and life insurance? <https://www.genevaassociation.org/publication/climate-change-environment-health-demography/climate-change-what-does-future-hold>
- 217 Lopez, L. A., Murphy, D., Tzur-Ilan, N., Wilkof, S. (2025). Up in smoke: The impact of wildfire pollution on healthcare municipal finance. Federal Reserve Bank of Dallas, Working Papers, 2025(2503). <https://doi.org/10.24149/wp2503>
- 218 SCOR. (2023). The relevance of climate change for life and health insurers. <https://www.scor.com/en/expert-views/relevance-climate-change-life-and-health-insurers>
- 219 ACPR. (2024). Main results of the climate exercise for the insurance sector. Banque de France. https://acpr.banque-france.fr/system/files/2025-03/20240527_main_results_of_the_climate_exercise_insurance_sector_2024_en.pdf

- 220 United Nations Environment Programme. (2023). Health is Our Greatest Wealth: How life & health insurers can drive better health outcomes and address the protection gap. <https://www.unepfi.org/industries/insurance/health-is-our-greatest-wealth-how-life-health-insurers-can-drive-better-health-outcomes-and-address-the-protection-gap>
- 221 World Health Organization. (2025). Nature-based solutions and health. <https://iris.who.int/bitstream/handle/10665/381437/WHO-EURO-2025-12214-51986-79744-eng.pdf?sequence=2>
- 222 Khoo, F., & Yong, J. (2023). Too hot to insure avoiding the insurability tipping point. Bank for International Settlements & Financial Stability Institute. <https://www.bis.org/fsi/publ/insights54.pdf>
- 223 Derue, V. (2025). Sustainability in 2025: Building resilience and navigating risks. AXA Investment Managers. https://www.axa-com.cdn.prismic.io/www-axa-com/anOfcJ5xUNk61XJp_Building_resilience_and_navigating_risks.pdf
- 224 Berns, M., Jones, E. R., Moore, N., et al. (2025). Climate change may trigger financial tipping points. Here's how leaders can prepare. BCG Global. <https://www.bcg.com/publications/2025/climate-change-trigger-financial-tipping-points>
- 225 Financial Stability Board. (2025). Assessment of Climate-related Vulnerabilities Analytical framework and toolkit. <https://www.fsb.org/uploads/P160125.pdf>, figure 1
- 226 The International Association of Insurance Supervisors. (2025). Global Insurance Market Report I Potential financial stability implications of natural catastrophe insurance protection gaps. <https://www.iais.org/uploads/2025/11/GIMAR-2025-special-topic-edition-on-NatCat-insurance-protection-gaps.pdf>
- 227 Fitch Wire. (2025). LA Fires May Consume 30% of European Reinsurers' 2025 Catastrophe Budgets. <https://www.fitchratings.com/research/insurance/la-fires-may-consume-30-of-european-reinsurers-2025-catastrophe-budgets-22-01-2025>
- 228 Zurich Insurance Group. (2025b). From risk to resilience: building an impactful strategy for climate adaptation. <http://www.zurich.com/commercial-insurance/sustainability-and-insights/commercial-insurance-risk-insights/from-risk-to-resilience-building-an-impactful-strategy-for-climate-adaptation>
- 229 WWF. (2025). WWF/UCL Policy Note on Ecosystem Tipping Points for Central Bankers and Financial Regulators. <https://wwf.panda.org/?14288941/Financial-Stability-at-Risk-An-Urgent-Call-to-Central-Banks-and-Regulators-to-Address-Ecosystem-Tipping-Points>
- 230 EIOPA. (2023). EIOPA Staff paper on nature-related risks and impacts for insurance. <https://www.eiopa.europa.eu/system/files/2023-03/EIOPA%20Staff%20paper%20-%20Nature-related%20risks%20and%20impacts%20for%20insurance.pdf>
- 231 See Table 7 on p.35 in Geneva Association. (2025). Safeguarding Home Insurance: Reducing exposure and vulnerability to extreme weather. https://www.genevaassociation.org/sites/default/files/2025-06/safeguarding_home_insurance_040625.pdf
- 232 First Street. (2025). The 13th National Risk Assessment Climate, The 6th "C" of Credit. https://assets.riskfactor.com/media/The%2013th%20National%20Risk%20Assessment%205_23_25
- 233 Ge, S., Johnson, S., & Tzur-Ilan, N. (2024). The Effect of Rising Insurance Premiums on Mortgage Delinquency and Household Relocation. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4992281
- 234 Sellers, M. (2025). Insurance could kill mortgages in some of the US – Powell. Insurance Business. <https://www.insurancebusinessmag.com/us/news/catastrophe/insurance-could-kill-mortgages-in-some-of-the-us-powell-524516.aspx>
- 235 Taylor, M., & Horton, H. (2025). Towns may have to be abandoned due to floods with millions more homes in Great Britain at risk. The Guardian. <https://www.theguardian.com/environment/2025/oct/14/millions-more-homes-in-great-britain-at-risk-of-flooding-investigation-finds>
- 236 Christoph Möhr, Yong J. & Zweimueller M. (2025). FSI Insights on policy implementation (No 65) Mind the climate-related protection gap – reinsurance pricing and underwriting considerations. IAIS, Financial Stability Institute, BIS. <https://www.bis.org/fsi/publ/insights65.pdf>
- 237 First Street. (2025). Property Prices in Peril. <https://firststreet.org/research-library/property-prices-in-peril>
- 238 Fontana, A., Jarmulski, B., Schwarz, et al. (2025). From flood to fire: Is physical climate risk taken into account in banks' residential mortgage rates? SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.5176497>
- 239 Nguyen, D. D., Ongena, S., Qi, S., & Sila, V. (2022). Climate Change Risk and the Cost of Mortgage Credit. <https://www.zora.uzh.ch/server/api/core/bitstreams/1b3c0c0c-6efd-43b4-95c2-5017de216c05/content?trackerId=6e8929bb41807407>
- 240 Sastry, P., Scharlemann, T., Sen, I., & Tenekedjjeva, A.-M. (2025). The Limits of Insurance Demand and the Growing Protection Gap. Harvard Business School. https://www.hbs.edu/ris/Publication%20Files/25-054_8068f2c0-0bac-4200-aa22-a18a2aef9c49.pdf
- 241 Sastry, P., Sen, I., & Tenekedjjeva, A.-M. (2024). When insurers exit: Climate losses, fragile insurers, and mortgage markets. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.467427> and Ge, S., Johnson, S., Tzur-Ilan, N. (2025). Climate risk, insurance premiums, and the effects on mortgage and credit outcomes. Federal Reserve Bank of Dallas, Working Papers <https://doi.org/10.24149/wp2505>
- 242 Freedman, A. (2025). Why climate risk could affect your credit score for buying a home. CNN.com. <https://www.cnn.com/2025/05/19/climate/flooding-credit-homeowners-insurance>
- 243 First Street. (2025). The 13th National Risk Assessment Climate, The 6th "C" of Credit. https://assets.riskfactor.com/media/The%2013th%20National%20Risk%20Assessment%205_23_25
- 244 The Salata Institute at Harvard University. (2025). Harvard Voices on Climate Change: Can Insurance Keep Up with Climate Change? [Video]. YouTube. <https://www.youtube.com/watch?v=uchdDcZuWk> and Sastry, P., Scharlemann, T., Sen, I., & Tenekedjjeva, A.-M. (2025). The Limits of Insurance Demand and the Growing Protection Gap. Harvard Business School. https://www.hbs.edu/ris/Publication%20Files/25-054_8068f2c0-0bac-4200-aa22-a18a2aef9c49.pdf
- 245 Senate Budget Committee. (2024). Next To Fall: The Climate-Driven Insurance Crisis Is Here – And Getting Worse | Staff Report. https://www.budget.senate.gov/imo/media/doc/next_to_fall_the_climate-driven_insurance_crisis_is_here_and_getting_worse.pdf
- 246 Gourevitch, J., Kousky, C., Liao, Y., et al. (2023). Unpriced climate risk and the potential consequences of overvaluation in US housing markets. Nature Climate Change. <https://doi.org/10.1038/s41558-023-01594-8>
- 247 First Street. (2022). The insurance issue. <https://pitch.com/v/Insurance-Bubble-ciHncu/9e1b145d-6722-4a33-81b3-01129c44a0c0>
- 248 Brown, C., & Rojanasakul, M. (2025). A climate "shock" is eroding some home values. New data shows how much. The New York Times. <https://www.nytimes.com/interactive/2025/11/19/climate/home-insurance-costs-real-estate-market.html>
- 249 First Street. (2025). Property Prices in Peril. <https://firststreet.org/research-library/property-prices-in-peril>
- 250 Clayton, J., Devaney, S., Sayce, S. and van de Wetering, J. (2021). Climate Risk and Commercial Property Values: a review and analysis of the literature. UNEP FI. [unepfi.org/publications/investment-publications/climate-risk-and-commercial-property-values](https://www.unepfi.org/publications/investment-publications/climate-risk-and-commercial-property-values)
- 251 Stone, J. (2025). UK housing market at risk: The financial impact of rising flood threats. Unda. <https://www.unda.co.uk/news/uk-housing-market-at-risk-the-financial-impact-of-rising-flood-threats/>
- 252 Weenink, P. (2025). How adaptation can preserve property values. Global Real Estate Engagement Network. <https://green-engagement.org/how-adaptation-can-preserve-property-values/>
- 253 Markiewicz, K. (n.d.). From Climate Risk to Climate Resilience. JLL. Retrieved 10 December 2025. <https://www.jll.com/en-uk/insights/from-climate-risk-to-climate-resilience>
- 254 OECD. (2024). Global Insurance Market Trends 2024. <https://doi.org/10.1787/5b740371-en>
- 255 Liu, T., Constantz, B., Hale, G., & Beck, M. W. (2025). Financial value of nature: coastal housing markets, mangroves, and climate resilience. <https://academic.oup.com/rof/advance-article/doi/10.1093/rof/rfa061/8304747?login=false#542667912>
- 256 Krichene, H., & Kirvaldize, G. (2025). Rethinking climate adaptation for global resilience. Allianz Research. https://www.allianz.com/content/dam/one-marketing/azcom/Allianz_com/economic-research/publications/specials/en/2025/april/2025-04-15-climate-adaptation.pdf
- 257 Liu, B. (2025). Hurricane Katrina: Long-term impacts and recovery. <https://storymaps.arcgis.com/stories/c34ca65395614175a4e6cb85e912888f>
- 258 García, I., Davis, D., & Peakcock, W. G. (2025). 20 Years After Katrina, What We've Learned. Governing. <https://www.governing.com/resilience/20-years-after-katrina-what-weve-learned>
- 259 Norman, A., Savours, B., & Pfitzner, S. (2025). From risk to resilience: The case for flood-resilient communities, economy and growth. Public First. https://www.publicfirst.co.uk/wp-content/uploads/2025/03/From-risk-to-resilience-report_PF_180325.pdf
- 260 Bartolozzi, P. (2024). The Rising Cost of Insurance in the European Tourism Industry and Climate Change. Skaleurope. <https://www.skaleurope.org/news/the-rising-cost-of-insurance-in-the-european-tourism-industry-due-to-climate-change/>
- 261 Krichene, H., & Kirvaldize, G. (2025). Rethinking climate adaptation for global resilience. Allianz Research. https://www.allianz.com/content/dam/one-marketing/azcom/Allianz_com/economic-research/publications/specials/en/2025/april/2025-04-15-climate-adaptation.pdf
- 262 Former Minister for Emergency Management. (2023). More than 100 families moved out of flood danger zone. Ministers for the Department of Home Affairs Website. <https://minister.homeaffairs.gov.au/MurrayWatt/Pages/more-than-100-families-moved-out-of-flood-zone.aspx>
- 263 Cords, S. (2022). One year after Germany's flood disaster. Deutsche Welle. <https://www.dw.com/en/publishing-and-tourism-sectors-still-dealing-with-aftermath-of-germanys-flood-disaster/a-62429958>
- 264 Deutsche Welle. (2021). German leaders agree on €30 billion for flood-hit regions. <https://www.dw.com/en/german-floods-leaders-agree-on-30-billion-reconstruction-fund/a-58822602>
- 265 Flandersnews. (2021). Insurers will pay out 590 million euro to flood victims, damage estimated at 1.7 billion euro. <https://www.vrt.be/vrtnws/en/2021/08/12/insurers-will-pay-out-590-million-euro-to-flood-victims-damage/>
- 266 Reuters. (2024). Spain announces 3.76 bln euros in new aid to Valencia after floods. <https://www.reuters.com/world/europe/spain-announces-376-bl-euros-new-aid-valencia-after-floods-2024-11-11/>
- 267 Friesenbichler, K. (2024). Floods caused 1.3 billion € in damage. Austrian Institute of Economic Research. <https://www.wifo.ac.at/en/news/hochwasser-verursachte-13-mrd-e-schaden/>
- 268 Renner, G. (2024). Nach dem Hochwasser: Wie der Katastrophenfonds funktioniert. Wienerzeitung.at. <https://www.wienerzeitung.at/a/nach-dem-hochwasser-wie-der-katastrophenfonds-funktioniert>
- 269 Schwarz-Goerlich, A., & Kaesebier, M. (2024). Flood-hit Austria to ramp up disaster fund to 1 billion euros. Reuters. <https://www.reuters.com/world/europe/austria-increase-federal-disaster-fund-1-billion-euros-chancellor-says-2024-09-18/>
- 270 Republic of Slovenia. (2023). More than half a billion euro to help people, businesses and municipalities to recover from floods. https://www.gov.si/en/news/2023-10-05-more-than-half-a-billion-euro-to-help-people-businesses-and-municipalities-to-recover-from-floods/?utm_source=chatgpt.com
- 271 Republic of Slovenia. (2024). Government adopts two flood recovery programmes by 2028 with development programme also being drafted
- 272 Swiss Re. (2024). Europe in the spotlight as global economic losses from natural catastrophes reach US\$280 billion in 2023. <https://www.swissre.com/reinsurance/insights/europe-global-natcat-losses-2023.html>
- 273 Korpar, N. (2023). Slovenia: Worst flooding in decades is the defining moment of the year. <https://www.wifo.ac.at/slovenia-worst-flooding-in-decades-is-the-defining-moment-of-the-year-dlp-6672.pdf>
- 274 Scholtes, J. & Tully-McNanus, K. (2024). Congress clears government shutdown patch following Trump, Musk disruptions. Politico. <https://www.politico.com/news/2024/12/21/congress-clears-government-shutdown-patch-00195785>

- 275 Bloomberg Intelligence. (2025). The Climate Economy 2025 Outlook. Bloomberg Finance L.P. https://assets.bbbhub.io/promo/sites/16/ClimateEconomyDeep-DiveFINAL_PRINT.pdf
- 276 IPCC. (2023). Overarching Frequently Asked Questions and Answers I Working Group II. https://www.ipcc.ch/report/ar6/wg2/downloads/faqs/IPCC_AR6_WGII_Overarching_OutreachFAQ2.pdf
- 277 The Joint Research Centre - EU Science Hub. (2022). Fires. European Commission. https://joint-research-centre.ec.europa.eu/projects-and-activities/natural-and-man-made-hazards/fires_en
- 278 European Commission - European Civil Protection and Humanitarian Aid Operations. (2023). Wildfires. https://civil-protection-humanitarian-aid.ec.europa.eu/what/civil-protection/wildfires_en
- 279 National Interagency Fire Center. (2024). Wildfires and Acres. <https://www.nifc.gov/fire-information/statistics/wildfires>
- 280 UNDRR. (2020). Ecosystem-Based Disaster Risk Reduction: Implementing Nature-based Solutions for Resilience. United Nations Office for Disaster Risk Reduction. <https://www.undrr.org/media/48333/download?startDownload=20251204>
- 281 Kurth, T., Wübbels, G., Portafaix, A. (2021). The biodiversity crisis is a business crisis. Bcg.com. <https://web-assets.bcg.com/fb/5e/74af5531468e9c1d4d5c9fc0bd7/bcg-the-biodiversity-crisis-is-a-business-crisis-mar-2021-r.pdf>
- 282 IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. doi:10.1017/9781009325844
- 283 Nature4Climate. (n.d.). Ecosystem services and green infrastructure. <https://nature4climate.org/about/nature-positive-recovery/ecosystem-services-and-green-infrastructure/#:~:text=The%20value%20of%20the%20services,Ecosystem%20services>
- 284 Ceglar, A., Parker, M., Pasqua, C., et al. (2024). Economic and financial impacts of nature degradation and biodiversity loss. European Central Bank. https://www.ecb.europa.eu/press/economic-bulletin/articles/2024/html/ecb.ebart202406_02-ae87ac450e.en.html
- 285 Network for Greening the Financial System. (2024a). Acute physical impacts from climate change and monetary policy. https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_acute_physical_impacts_from_climate_change_and_monetary_policy.pdf
- 286 US Fish & Wildlife Service. (n.d.). Marsh Restoration at Prime Hook National Wildlife Refuge. <https://www.fws.gov/project/marsh-restoration-prime-hook-national-wildlife-refuge>
- 287 The International Association of Insurance Supervisors. (2025). Global Insurance Market Report I Potential financial stability implications of natural catastrophe insurance protection gaps. <https://www.iais.org/uploads/2025/11/GIMAR-2025-special-topic-edition-on-NatCat-insurance-protection-gaps.pdf>
- 288 Centre for coastal climate resilience, US Santa Cruz. (2025). California urban forest insurance. <https://bp-us-w2.wp.mucdn.com/wordpress.ucsc.edu/dist/1/154/files/2025/10/CA-Urban-Forest-Insurance-Feasibility-Report-2025-FINAL.pdf>
- 289 Hemenway, C. (2025). Update: FEMA to Borrow \$2B to Pay Flood Claims After Hurricanes Helene and Milton. Insurance Journal. <https://www.insurancejournal.com/news/national/2025/02/13/811873.htm>
- 290 Bray, S., Nieto, A., & Wilson, E. (2024). Eastern and southern Spain: October 2024 Dana floods. Guy Carpenter. <https://www.guycarp.com/content/dam/guycarp-rebrand/insights-images/2024/11/spain-dana/11082024-valencia-dana-flooding.pdf>
- 291 Carrier Management. (2025). AM best data insights: FAIR Plan, E&S growth soars in California. <https://www.carriermanagement.com/news/2025/02/10/271636.htm>
- 292 Nguyễn, T. (2025). California's insurer for people without private coverage needs \$1 billion more for LA fires claims. The Associated Press. <https://apnews.com/article/california-wildfires-insurance-fair-plan-df-b7cda506560ec50ede8ad72cbcdad8>
- 293 Swanek, T. (2024). Being prepared for the next disaster pays off, new study shows. US Chamber of Commerce. <https://www.uschamber.com/security/being-prepared-for-the-next-disaster-pays-off-new-study-shows>
- 294 Norman, A., Savours, B., & Pfitzner, S. (2025). From risk to resilience: The case for flood-resilient communities, economy and growth. Public First. https://www.publicfirst.co.uk/wp-content/uploads/2025/03/From-risk-to-resilience-report_PF_180325.pdf
- 295 Delta Commissioner. (2025). Choosing, sharing and adapting The next chapter in our water tradition. National Delta Programme. <https://english.deltaprogramma.nl/faq/frequently-asked-questions-about-the-delta-programme/what-is-set-down-in-the-delta-act>
- 296 von Peter, G., von Dahlen, S., & Saxena, S. (2024). BIS Working Papers No 1175: Unmitigated disasters? Risksharing and macroeconomic recovery in a large international panel. <https://www.bis.org/publ/work1175.pdf>
- 297 Norman, A. (2025). From risk to resilience: The case for flood-resilient communities, economy and growth. Public First. <https://www.publicfirst.co.uk/from-risk-to-resilience-the-case-for-flood-resilient-communities-economy-and-growth.html>
- 298 AXA XL & Centre for Risk Studies at Cambridge Judge Business School. (2020). Optimizing Disaster Recovery: The Role of Insurance Capital in Improving Economic Resilience. <https://www.axa.com/en/insights/axa-xl-unveils-comprehensive-disaster-recovery-report-by-cambridge-centre-for-risk-studies>
- 299 Bock, S., Browne, M. J., Lin, J., & Steinorth, P. (2024). Flood insurance, disaster aid, and economic recovery in Europe. <https://www.aeaweb.org/conference/2025/program/paper/DRYY34E>
- 300 Giuzio, M., Rousová, L., Kapadia, S., Kumar, et al. (2026). Climate change, catastrophes, insurance and the macroeconomy. European Economic Review. <https://doi.org/10.1016/j.euroecorev.2025.105210>
- 301 Cevik, S., & Jalles, J. T. (2020). Feeling the heat: Climate shocks and credit ratings. IMF Working Papers, 20(286). <https://doi.org/10.5089/9781513564548.001>
- 302 Fahr, S., Giuzio, M., Mc Sweeney, C., & et al. (2023). Climate change and sovereign risk I Financial Stability Review. European Central Bank. https://www.ecb.europa.eu/press/financial-stability-publications/fsr/special/html/ecb.fsrart202305_03-f51dd11fd7.en.html
- 303 Fitch Ratings. (2017). Sovereign Catastrophe Risk in Latin America and the Caribbean (Assessing the Economic and Rating Implications of Natural Disasters). Fitchratings.com. <https://www.fitchratings.com/research/sovereigns/sovereign-catastrophe-risk-in-latin-america-and-caribbean-assessing-economic-rating-implications-of-natural-disasters-30-10-2017>
- 304 Fitch Ratings. (2025b). Sovereign Rating Criteria - Exposure Draft. <https://www.fitchratings.com/research/sovereigns/sovereign-rating-criteria-exposure-draft-16-06-2025>
- 305 EIOPA. (2019). EIOPA Staff Discussion Paper Protection Gap for natural catastrophes. https://register.eiopa.europa.eu/Publications/EIOPA-19-485_EIOPA%20Staff_Discussion_Paper_Protection_Gap.pdf, Figure 1
- 306 Hillier, D. (2023). Climate-vulnerable countries need better recovery support to avoid debt: Here are some measures that can help. World Economic Forum. <https://www.weforum.org/stories/2023/10/countries-recovering-from-climate-disasters-forced-into-debt-crises>
- 307 The World Bank. (n.d.). World Bank Catastrophe Bond provides Jamaica with Financial Protection against Tropical Cyclones (Case Study). Retrieved 9 December 2025 from <https://thedocs.worldbank.org/en/doc/43a111757d3b1ff1cabe80ee7eb0535-0340012021/original/Case-Study-Jamaica-Cat-Bond.pdf>
- 308 Francis, R. P., Latorre, M.G. (2025). Hurricane Melissa left \$8 billion in damage. Jamaica needs US support to get back on its feet. Atlantic Council. <https://www.atlanticcouncil.org/blogs/new-atlanticist/hurricane-melissa-left-8-billion-in-damage-jamaica-needs-us-support-to-get-back-on-its-feet/>
- 309 McNeil, D., & Tang, M. (2020). Growing Protection Gap for Physical Climate Risks I Patchwork of Insurance Coverage Increases Sectoral, Geographical Exposure. Sustainable Fitch. <https://www.sustainablefitch.com/assets/special-reports/growing-protection-gap-for-physical-climate-risks.pdf>
- 310 Kotz, M., Kuik, F., Lis, E., & Nickel, C. (2024). Global warming and heat extremes to enhance inflationary pressures. Communications Earth & Environment, 5(1), 116. <https://doi.org/10.1038/s43247-023-01173-x>
- 311 WWF. (2025a). Weathering the storm: climateflation & fossilflation in Belgium. https://wwf.panda.org/discover/our_focus/climate_and_energy_practice/cop29/?14212466/Weathering-the-storm
- 312 Birkmann, J., E. Liwenga, R. Pandey, E. Boyd et al. (2022). Poverty, Livelihoods and Sustainable Development. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change doi:10.1017/9781009325844.010
- 313 Gropper, M. J., & Kuhnen, C. M. (2021). Nber working paper series wealth and insurance choices: Evidence from US households. Nber.org. https://www.nber.org/system/files/working_papers/w29069/w29069.pdf
- 314 The Geneva Association. (2024b). Inclusive Insurance in Advanced Economies: Alleviating strains on society. https://www.genevaassociation.org/sites/default/files/2024-11/inclusive_report_0711.pdf
- 315 Hallegatte, S., Vogt-Schilb, A., & Rozenberg, E., et al. (2020). From poverty to disaster and back: A review of the literature. Economics of Disasters and Climate Change. <https://doi.org/10.1007/s41885-020-00060-5>
- 316 Hallo, S. (2021). Low-income homeowners pay more for insurance in most states. Property Casualty. <https://www.propertycasualty360.com/2021/05/06/low-income-homeowners-pay-more-for-insurance-in-most-states/>
- 317 Cornelissen, S., Heller, D., & Delong, M. (2024). EXPOSED: A report on 1.6 trillion dollars of uninsured American homes. The Consumer Federation of America. <https://consumerfed.org/wp-content/uploads/2024/03/Exposed-UninsuredHomes-1.pdf>
- 318 Zhu, L., & Zinn, A. (2024). Homeownership's promise and pitfalls in transferring wealth across generations. Inequality. <https://inequality.org/article/promise-and-pitfalls-in-transferring-wealth-across-generations/>
- 319 Fenlock, L., Slidders, C., & Reisch, N. (2024). Is Bluelining the 'New' Redlining? How Insurance Discrimination Deepens Climate Disparities. Center for International Environmental Law. <https://www.ciel.org/bluelining-insurance-discrimination-climate-crisis/>
- 320 Gerstenberg, F. (2025). Ahtal-Drama: „Nicht die Flut hat uns zu Opfern gemacht, sondern die Behörden“. FOCUS online. https://www.focus.de/panorama/psychisch-und-finanziell-ruiniert-nicht-die-flut-hat-uns-zu-opfern-gemacht-sondern-die-behoerden_id_260633657.html
- 321 Meiler, S., Mühlhofer, E., Lüthi, S., et al. (2025). A natural hazard risk modelling approach to human displacement – frontiers & challenges. Environmental Research: Climate, <https://doi.org/10.1088/2752-5295/ae014c>
- 322 Institute for Economics & Peace. (2020). Over one billion people at threat of being displaced by 2050 due to environmental change, conflict and civil unrest. <https://www.economicsandpeace.org/wp-content/uploads/2020/09/Ecological-Threat-Register-Press-Release-27-08-FINAL.pdf>
- 323 See also for additional information: Anglin, A. (2024). How climate change challenges and solutions are impacting the geopolitical risk landscape. WTW. <https://www.wtwco.com/en-ch/insights/2024/06/how-climate-change-challenges-and-solutions-are-impacting-the-geopolitical-risk-landscape>
- 324 National Association of Insurance Commissioners. (2024). National Climate Resilience Strategy for Insurance. <https://content.naic.org/sites/default/files/national-climate-resilience-strategy.pdf>.
- 325 Coalition of Finance Ministers for Climate Action. (2025). How Ministries of Finance Can Assess and Manage Physical Climate Risks and Adaptation: Available Analytical Tools and Emerging Good Practice. Economic Analysis for Green and Resilient Transitions. <https://www.financeministersforclimate.org/sites/default/files/2025-06/CFMA%20HP4%20Thematic%20Paper%20-%20Physical%20Climate%20Risks%20and%20Adaptation.pdf>
- 326 Network for Greening the Financial System. (2024b). Conceptual Note on Adaptation I Technical Document. https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_conceptual_note_on_adaptation.pdf

- 327 For a comparison of flood insurance schemes, e.g., see: Crawford, S., & Mangalmurti, D. (2025). Comparing National Flood Insurance Frameworks: Lessons and Trade-Offs. Carnegie Endowment for International Peace. <https://carnegieendowment.org/research/2025/05/comparing-national-flood-insurance-frameworks-lessons-and-trade-offs?lang=en>
- 328 Howden. (2025). Italy is implementing a mandatory regime to cover natural disasters: What do you need to know? Howden France. <http://www.howdengroup.com/fr-en/news/italy-implements-a-mandatory-regime-to-cover-natural-disasters>
- 329 Gesamtverband der Versicherer. (2025). Elementar Re bündelt Hochrisikogebäude und hält Schutz bezahlbar. <https://www.gdv.de/gdv/medien/medieninformationen/elementarschutz-fuer-alle-versicherer-legen-modell-fuer-sicherungssystem-gegen-naturgefahren-vor-194780>
- 330 Zentrum für Europäischen Verbraucherschutz. (2025). Das französische System der Elementarschadenversicherung. https://www.cec-zev.eu/fileadmin/Media/PDF/publications/Etudes-Rapports_DE/Studie_Elementarschadenversicherung_Frankreich_ZEV.pdf
- 331 Jorio, L. (2025). Is Switzerland's natural disaster insurance a model for the world? <https://www.swissinfo.ch/eng/climate-adaptation/is-switzerlands-natural-disaster-insurance-a-model-for-the-world/89825878>
- 332 Trust Risk Control. (2024). Mandatory natural disaster insurance for businesses in Greece. <https://ustrc.com/en/mandatory-natural-disaster-insurance-for-businesses-in-greece/>
- 333 Gesamtverband der Versicherer. (2025). Elementar Re bündelt Hochrisikogebäude und hält Schutz bezahlbar. <https://www.gdv.de/gdv/medien/medieninformationen/elementarschutz-fuer-alle-versicherer-legen-modell-fuer-sicherungssystem-gegen-naturgefahren-vor-194780>
- 334 Business Insurance. (2025). Greek firms struggle to find property coverage. https://www.businessinsurance.com/greek-firms-struggle-to-find-property-coverage/?utm_source=chatgpt.com
- 335 NOAA. (n.d.). Climate Mapping for Resilience and Adaptation. Retrieved 10 December 2025, from <https://resilience.climate.gov/>
- 336 Met Office. (2025). UK Climate Projections (UKCP18). <https://www.metoffice.gov.uk/research/approach/collaboration/ukcp>
- and Government UK. (n.d.). Get flood risk information for planning in England. Environment Agency. Retrieved 10 December 2025, from <https://flood-map-for-planning.service.gov.uk/>
- 337 Climate Adaptation Services. (n.d.). Klimaateffektatlas. Klimaateffektatlas.NL. Retrieved 10 December 2025, from <https://www.klimaateffektatlas.nl/en/about-us>
- 338 International Code Council. (2024). The Florida Building Code Story: Building Safety, Resilience and Affordability. Retrieved 14 December 2025, From <https://www.iccsafe.org/content/florida-case-study/>
- 339 Parry, C., & Wessel, D. (2025). What incentives are states offering to make houses less vulnerable to extreme weather damage? Brookings. <https://www.brookings.edu/articles/what-incentives-are-states-offering-to-make-houses-less-vulnerable-to-extreme-weather-damage/>
- 340 European Commission- Climate Action. (2025). European Climate Resilience and Risk Management – Integrated Framework. https://climate.ec.europa.eu/eu-action/adaptation-and-resilience-climate-change/european-climate-resilience-and-risk-management-integrated-framework_en
- 341 European Environment Agency. (2025c). National adaptation policies in 2025 in the EEA-32. <https://www.eea.europa.eu/en/analysis/publications/from-adaptation-planning-to-action/national-adaptation-policies-in-2025-in-the-eea-32>
- 342 Manke, K. (2025). Home hardening and defensible space can halve wildfire damage, study finds. Phys.org. <https://phys.org/news/2025-08-home-hardening-defensible-space-halve.html>
- 343 Holscher, L., Schulze, P., Kohli, A., & Peter, M. (2025). Tracking climate adaptation spending in Germany. Umweltbundesamt. <https://www.prevention-web.net/quick/93263>
- 344 Climate-ADAPT. (2023). Closing the Gap in German Loss and Damage Data. The Importance of Heat- and Drought-related Extreme Events. <https://climate-adapt.eea.europa.eu/en/metadata/publications/closing-the-gap-in-german-loss-and-damage-data-the-importance-of-heat-and-drought-related-extreme-events>
- 345 Bundesumweltministerium. (2023). <https://www.bundesumweltministerium.de/programm/foerdermassnahmen-im-ank>
- 346 Gillam, L. H. (2024). Responding to the financial impacts of Climate change. The White House. <https://bidenwhitehouse.archives.gov/omb/briefing-room/2024/04/22/responding-to-the-financial-impacts-of-climate-change/>
- 347 IPCC. (2023a). AR6 Synthesis Report I Headline statements. <https://www.ipcc.ch/report/ar6/syr/resources/spm-headline-statements/>
- 348 The International Association of Insurance Supervisors. (2023). A call to action: the role of insurance supervisors in addressing natural catastrophe protection gaps. Iais.org. <https://www.iais.org/uploads/2023/11/AIS-Report-A-call-to-action-the-role-of-insurance-supervisors-in-addressing-natural-catastrophe-protection-gaps.pdf>
- 349 The International Association of Insurance Supervisors. (2025a). Application Paper on the supervision of climate-related risks in the insurance sector. <https://www.iais.org/uploads/2025/04/Application-Paper-on-the-supervision-of-climate-related-risks-in-the-insurance-sector.pdf>
- 350 Christoph Möhr, Yong J. & Zweimueller M. (2025). FSI Insights on policy implementation (No 65) Mind the climate-related protection gap – reinsurance pricing and underwriting considerations. IAI, Financial Stability Institute, BIS. <https://www.bis.org/fsi/publ/insights65.pdf>
- 351 National Association of Insurance Commissioners. (2024). National Climate Resilience Strategy for Insurance. <https://content.naic.org/sites/default/files/national-climate-resilience-strategy.pdf>
- 352 European Central Bank. (2025). Financial Stability Review I May 2025. <https://www.ecb.europa.eu/press/financial-stability-publications/fsr/html/ecb.fsr202505-0cde5244f6.en.html>
- 353 EIOPA. (2025b). Report on biodiversity risk management by insurers. https://www.eiopa.europa.eu/publications/report-biodiversity-risk-management-insurers_en
- 354 European Central Bank. (2024). The climate insurance protection gap. <https://www.ecb.europa.eu/ecb/climate/climate/html/index.en.html>
- 355 WWF. (2025). 2025 SUSREG Annual Report: An Assessment of Sustainable Financial Regulations and Central Bank Activities. <https://www.wwf.eu/?20380341/SUSREG-2025-WWF>
- 356 WWF. (2024a). 2024 SUSREG Annual Report: An Assessment of Sustainable Financial Regulations and Central Bank Activities. https://wwfint.awsassets.panda.org/downloads/wwf_susreg-exec-summary-2024_1.pdf
- 357 New York Department of Financial Services. (2021). Guidance for New York Domestic Insurers on Managing the Financial Risks from Climate Change. https://www.dfs.ny.gov/system/files/documents/2021/11/dfs-insurance-climate-guidance-2021_1.pdf
- 358 FINMA. (2024). FINMA publishes new 'Nature-related financial risks' circular. Eidgenössische Finanzmarktaufsicht FINMA. <https://www.finma.ch/en/news/2024/12/20241207-mm-rs-2026-01-naturbezogene-finanzrisiken/>
- 359 Bank of England. (2025). CP10/25 – Enhancing banks' and insurers' approaches to managing climate-related risks – Update to SS3/19. <https://www.bankofengland.co.uk/prudential-regulation/publication/2025/april/enhancing-banks-and-insurers-approaches-to-managing-climate-related-risks-consultation-paper>
- 360 Crugnola-Humbert J., Kivisaari E., Leitner M., Zach V. (2024). AAE Discussion Paper I Social Sustainability in Insurance: What, Who and How. <https://actuary.eu/wp-content/uploads/2024/02/Social-Sustainability-in-Insurance.pdf>
- 361 For example, the UK's Prudential Regulation Authority has found limitations in insurer's maturity on climate-related risk management. CP10/25 – Enhancing banks' and insurers' approaches to managing climate-related risks – Update to SS3/19 | Bank of England
- 362 The International Association of Insurance Supervisors. (2025a). Application Paper on the supervision of climate-related risks in the insurance sector. <https://www.iais.org/uploads/2025/04/Application-Paper-on-the-supervision-of-climate-related-risks-in-the-insurance-sector.pdf>
- 363 EIOPA. (2025). Dashboard on insurance protection gap for natural catastrophes. https://www.eiopa.europa.eu/tools-and-data/dashboard-insurance-protection-gap-natural-catastrophes_en
- 364 IMF, FSB, BIS. (2016). Elements of Effective Macroprudential Policies Lessons from International Experience. https://www.fsb.org/uploads/Elements-of-Effective-Macroprudential-Policies_1.pdf
- 365 WWF. (2022). Central Banking and Financial Supervision Roadmap: Transitioning to a Net Zero and Nature Positive Economy. http://wwfint.awsassets.panda.org/downloads/wwf_gfri-roadmap.pdf
- 366 ACPR. (2020). Scenarios and main assumptions of the ACPR pilot climate exercise. Banque de France. <https://acpr.banque-france.fr/en/publications-and-statistics/publications/scenarios-and-main-assumptions-acpr-pilot-climate-exercise>
- 367 Institute and Faculty of Actuaries. (2024). Climate Scorpion – the sting is in the tail. <https://actuaries.org.uk/news-and-media-releases/news-articles/2024/mar/14-mar-24-climate-scorpion-the-sting-is-in-the-tail/>
- 368 WWF. (2025). WWF/UCL Policy Note on Ecosystem Tipping Points for Central Bankers and Financial Regulators. <https://wwf.panda.org/?14288941/Financial-Stability-at-Risk-An-Urgent-Call-to-Central-Banks-and-Regulators-to-Address-Ecosystem-Tipping-Points>
- 369 European Commission, Climate Action. (2024). How to build climate resilience and narrow the climate protection gap: conclusions from the Climate Resilience Dialogue. https://climate.ec.europa.eu/news-your-voice/news/how-build-climate-resilience-and-narrow-climate-protection-gap-conclusions-climate-resilience-2024-09-02_en
- 370 González Peláez, A., Daniell, J., & Douglas, R. (2025). Insurance and risk management tools for agriculture in the EU (Fi-Compass Market Analysis). European Investment Bank. https://www.fi-compass.eu/sites/default/files/publications/EAFRD_AGRRI_Insurance_Risk_MA.pdf
- 371 Office of the Governor of California. (2025). Governor Newsom signs executive order launching next phase of whole-of-government response to the economic and insurance consequences of climate crisis. <https://www.gov.ca.gov/2025/09/30/governor-newsom-signs-executive-order-launching-next-phase-of-whole-of-government-response-to-the-economic-and-insurance-consequences-of-climate-crisis/>
- 372 WWF. (2025). SUSREG Tracker. <https://susreg.panda.org/>
- 373 NGFS. (2024). Nature-Related Financial Risks: a Conceptual Framework to Guide Action by Central Banks and Supervisors. https://www.ngfs.net/system/files/import/ngfs/medias/documents/ngfs_conceptual-framework-on-nature-related-risks.pdf
- 374 European Union, International Monetary Fund and Organisation for Economic Co-operation and Development. (2021). Green Budgeting: Towards Common Principles. Luxembourg: Publications Office of the European Union. https://economy-finance.ec.europa.eu/system/files/2021-11/coop26_en.pdf
- 375 EU. (2022). COUNCIL REGULATION (EC) No 2012/2002 establishing the European Union Solidarity Fund. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02002R2012-20200401&qid=1601971117690>
- 376 European Union Solidarity Fund. (2025). Ministry of Physical Planning, Construction and State Assets Croatia. Remediation of consequences of the March 2020 earthquake. <https://portal-ispu.gov.hr/en/eu-projects/european-union-solidarity-fund>
- 377 Weeden M. (2025). 8.8 million trees planted in California for forest fire restoration since 2018. One Tree Planted. <https://onetreeplanted.org/blogs/stories/california-forest-fire-restoration-2021>
- 378 Further elaborated in: WWF. (2025). WWF Expectations for COP30: Climate Action In Challenging Times: Holding The Line On 1.5°C. <https://wwfint.awsassets.panda.org/img/original/cop30-expectations-sept-v3-final-1.pdf>

- 379 Green & Resilient Economics. (n.d.). Compendium of Practice. Retrieved on 12 December, from <https://greenandresilienteconomics.org/compendium-of-practice>
- 380 Contreras, M. F., Abdelli, M., Carella, C., & et al. (2023). Deforestation and Conversion: An Introductory Guide for Central Bankers, Financial Regulators and Supervisors. WWF. <https://wwfint.awsassets.panda.org/downloads/wwf-deforestation-guide-central-banking.pdf>
- 381 WWF. (2024). Catalysing Change: The Urgent Need For Nature Transition Plans. https://wwf.eu.awsassets.panda.org/downloads/wwf_ntp_2024_v04_compressed.pdf
- 382 Lloyds Bank. (2024). Credible Transition Plans - Reporting vs Reality. <https://www.lloydsbank.com/assets/assets-business-banking/pdfs/credible-transition-plans.pdf>
- 383 CDP (n.d.). Climate transition plans. Cdp.net. Retrieved 11 December 2025, from <https://www.cdp.net/en/climate-transition-plans>
- 384 WWF. (2024). 2024 SUSREG Annual Report: An Assessment of Sustainable Financial Regulations and Central Bank Activities. https://wwfint.awsassets.panda.org/downloads/wwf_susreg-exec-summary-2024_1.pdf
- 385 Agreda, M., & et al. (2025). Spain requires large companies to report their carbon footprints and develop GHG emissions reduction plans. <https://sustainablefutures.linklaters.com/post/10216fz/spain-requires-large-companies-to-report-their-carbon-footprints-and-develop-ghg>
- 386 WWF. (2023). Transition plans: Recommendations for credible and coherent transition planning in the financial sector. https://wwfint.awsassets.panda.org/downloads/tf03_st_01_transition_plans.pdf
- 387 UNEP FI. (2025). A Total Balance Sheet Transition: A holistic transition plan guide linking the underwriting and investment portfolios of insurers and reinsurers. <https://www.unepfi.org/industries/insurance/a-total-balance-sheet-transition-a-holistic-transition-plan-guide-linking-the-underwriting-and-investment-portfolios-of-insurers-and-reinsurers/>
- 388 WWF. (2025). Global experts call on G20 to address impacts of nature loss on the global economy. https://wwf.panda.org/wwf_news/?14.145966/Global-experts-call-on-G20-to-address-impacts-of-nature-loss-on-the-global-economy%20and%20Nature%20Positive%20Pathways
- 389 Department for Environment, Food & Rural Affairs. (2025) Call for evidence outcome. Expanding the role of the private sector in nature recovery. <https://www.gov.uk/government/calls-for-evidence/expanding-the-role-of-the-private-sector-in-nature-recovery>
- 390 Pachon, A. (2025). 6 case studies for a successful agricultural transition. AXA Climate. <https://climate.axa.com/publications/agri-transition-insurance-case-studies/>
- 391 California Wildfire Resilience Task Force. (2023). Prescribed Fire Liability Claims Fund Pilot. <https://wildfiretaskforce.org/prescribed-fire-liability-claims-fund-pilot/>
- 392 Christoph Möhr, Yong J. & Zweimueller M. (2025). FSI Insights on policy implementation (No 65) Mind the climate-related protection gap – reinsurance pricing and underwriting considerations. IAIS, Financial Stability Institute, BIS. <https://www.bis.org/fsi/publ/insights65.pdf>, graph 3
- 393 Insure our Future. (2025). Renewables Gallop As Fossil Fuels Stall - Opportunities and Risks in the Energy Transition. https://global.insure-our-future.com/wp-content/uploads/sites/2/2025/09/IOF_MonteCarloBriefing_090225_Digital.pdf
- 394 WWF Switzerland. (2023). Underwriting Our Planet: How Insurers can help address the crises in climate and biodiversity. https://wwf.panda.org/wwf_news/?9548441/WWF-urges-insurance-companies-to-take-responsibility-for-their-underwriting-business
- 395 IEA (2023). Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach. <https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-c-goal-in-reach>
- 396 Insure our Future. (2023). Fifty Years of Climate Failure 2023 Scorecard on Insurance, Fossil Fuels and the Climate Emergency. <https://global.insure-our-future.com/50-years-of-climate-failure-2023-scorecard-on-insurance-fossil-fuels-and-the-climate-emergency/>
- 397 Veury, X. (2021). Valuing client actions to reduce carbon emissions and promote biodiversity. AXA XL. <https://axa.com/fast-fast-forward/articles/valuing-client-actions-to-reduce-carbon-emissions-and-promote-biodiversity>
- 398 Collins, S. (2024). Swiss captive SBB pilots first-ever sustainability-linked insurance contract. Commercial Risk. <https://www.commercialriskonline.com/swiss-captive-sbb-pilots-first-ever-sustainability-linked-insurance-contract/>
- 399 Charbonnier M., Longpré F. (2025). Making the link: captives and sustainability. AXA XL. <https://axa.com/fast-fast-forward/articles/making-the-link-captives-and-sustainability>
- 400 Flood Re. (2023). Future Build Back Better insurance providers. <https://www.floodre.co.uk/buildbackbetter>
- 401 WWF Switzerland. (2025). Climate Contributions For People & Nature: A Discussion Around Meaningful Corporate Action Beyond Value Chains. https://www.wwf.ch/sites/default/files/doc-2025-06/WWF%20Climate%20%26%20Nature%20Contributions%20Report_FINAL.pdf
- 402 Tubiana, L. (2025). Yesterday, I said to insurance leaders: If you see the risks becoming unmanageable, say so. LinkedIn.com. https://www.linkedin.com/posts/laurecetubiana_yesterday-i-said-to-insurance-leaders-activity-7336743733511516160-WDEO/
- 403 Forum for Insurance Transition. (2025). COP30 Insurance Communiqué: Insuring the Transition. <https://www.unepfi.org/wordpress/wp-content/uploads/2025/11/FIT-COP30-Insurance-Communiqué.pdf>
- 404 Reinsurance Association of America. (2025). RAA Calls for Full NOAA Funding. <https://www.reinsurance.org/RAA/RAA/About-the-RAA/Press-Releases/RAA%20Press%20Release%20061825.aspx>
- 405 UNEP FI. (2025). UN forum launches first-of-its-kind global transition plan guide for insurance underwriting portfolios. Unepfi.org. <https://www.unepfi.org/industries/insurance/un-forum-launches-first-of-its-kind-global-transition-plan-guide-for-insurance-underwriting-portfolios/>
- 406 UNEP FI. (2024). Insuring a resilient nature-positive future: Global guide for insurers on setting priority actions for nature. <https://www.unepfi.org/industries/insurance/insuring-a-resilient-nature-positive-future-global-guide-for-insurers-on-setting-priority-actions-for-nature/>
- 407 UNEP FI. (2025). Rooted in Risk: Framing nature-related assessments for insurers. <https://www.unepfi.org/industries/insurance/rooted-in-risk-framing-nature-related-assessments-for-insurers/>
- 408 Science Based Targets Initiative. (2025). Financial institutions net-zero standard version 1.0. <https://files.sciencebasedtargets.org/production/files/Financial-Institutions-Net-Zero-Standard.pdf>
- 409 Kousky, C., Burley, T. (2025). Nature for Insurance and Insurance for Nature. Environmental Defense Fund. <https://library.edf.org/AssetLink/uky3347ks0532vxm44um360jb0x2uwup.pdf>
- 410 Horn, D. P. (2025). Floodplain Buyouts: Federal Funding for Property Acquisition. Congressional Research Service. <https://www.congress.gov/crs-product/IN11911>
- 411 Mendonca, J. (2023). Zoning for Climate Change: How cities are preparing for future threats. Smart Growth America. <https://www.smartgrowthamerica.org/knowledge-hub/news/zoning-for-climate/>
- 412 City of Amsterdam. (n.d.). Policy: Climate adaptation: Together we're working on a climate-proof Amsterdam. Retrieved 11 December 2025, from <https://www.amsterdam.nl/en/policy/sustainability/policy-climate-adaptation/#h-026da261-5252-4527-b1b4-a4c84805366e>
- 413 Landeshauptstadt Stuttgart. (2003). Stellungnahme zum Antrag: Begrünung von Dächern/Garagendächern. <https://www.domino1.stuttgart.de/web/KSD/ksdarchiv.nsf/0/69BAD662328283FE-EC12571DF003180EF?OpenDocument>
- 414 Presse- und Informationsamt des Landes Berlin. (2023). 6. Änderungsgesetz der Bauordnung für Berlin beschlossen. <https://www.berlin.de/rbmskzl/aktuelles/pressemitteilungen/2023/pressemitteilung.1369717.php>
- 415 Climate-ADAPT. (2016). Four pillars to Hamburg's Green Roof Strategy: financial incentive, dialogue, regulation, and science. <https://climate-adapt.eea.europa.eu/en/metadata/case-studies/four-pillars-to-hamburg2019s-green-roof-strategy-financial-incentive-dialogue-regulation-and-science>
- 416 City of Toronto. (2017). City of Toronto Green Roof Bylaw. <https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw>
- 417 National Parks Board. (2025). Skyrise Greenery Incentive Scheme. Government of Singapore. <https://syrisegreenerly.nparks.gov.sg/incentive-scheme/about/>
- 418 Ministry of National Development. (2023). Written answer on target green plot ratio for BTO projects. <https://www.mnd.gov.sg/newsroom/parliament-matters/q-as/view/written-answer-by-ministry-of-national-development-on-target-green-plot-ratio-for-bto-projects>
- 419 Direction de l'information légale et administrative (Premier ministre). (2025). Obligation de production d'énergies renouvelables ou de végétalisation de toitures. Entreprendre Service Public. <https://entreprendre.service-public.gov.fr/vosdroits/F38107>
- 420 Bureau of Planning and Sustainability. (2019). Central City 2035 – Ecoroof Standard. City of Portland. <https://www.portland.gov/ppd/zoning-land-use/documents/central-city-2035-ecoroof-standard/download>
- 421 ProGov21. (2015). Chicago ordinance 1741015 providing zoning incentives for green roofs. University of Wisconsin. <https://progov21.org/Home/Document/T3P452>
- 422 Ecologic Institute. (2018). Climate Mitigation Through Nature-Based-Solutions in Urban Poland - Fostering Awareness and Capacity (ClimateNBS Polska). Ecologic Institute. <https://www.ecologic.eu/16115>
- 423 Légifrance. (2025). Code de la construction et de l'habitation. https://www.legifrance.gouv.fr/codes/article_lc/LEGIARTI000051506092
- 424 Ooms, V., Endendijk, T., Aerts, et al. (2025). Assessing effects of nature-based and other municipal adaptation measures on insured heavy rain damages. *Natural Hazards and Earth System Sciences*, 25(11), 4283–4298. <https://doi.org/10.5194/nhess-25-4283-2025>
- 425 Delta Commissioner. (2025). National Delta Programme. <https://english.deltaprogramma.nl/> Delta Commissioner. (2025). NATIONAL DELTA PROGRAMME. <https://english.deltaprogramma.nl/>
- 426 For a useful body of work related to green-gray infrastructure, see Conservation International. (2025). Green-Gray Infrastructure. <https://www.conservation.org/projects/green-gray-infrastructure>
- 427 The Sustainable Infrastructure Partnership. (2022). Case Study - Ecosystem-Based Disaster Risk Reduction As "Natural Infrastructure" In Japan. UNEP. https://www.greenpolicyplatform.org/sites/default/files/downloads/best-practices/SI%20Principle%204%20case%20study_Japan.pdf
- 428 Administration of Governor Gavin Newsom. (2024). California's NBS Climate Targets. <https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Expanding-Nature-Based-Solutions/Californias-NBS-Climate-Targets-2024.pdf>
- 429 European Investment Bank. (2024). Adrian nature based solutions fund. <https://www.eib.org/en/projects/all/20240330>.
- 430 European Investment Bank. (2024). Boost for climate adaptation in Europe as EIB and WWF join forces to develop Nature-based Solutions at scale. <https://www.eib.org/en/press/all/2024-402-boost-for-climate-adaptation-in-europe-as-eib-and-wwf-join-forces-to-develop-nature-based-solutions-at-scale>
- 431 US Forest Service. (2009). Collaborative Forest Landscape Restoration Program. <https://www.fs.usda.gov/restoration/CFLRP/>
- 432 FEMA. (2024). Community Rating System Discount (FAQs). <https://agents.floodsmart.gov/sites/default/files/media/document/2025-07/fema-nfip-community-rating-system-discount-faq-09-2024.pdf>
- 433 Fonds Barrière. (n.d.). Les services de l'État en Seine-Maritime. Retrieved 11 December 2025, from <https://www.seine-maritime.gouv.fr/Actions-de-l-Etat/Environnement-et-prevention-des-risques/Risques-technologiques-et-naturels/Fonds-Barrière>
- 434 See the following report for more information about CBCL: Bernhardt, A., Kousky, C., Read, A., et al. (2021). Community-Based Catastrophe Insurance: A model for closing the disaster protection gap. Marsh McLennan <https://www.marshmclennan.com/assets/insights/publications/2021/february/Community-Based-Catastrophe-Insurance--Final.pdf>

- 435 Munich Re & The Nature Conservancy. (2021). Nature's remedy: Improving flood resilience through community insurance and nature-based mitigation. https://www.munichre.com/content/dam/munichre/mram/content-pieces/pdfs/reinsurance-solutions/TNC_Whitepaper.pdf/jcr_content/renditions/original/TNC_Whitepaper.pdf
- 436 Global Facility for Disaster Reduction, EU, UNDG & Recovery & World Bank. (2017). PNDA guidelines Volume B – Environment. World Bank Group. <https://documents1.worldbank.org/curated/en/773111493642626075/pdf/114670-WP-PUBLIC-pnda-guidelines-vol-b-environment.pdf>
- 437 Coastal Protection and Restoration Authority. (2023). Maurepas Swamp final full fact sheet. <https://coastal.la.gov/wp-content/uploads/2023/04/Maurepas-Swamp-Final-Full-Fact-Sheet.pdf>
- 438 Ministry of Physical Planning, Construction and State Assets. (2025). European Union Solidarity Fund. <https://portal-ispu.gov.hr/en/eu-projects/european-union-solidarity-fund>
- 439 For a longer discussion of the topic, see: Kousky, C., Burley, T. (2025). Nature for Insurance and Insurance for Nature. Environmental Defense Fund. <https://library.edf.org/AssetLink/uky3347ks0532vxn44um360jb0x2uwup.pdf>
- 440 Moody's. (2025). Why rigorous details in models matter: Modeling the impact of mangroves on hurricane risk. <https://www.moody.com/web/en/us/insights/insurance/rigorous-details-in-models-matter-modeling-impact-of-mangroves-hurricane-risk.html?linkId=17779391&CID=soc-mplyadvccy-18678>
- 441 Colorado General Assembly. (2025). Bill: Risk Model Use in Property Insurance Policies. <https://leg.colorado.gov/bills/hb25-1182>
- 442 California Department of Insurance. (2024). Commissioner Lara enforces groundbreaking regulation to expand insurance coverage in wildfire-prone areas. <https://www.insurance.ca.gov/0400-news/0102-alerts/2024/Commissioner-Lara-enforces-ground-breaking.cfm>
- 443 Hülsen, S., Dee, L.E., Kropf, C.M. et al. (2025). Mangroves and their services are at risk from tropical cyclones and sea level rise under climate change. *Commun Earth Environ*. <https://doi.org/10.1038/s43247-025-02242-z>
- 444 Wildlife Corridors and Habitat Connectivity Conservation Act of 2024, H.R. 9776, 118th Cong. (2024). <https://www.congress.gov/bills/118th-congress/house-bill/9776/text/ih>
- 445 Kousky, C., Burley, T. (2025). Nature for Insurance and Insurance for Nature. Environmental Defense Fund. <https://library.edf.org/AssetLink/uky3347ks0532vxn44um360jb0x2uwup.pdf>
- 446 Environment Act 2021 (U.K.). (2025). Schedule 14: Biodiversity gain as condition of planning permission. <https://www.legislation.gov.uk/ukpga/2021/30/schedule/14>
- 447 BeZero Carbon, Howden, & Blackford. (2021). Insuring nature-based solutions in the UK. https://www.howdengroupholdings.com/sites/default/files/2021-12/InsuranceReport_BeZeroHowden-Blackford_09122021.pdf
- 448 Marsh McLennan. (2024). UK biodiversity net gain legislation presents risks and opportunities. <https://www.marsh.com/en/risks/climate-change-sustainability/insights/biodiversity-legislation-risks-opportunities.html>
- 449 Kita. (n.d.). Carbon insurance products. Retrieved 11 December 2025, from <https://www.kita.earth/whycarboninsurance>
- 450 CarbonPool. (n.d.). Innovative carbon credit insurance which pays claims in carbon credits, not cash. Retrieved 11 December 2025, from <https://www.carbonpool.earth/>
- 451 Howden & Pollination. (2024). Through the Wilderness October 2024 The Role of Insurance in Unlocking Nature Finance. https://www.howdengroup.com/sites/mexico.howdenprod.com/files/2024-10/Howden_%26_Pollination_Through_the_Wilderness_report.pdf
- 452 Swiss Re. (n.d.). Traditional indemnity-based insurance solutions. Retrieved 5 January 2026, from <https://www.swissre.com/our-business/public-sector-solutions/traditional-indemnity-based-insurance-solutions.html>
- 453 SCOR. (n.d.). Nature Restoration & Conservation Insurance Initiative. Retrieved 11 December 2025, from <https://www.scor.com/en/nature-restoration-conservation-insurance-initiative>
- 454 SCOR. (2024). Launch of a new insurance product. <https://www.scor.com/en/news/scor-launches-new-insurance-product-support-ecological-restoration-restore-product>
- 455 Swiss Re. (2025). Using innovative insurance to help protect the economic value of natural ecosystems I China: Wetlands typhoon and drought cover. <https://www.swissre.com/our-business/public-sector-solutions/case-studies/china-typhoon-and-drought-cover.html>
- 456 Pachon, A. (2023). AXA Climate, AXA Seguros Mexico and ClimateSeed are jointly creating the 1st insurance policy for the protection of mangrove forests in Mexico. AXA Climate. <https://climate.axa/publications/1st-insurance-policy-for-the-protection-of-mangrove-forests-in-mexico/>
- 457 The Nature Conservancy. (2025). Hawaii's Coral Reef Insurance Policy Renewed for 2025, Fostering Hawaii Emergency Reef Restoration Network. <https://www.nature.org/en-us/newsroom/hi-reef-insurance>
- 458 Cebotari, A., & Youssef, K. (2020). IMF Working Paper Natural Disaster Insurance for Sovereigns: Issues, Challenges and Optimality. International Monetary Fund. <https://www.imf.org/-/media/files/publications/wp/2020/english/wpiea2020003-print-pdf.pdf>
- 459 Marsh McLennan & The Nature Conservancy. (n.d.). Quantifying insurance benefits of a nature-based approach to reducing risk: wildfire risk reduction buffers. Retrieved 11 December 2025, from <https://www.guycarp.com/content/dam/guycarp-rebrand/pdf/Insights/2021/Quantifying-Insurance-Benefits-Wildfire-Risk-Reduction-Buffers.pdf>
- 460 Ocean Risk and Resilience Action Alliance. (n.d.). Coastal Risk Index. Retrieved 5 January 2026, from <https://coastalriskindex.com/>
- 461 Swiss Re Institute. (2025). Natural habitats can reduce flood losses. Swiss Re. <https://www.swissre.com/dam/jcr:7b127375-7954-4255-8d0e-0b5e21ec5b2f/sri-natural-habitats-reduce-flood-losses.pdf>
- 462 UC Berkeley School of Law, Center for Law, Energy & the Environment. (2025). First ever wildfire resilience insurance policy written and placed. UC Berkeley Law. <https://www.law.berkeley.edu/research/ceel/research/climate/climate-risk-initiative/wildfire-resilience-insurance-policy/>
- 463 WWF. (2025). Balancing Bankability and Integrity: Fostering Investment-Ready Nature-based Solutions. <https://www.wwf.org.uk/our-reports/balancing-bankability-and-integrity-fostering-investment-ready-nature-based-solutions>
- 464 United Nations Environment Programme Copenhagen Climate Centre. (2024). Business Models for Financing Nature-based Solutions in Urban Climate Action: A Knowledge Resource for Cities in Developing Countries. <https://unepccc.org/wp-content/uploads/2025/02/24442-unepccc-business-models-v09-au-pages-hq.pdf>
- 465 South Pole & WWF. (2022). Common success factors for bankable nature-based solutions. <https://www.wwf.org.uk/sites/default/files/2022-08/Common-success-factors-for-bankable-NbS-report.pdf>
- 466 WWF Switzerland. (2025). Climate Contributions For People & Nature A Discussion Around Meaningful Corporate Action Beyond Value Chains. https://www.wwf.ch/sites/default/files/doc-2025-06/WWF%20Climate%20%26%20Nature%20Contributions%20Report_FINAL.pdf
- 467 WWF-UK. (2024). Aviva Partnership (2021-25). <https://www.wwf.org.uk/who-we-are/who-we-work-with/aviva>
- 468 California Department of Insurance Climate Insurance Working Group. (2021). Protecting Communities, Preserving Nature and Building Resiliency How First-of-its-Kind Climate Insurance Will Help Combat the Costs of Wildfires, Extreme Heat, and Floods. <https://www.insurance.ca.gov/ccidocs/climate-insurance-report-07-22-2021.pdf>
- 469 For a general framework that could be extended to insurance, see Council on Economic Policies. (2024). Principles for Addressing Climate Systemic Risks with Capital Buffers <https://www.cepweb.org/wp-content/uploads/2024/10/iked-a-Monnin-2024.-Principles-for-addressing-climate-systemic-risks-with.pdf>
- 470 The International Association of Insurance Supervisors. (2025a). Application Paper on the supervision of climate-related risks in the insurance sector. <https://www.iais.org/uploads/2025/04/Application-Paper-on-the-supervision-of-climate-related-risks-in-the-insurance-sector.pdf>
- 471 Taskforce on Nature-related Financial Disclosures. (2025). Guidance on nature in transition plans. https://tnfd.global/wp-content/uploads/2025/11/Guidance-on-nature-in-transition-plans_DIGITAL-1.pdf?v=1762260405
- 472 Crugnola-Humbert J., Kivisaari E., Leitner M., Zach V. (2024). AAE Discussion Paper I Social Sustainability in Insurance: What, Who and How. <https://actu.ary.eu/wp-content/uploads/2024/02/Social-Sustainability-in-Insurance.pdf>
- 473 EIOPA. (2024b). Towards a European system for natural catastrophe risk management. https://www.eiopa.europa.eu/document/download/d8c87070-f602-4bf7-b8d8-726ec0b5c173_en?filename=eiopa-ecb-climate-insurance-protection-gap.pdf
- 474 Vandeloise, V., Fox, P., & Ferrari, S.-C. (2025). Breaking the spiral of uninsurable climate losses How effective investment can shield taxpayers from mounting natural catastrophe costs. *Finance-watch.org*. https://www.finance-watch.org/wp-content/uploads/2025/10/report-Breaking_the_spiral_of_uninsurable_climate_losses.pdf
- 475 Real Estate Japan. (2022). Homeowners Insurance in Japan: Fire and Flood Insurance Explained. <https://resources.realestate.co.jp/buy/homeowners-insurance-in-japan-fire-and-flood-insurance-explained/>
- 476 French-property.com (n.d.). Building Guarantees in France. Retrieved 10 December 2025, from <https://www.french-property.com/guides/france/building/new-build/defect-guarantee/builders>
- 477 WWF. (2024). Sustainable Financial Regulations and Central Bank Activities (SUSREG) Tracker. <https://susreg.panda.org/>
- 478 International Bank for Reconstruction and Development, The World Bank and the International Association of Insurance Supervisors. (2025). G20 Sustainable Finance Working Group input paper: Identify and address insurance protection gaps. <https://www.iais.org/uploads/2025/07/G20-SFWG-input-paper-Identify-and-address-insurance-protection-gaps.pdf>
- 479 ECB & EIOPA. (2023). Policy options to reduce the climate insurance protection gap. Discussion Paper. https://www.ecb.europa.eu/pub/pdf/other/ecb.policy-options_EIOPA-c0adae58b7.en.pdf
- 480 National Association of Insurance Commissioners. (2024). National Climate Resilience Strategy for Insurance. <https://content.naic.org/sites/default/files/national-climate-resilience-strategy.pdf>
- 481 Crugnola-Humbert, J. (2025). From Risk to Resilience. Closing the Climate Insurance Protection Gap. Council on Economic Policies. <https://www.cepweb.org/from-risk-to-resilience-closing-the-climate-insurance-protection-gap/>



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Together, we protect the environment and create a future worth living for generations to come.

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