Climate Change & Insurance

The Interaction of Physical and Transition Risks

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POLICY PAPER

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Table of Contents

Executive Summary

This paper is the third in GAIP's three-part series on the impact of climate change on the insurance sector. The first paper, Climate Change & Insurance: Physical Risks on the Insurance Industry, examined physical risks and their effects on loss patterns and insurability. The second paper, Climate Change & Insurance: Transition Risks on the Insurance Industry, examined transition risks arising from policy changes, technological developments, and market adjustments. Building on both, this paper examines how physical and transition risks interact and the strategic priorities that can help the insurance sector navigate their combined effects.

Climate change is reshaping insurance through two forces that cannot be managed separately: physical risks and transition risks. Physical risks reflect the direct consequences of a warming climate, from extreme heat and flooding to intensified wind events and sea-level rise. Transition risks arise from society's response, including policy tightening, technological change, market repricing, and changing behaviour.
Physical and transition risks are often analysed separately because they operate through different channels. However, the two are closely connected. Both ultimately stem from the accumulation of greenhouse gases and should therefore be understood as interconnected dimensions of a single climate risk system rather than independent categories. For the insurance sector, this means that physical and transition risks cannot be considered in isolation. Insurers are exposed to both simultaneously, through underwriting losses on the liability side and asset repricing on the investment side of their balance sheet. Climate-related losses can escalate in the real economy at the same time that transition policies, technologies, and market expectations reprice assets and reshape liability landscapes. Together, they are increasingly influencing how fast the boundaries of insurability evolve, and how uncertain the path becomes for insurers, customers and public balance sheets.

Their relationship is not linear and often creates strategic trade-offs across time. Delayed mitigation could worsen physical damage and raise future protection gaps, but it also compresses the transition timeline and increases the likelihood of abrupt and disorderly adjustment. Conversely, faster transition reduces long-term physical risks, yet can create near-term volatility if policies, infrastructure, and markets adjust unevenly.

Under some conditions, these dynamics can reinforce one another. Rising physical losses increase pressure on insurers, reinsurers, and public finances. Governments and markets may respond through accelerated climate policies or emergency fiscal measures following major disasters. If these adjustments occur rapidly, they can trigger market volatility that weakens insurance capacity and reduces the availability of coverage. Reduced protection in turn increases vulnerability to future climate shocks, reinforcing the cycle.

Sustaining insurability requires coordinated action across three strategic priorities. First, further integration of risk intelligence to ensure decisions reflect evolving climate risks. Second, increasing adaptive protection design to deliver timely support, incentivise risk reduction, and address emerging transition risks. Third, aligning investment and channelling private and public finance towards resilience, enabling insurance markets to remain viable as risks intensify.

Progress across these efforts requires further coordinated action between private and public actors. The private sector is advancing climate modelling, scenario analysis, and adaptive protection approaches, while the public sector is incorporating climate risk into supervisory frameworks, strengthening disclosure, and expanding data systems. Further development of public-private risk pools and blended finance structures can support adaptation investment and provide timely post-disaster liquidity, while remaining aligned with market principles.

The insurance sector, therefore, becomes not only a mechanism for transferring climate risk but can also support a coordinating system that influences how risk is priced, reduced, and financed across the broader economy.

Introduction

Climate change is transforming the risk landscape in ways that challenge the foundations of traditional insurance practice. Hazards are shifting geographically, extreme events are becoming more frequent or severe in many regions, and economic exposures continue to grow in climate sensitive areas. At the same time, the global response to climate change is accelerating through policy action, technological change, and market adjustments. Together these developments are reshaping how risks emerge, accumulate, and propagate across economies and financial systems.

This paper completes a three-part assessment of climate change and the insurance sector. The first paper in this series, Climate Change & Insurance: Physical Risks on the Insurance Industry[1], examined how physical climate hazards are altering loss patterns and insurability conditions. The second paper, Climate Change & Insurance: Transition Risks on the Insurance Industry[2], analysed transition risks arising from technological change, policy developments, and market adjustments associated with decarbonisation. Building on the analyses in those two studies, this paper integrates the two dimensions together and examines how their interaction affects the functioning and resilience of insurance markets.

Physical risks refer to damages and losses arising from climate related phenomena, including both long term environmental trends and acute events that alter the frequency, severity, and correlation of losses across regions and lines of business. These changes affect the predictability of hazards, the distribution of insured exposures, and the stability of loss patterns that historically underpinned actuarial modelling.

Transition risks arise from the economic and policy adjustments required to move toward a lower carbon economy. They include shifts in regulation, technological transformation, evolving market expectations, and expanding climate related information that can reprice assets, disrupt business models, and reshape liability exposures.

Although often analysed separately, physical and transition risks are closely interconnected. Both originate from the accumulation of greenhouse gases in the atmosphere and operate within a single system. Physical risks represent the

[1] Yao, L. & Yeo, Z. X. (2025). Climate Change & Insurance: Physical Risks on the Insurance Industry. Global Asia Insurance Partnership (GAIP). Singapore.

[2] Yao, L. & Yeo, Z. X. (2025). Climate Change & Insurance: Transition Risks on the Insurance Industry. Global Asia Insurance Partnership (GAIP). Singapore.

consequences of a changing climate, while transition risks reflect society's responses. Their interaction introduces strategic trade-offs and non-linear dynamics that can amplify volatility across both the real economy and financial markets.

For the insurance sector, understanding this interaction is essential. Insurers, reinsurers, and brokers operate at the intersection of risk assessment, capital allocation, and public policy. Climate hazards influence underwriting performance and claims volatility, while transition dynamics affect investment portfolios, liability exposures, and the long-term operating environment of insurance markets. The interaction between these forces therefore shapes not only the magnitude of future losses but also the stability of the path insurers navigate to continue underwriting, pricing, and allocating capital with confidence.

This paper adopts a system level analysis to examine how physical and transition risks interact within the broader climate risk system. It then explores implications for key actors across the insurance ecosystem, including life and health insurers, property and casualty insurers, reinsurers, brokers, and public authorities. The final section outlines strategic priorities that can strengthen risk intelligence, support the development of adaptive protection mechanisms, and align financial capital with long term climate resilience.

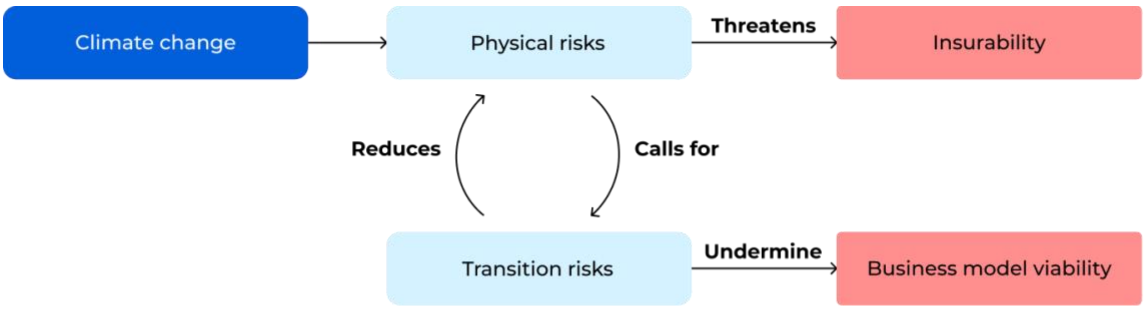
The Interplay between Physical and Transition Risks

The first two papers in this series examined physical and transition risks separately in order to present each dimension comprehensively. In practice, however, they are not isolated categories; they are two currents within a single, integrated system. Physical risks represent the natural symptoms of a warming climate, while transition risks are society's socio-economic responses. Understanding the relationship between these two forces is essential for coming up with a sustainable strategy plan, as they share a common origin, maintain an inverse yet volatile trade-off, and operate through highly unpredictable, non-linear dynamics.

Common Origin: Symptoms and Responses in One System

Both physical and transition risks originate from the same root cause: the historical and ongoing accumulation of greenhouse gases in the atmosphere. The Intergovernmental Panel on Climate Change (IPCC) has established that anthropogenic emissions, particularly carbon dioxide and methane, have increased atmospheric concentrations to levels unprecedented in at least the past 800,000 years[3]. This shared origin means that physical and transition risks cannot be understood or managed in isolation when assessing the long-term insurance market conditions; they are fundamentally linked facets of the same underlying challenge.

Figure 1: Interconnections between physical and transition risks



As the above chart illustrates, physical risks threaten insurability while transition risks can undermine key aspects of business model viability, balance sheet resilience and long-term profitability. These two forces are also interconnected: escalating physical risks call for greater transition efforts, while transition efforts work to reduce future physical risks.

[3] IPCC. (2023). Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (H. Lee & J. Romero, Eds.). IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647

Physical Risks as Direct Climate Impact

Physical risks are the direct manifestations of climate change, and the tangible consequences were examined in the Physical Risks report. They include heat, precipitation changes, wind events, cryosphere change, and coastal and oceanic changes. These manifestations are already affecting human well-being, disrupting economies, and placing pressure on insurability.

The severity of these manifestations continues to escalate. In 2024, global insured losses from natural catastrophes reached US$140 billion, the third highest in three decades[4]. Across Southeast Asia, extreme flooding in 2025 claimed more than 1,600 lives across Sri Lanka, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. Indonesia alone saw 1.5 million people affected and 570,000 displaced. Thailand's floods displaced roughly 2 million people, while Vietnam recorded at least 90 deaths in November, worsened by successive typhoons[5]. These events underscore that escalating physical risks are present realities.

Transition Risks as Responses

Transition risks are the disruptions and structural shifts that arise from society's efforts to address the root cause of physical risks. As explored in the Transition Risks paper, these risks emerge from five main drivers identified by the International Association of Insurance Supervisors (IAIS): changes to infrastructure and technology use, new government policies, changing consumer preferences, shifting investor perceptions, and information gaps on climate-sensitive exposures[6].

Where physical risks are imposed by nature, transition risks are consequences of deliberate human choices: how quickly and through what means societies choose to decarbonise. These forces create an environment of structural adjustment that, if poorly sequenced, can generate significant shocks to business.

Although not itself a climate transition event, Europe's energy shock following Russia's invasion of Ukraine illustrates how quickly fuel and electricity prices can surge when energy systems are exposed to sudden constraints. Similar shocks could arise under

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[4] Munich Re. (2025). Climate change is showing its claws: The world is getting hotter, resulting in severe hurricanes, thunderstorms and floods. Munich Re. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-2024.html

[5] Encyclopaedia Britannica, Asia Floods of 2025 (published 8 December 2025).https://www.britannica.com/event/Asia-Floods-of-2025

[6] International Association of Insurance Supervisors (IAIS). (2025). 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

abrupt climate policy tightening, such as rapid fossil fuel subsidy removal or sudden restrictions on fossil fuel use. In such scenarios, the disruption may be larger and more persistent, as it is driven not by a temporary supply shock but by compressed decarbonisation pathways and structural adjustment.

Unified Exposure

For the insurance sector, the challenge is not simply that physical and transition risks both matter. It is that they can become correlated under stress, affecting underwriting performance, investment portfolios, pricing flexibility, and market confidence at the same time. Delay in addressing one inevitably magnifies exposure in the other. Postponing decarbonisation locks in more severe physical impacts and higher claims. Ignoring transition dynamics leaves portfolios and business models vulnerable to sudden repricing. As GAIP noted in Too Hot to Insure, "inaction is therefore not a choice"[7].

The Strategic Trade-offs

The relationship between physical and transition risks involves important strategic trade-offs. As shown in Chart 1, transition efforts work to reduce future physical risks, but they come with their own costs and disruptions. At the same time, allowing physical risks to escalate unchecked calls for more urgent and potentially disorderly transition responses. This trade-off presents a core strategic tension. Bearing greater transition risks today can slow the accumulation of physical damage tomorrow. But avoiding transition costs today allows physical risks to compound, ultimately forcing a more abrupt and costly adjustment later. For insurers, the choice is not between physical or transition risk. It is about how the balance between them is managed over time.

The Opportunity Side of Transition

The trade-off between physical and transition risks operates in both directions. By bearing greater transition risks today, economies can slow down the accumulation of physical risk, preserving the conditions under which insurance markets can function. As physical risks escalate toward what GAIP describes as an "insurability tipping point", proactive transition efforts can slow this trajectory. The same dynamic also generates a more immediate opportunity: as the energy system shifts, it produces new categories of insurable risk that insurers can move into.

[7] GAIP (2023). Too hot to insure? The rising challenge of climate change and risk pricing. Global Association of Insurance Professionals. https://www.gaip.global/publications/too-hot-to-insure/

Japan's post-Fukushima energy transition illustrates both dimensions. Following the 2011 nuclear disaster, Japan launched the Feed-in Tariff Act in 2012 to accelerate renewable energy deployment. The policy imposed higher electricity costs on businesses and households through surcharges, but it drove renewable capacity from 20 gigawatts in 2012 to over 81 gigawatts by 2021, with renewables' share in the power mix more than doubling from 10.4% in 2011 to 21.7% by 2022 [8] [9]. For insurers, this created new coverage lines in solar and wind operations, including specialised products that did not previously exist at scale, while also surfacing new questions around grid infrastructure liability, policy reversal risk, and technology performance. The transition did not simply add volume to existing insurance lines; it changed which risks existed. Crucially, this interaction runs in both directions, which is what distinguishes it from a purely transition-driven opportunity. The renewable assets the transition creates are themselves increasingly exposed to intensifying physical hazards. Solar installations, for example, face rising hail and severe convective storm risk in locations where such perils were historically benign, with more than a million photovoltaic modules damaged by hail between 2019 and 2025. The opportunity is therefore not simply that transition generates new insurable lines; those new lines carry physical risks that a warming climate is simultaneously amplifying, so insurers pricing them must underwrite the physical and transition dimensions together rather than treating the new market as a transition play alone.

The implication for insurers can be practical. Those who assess the physical-transition risk relationship could be better placed to anticipate where coverage gaps are opening and where new demand is forming. Managing transition risk should not only be a defensive exercise as the reshaping of the risk landscape it produces could also be a signal about where the next generation of insurance products might be needed.

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[8] Renewable Energy Institute. (2017). Feed-in tariffs in Japan: Five years of achievements and future challenges. https://www.renewable-ei.org/en/activities/reports/img/pdf/20170810/REI_Report_20170908_FIT5years_Web_EN.pdf

[9] Oxford Institute for Energy Studies. (2025). Japan's energy transition: The interplay of renewables, nuclear and fossil fuels. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2025/02/Insight-163-Japans-Energy-Transition.pdf

Temporal Divergence

A critical distinction between physical and transitional risks lies in their temporal characteristics. Physical risks often involve irreversible destruction: homes lost to flooding, agricultural land rendered unviable, lives cut short. Transition risks, by contrast, represent structural adjustments that can be planned, phased, and cushioned through policy intervention.

Vietnam's Mekong Delta demonstrates the irreversibility of physical risks. The delta, which produces over 50% of Vietnam's rice and 90% of its rice exports, is experiencing accelerating salinisation from sea-level rise, upstream dam construction, and land subsidence. Projections indicate that a 1-metre rise in sea level could inundate over 12,000 km^2 of delta land, while 30% of the region already experiences salinity stress when river water salinity exceeds 5 g/L[10].Between 2019 and 2020, saline drought damaged approximately 39,000 hectares of agricultural land (Rosa Luxemburg Stiftung, 2021). For insurers, this creates a shrinking pool of insurable agricultural assets and raises questions about the long-term viability of crop coverage in the region. The contrast is stark: transition costs, such as investment in salt-tolerant crops or sustainable farming practices, remain monetary and manageable. The loss of fertile land is permanent.

This temporal divergence underscores the strategic imperative for early action. The costs of a managed transition could be recoverable investments in a stable future. The costs of unchecked physical risk could lead to permanent destruction of value and well-being. The two dimensions are not merely different in character; their difference is precisely what links them. Because physical losses are irreversible while transition costs are recoverable, the timing of the transition directly determines how much permanent physical damage is locked in. The irreversibility of the physical side is therefore what gives the transition trade-off its urgency, rather than the two sitting as separate categories.

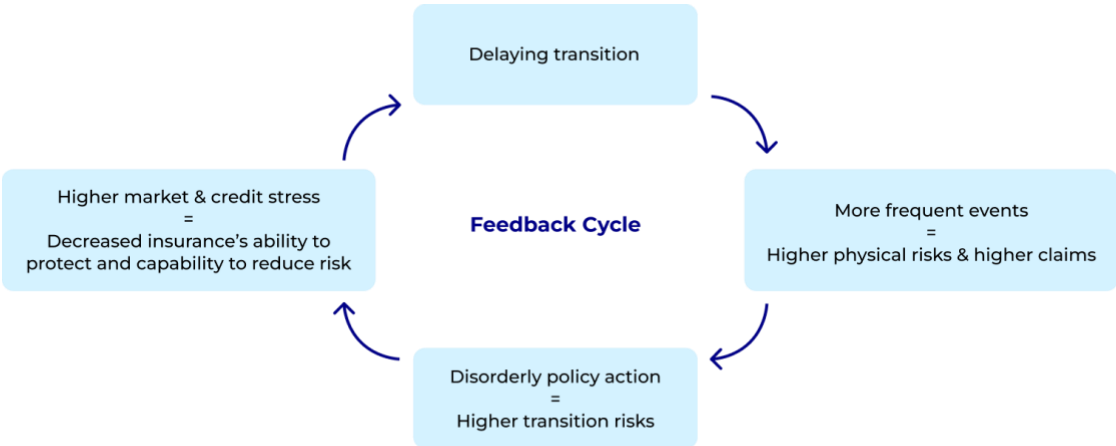
[10] Liu, S., et al. (2025). Quantifying salinity and drought drive forces on paddy field loss in the Mekong Delta, Vietnam. Communications Earth & Environment. https://www.nature.com/articles/s43247-025-02490-z

The Feedback Cycle and Non-linear Dynamics

The interaction between physical and transition risks is rarely a straightforward trade-off. Instead, it is governed by non-linear dynamics, where small delays can lead to massive, unpredictable jumps in total risk. Traditional risk frameworks tend to assume a predictable sequence: a hazard occurs, losses are assessed, recovery follows, and mitigation is implemented. Climate risk might not behave this way. It can unfold through feedback loops and tipping points, where one impact triggers another and where delayed responses can amplify disruption rather than contain it.

One way to illustrate this complexity is through a feedback cycle demonstrated below, in which delayed adjustment, rising physical losses, catch-up policy responses, and financial stress can reinforce one another.

Figure 2: The Feedback Cycle



This cycle is driven by four key reinforcing dynamics:

Delaying Transition

Postponing decarbonisation efforts allows for continued greenhouse gas accumulation. Each year of delay adds to the cumulative stock of emissions, deepening the warming already locked into the climate system.

More Frequent Events can drive Higher Physical Risks & Higher Claims

This delay results in more frequent and severe climate events, which could translate directly into higher insurance claims. In 2025, global insured losses from natural catastrophes reached US$107 billion, marking the sixth consecutive year that losses exceeded US$100 billion. The January wildfires in Los Angeles alone generated US$40 billion in insured losses, the costliest wildfire event in history, while severe convective storms contributed US$50 billion globally[11].

Disorderly Policy Action could lead to Higher Transition Risks

As physical damage becomes undeniable, governments often trigger “catch-up” policies that can cause sudden spikes in transition risk. Regulatory responses compressed in timeline could create financial volatility that cascades through the economy.

Higher Market & Credit Stress could result in decreased Insurance's Ability to Protect and Capability to Reduce Risk

Rapid policy shifts could lead to higher market and credit stress, reducing the capital and reserves that insurers need to protect communities and invest in resilience. Insurers might be forced to raise premiums, reduce coverage, or withdraw from markets entirely, precisely when protection is most needed.

Together, these forces form a loop where physical impacts push for a faster, potentially “disorderly” transition. If unmanaged, the resulting financial volatility could reduce the very capital needed to build physical resilience. This is what makes the cycle an interaction rather than simply a more severe case of delayed transition. The return arm closes the loop: weakened insurance capacity and depleted reserves reduce the system’s ability to fund adaptation and absorb the next shock, leaving communities and assets more physically exposed, which drives higher losses and renewed pressure for abrupt policy action. Physical and transition risks therefore do not act in sequence but amplify one another, so that each turn of the cycle raises both the physical damage carried and the transition volatility required to respond to it.

[11] Swiss Re. (2025, December 16). 2025 marks sixth year insured natural catastrophe losses exceed USD 100 billion, finds Swiss Re Institute [Press release]. https://www.swissre.com/press-release/2025-marks-sixth-year-insured-natural-catastrophe-losses-exceed-USD-100-billion-finds-Swiss-Re-Institute/f710c271-58c8-4c48-9004-05203634d1e0

Case Study: California's Insurance Crisis

California's ongoing insurance crisis illustrates how the feedback cycle operates in practice. Years of delayed climate action allowed greenhouse gas emissions to continue accumulating, contributing to hotter, drier conditions and longer fire seasons. This translated into escalating physical risks.

These mounting losses triggered insurer withdrawal. State Farm, California's largest home insurer, stopped writing new policies in 2023 and subsequently non-renewed over 30,000 policies, including more than 1,600 in Pacific Palisades shortly before the fires struck[12]. Allstate, Farmers, and other major insurers followed similar paths, citing climate-driven catastrophe exposure, rising construction costs, and reinsurance challenges [13].

The result has been accelerated policy correction. California approved emergency rate increases of 17% for State Farm in 2025 and introduced new regulations requiring insurers to offer coverage in wildfire-prone areas, but only if they can use forward-looking climate models to price risk[14]. These abrupt regulatory shifts represent the "catch-up" policies characteristic of the feedback cycle.

The consequences now ripple through the broader economy. Homeowners pushed onto the state's insurer of last resort, the FAIR Plan, saw its exposure quadruple in Pacific Palisades between 2020 and 2024. A U.S. Senate Budget Committee report warned that insurance market collapse could trigger plunging property values, unavailable mortgages, and a cascading financial crisis similar to 2008[15]. The capital that insurers need to protect communities and invest in resilience is being depleted by the very losses that delayed transition helped create.

Implications for the Insurance Industry

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[12] NBC News. (2025, January 12). Los Angeles wildfires magnify California 'insurance crisis' as homeowners face $10B in losses. https://www.nbcnews.com/news/us-news/los-angeles-wildfires-rage-as-homeowners-battle-insurance-crisis-rcna186783

[13] Insurance.com. (2025, May 14). State Farm in California: What you need to know. https://www.insurance.com/home-insurance/state-farm-stops-selling-home-insurance-in-california

[14] Merlin Law Group. (2025, October 13). California fire insurance crisis: Why insurers are cancelling policies and how homeowners can respond. https://www.merlinlawgroup.com/insurance-companies-cancel-fire-insurance/

[15] CBS News. (2025, January 20). Thousands of Los Angeles homeowners were dropped by their insurers before the Palisades Fire. https://www.cbsnews.com/news/fires-california-palisades-fire-homeowners-insurance-state-farm-fair-losses/

For insurers, this uncertainty could make it extremely difficult to determine a clear cost–benefit ratio for investing in physical resilience versus transition mitigation. The impacts unfold over different timeframes, through interdependent systems that react to policy, technology and behavioural change. As a result, insurers should not focus solely on one side of the equation. Concentrating too heavily on rapid transition efforts can trigger short-term market instability if the pace of change outstrips the system's capacity to adapt, while prioritising physical-risk reduction without advancing decarbonisation could lock in higher long-term losses.

The Impacts on Insurance Sector Players

Physical and transition risks do not operate independently. As outlined in the previous section, they interact through feedback loops that can amplify stress across balance sheets. Severe loss events may accelerate regulatory responses and policy reform, which in turn may influence investment allocation, asset valuations, and underwriting capacity. These shifts can affect the sector's ability to absorb subsequent shocks, creating reinforcing cycles that shape both revenue and cost dynamics.

This section examines how these interactions manifest across the insurance ecosystem, focusing on the combined effects that neither dimension captures in isolation. Detailed impact tables for each insurance sector participant are provided in the Appendix. The tables present physical and transition risk impacts in a structured format to enable joint interpretation of exposure, performance pressures, and strategic constraints.

The heatmap below offers a high-level summary of how the combined effects of physical and transition risks vary across the insurance sector players examined in this section. For life and health insurers, property and casualty insurers, brokers, and reinsurers, it indicates the relative intensity of impact across four dimensions: revenue and demand pressure, cost pressure, capital pressure, and market and business model disruption. The ratings, from Low to Very High, are intended to be read across both the four dimensions and the four subsectors. The detailed drivers behind these ratings, and the interactions between physical and transition risks, are discussed in the sector-specific analysis that follows.

Figure 3: Insurance sector impact heat map

Insurance Subsector	Revenue & Demand Pressure	Cost Pressure	Capital Pressure	Market & Business Model Disruption
Life & Health Insurers	Medium	Medium	Medium	Medium
Property & Casualty Insurers	High	Very High	High	Very High
Insurance Brokers	Medium	Medium	Low	Medium
Reinsurers	High	High	Very High	High

Low Medium High Very High

Life & Health Insurance

Revenue and Demand Pressures

For life and health insurers, the combined effect of physical and transition risks plays out across both the liability and demand sides of the business. More frequent extreme weather events, chronic heat stress, and shifting disease patterns directly affect mortality and morbidity outcomes, raising claims across both life and health lines. At the same time, growing awareness of climate-linked health risks can increase demand for coverage, but physical risk-driven cost-of-living pressures erode the disposable income available for premiums, particularly among lower-income policyholders.
On the transition side, the shift away from carbon-intensive industries may reduce group insurance demand from companies facing stranded assets or declining profitability. Energy price volatility and broader cost-of-living pressures from an uneven transition could further constrain individual affordability. Insurers that position themselves as sustainability leaders may, however, gain traction with climate-conscious consumers, opening opportunities in green and wellness-linked products.

Cost and Capital Pressures

Underwriting processes should increasingly incorporate climate data and environmental indicators to accurately reflect mortality and morbidity assumptions. Reinsurance and claims costs rise as physical risks drive up both frequency and severity. Compliance costs expand as climate-related disclosure requirements grow across jurisdictions. On the investment side, life insurers with long-duration liability profiles could also be exposed to transition-driven asset repricing in carbon-intensive sectors, as well as physical risk-linked deterioration in real estate and infrastructure holdings.

The result is a potential profitability squeeze from both directions as higher claims from physical events coincide with affordability constraints that limit the ability to price risk adequately. In more severe scenarios, capital pressure from rising claims and transition-stressed investment portfolios may compound with higher reinsurance costs and declining group insurance revenue from transition-exposed companies.

A detailed breakdown of physical and transition risk impacts across revenue and cost items for life and health insurers is provided in the Appendix.

Interplay and Strategic Trade-offs

Delayed climate action could worsen this dynamic as continued emissions accumulation intensifies health impacts on the physical side, while eventual policy catch-up creates economic volatility that reduces insurance affordability on the transition side. Conversely, rapid transition may reduce long-term health risks but can create near-term economic disruption that constrains policyholder purchasing power. The interplay creates a dual exposure across both mortality and morbidity assumptions and policyholder affordability that neither physical nor transition risk analysis captures in isolation.

Feedback Dynamics and Non-linear Effects

A single severe heat event can both trigger immediate health claims and accelerate policy responses, including emergency heat standards and building code changes, affecting life and health products pricing more broadly. Updated building codes may raise construction and renovation costs, flowing through to group benefit programme costs and individual living expense pressures that further affect premium affordability. These cascading effects illustrate how a physical event can trigger transition responses that loop back to affect insurability.

Property & Casualty Insurance

Revenue and Demand Pressures

Climate change could affect property and casualty insurers across every major product line. Rising flood risk, intensifying catastrophe events, and worsening wildfire conditions would increase claims frequency and severity in property, catastrophe, and agricultural lines. In the most affected regions, sustained loss escalation can render coverage economically unviable, as illustrated by insurer withdrawals from wildfire-prone areas in California and parts of Southeast Asia. While elevated risk awareness can initially expand demand, in highly exposed markets the dominant dynamic is capacity contraction rather than revenue growth.

Transition dynamics introduce a second layer of structural change. Demand from high-carbon industries may decline as stranded assets reduce insurable values, while electric vehicles, green buildings, and renewable energy infrastructure create new underwriting categories with limited historical loss data and evolving risk profiles. Insurers that develop expertise in these areas early can capture new revenue streams; those that do not may see existing product lines become obsolete.

Cost and Capital Pressures

Rising physical loss ratios increase reinsurance costs and claims handling workloads, while transition-driven underwriting complexity may add to assessment and compliance costs. The need to reprice products using forward-looking hazard models rather than historical averages can create pricing friction, particularly in markets where rate approval processes are slow to accommodate updated risk assessments. Physical damage from flooding, wildfires, and severe storms generates immediate spikes in claims, while transition policies simultaneously influence investment performance and pricing flexibility.

A detailed breakdown of physical and transition risk impacts across revenue and cost items for property and casualty insurers is provided in the Appendix.

Interplay and Strategic Trade-offs

Rapid policy tightening following severe events may introduce short-term market stress and asset repricing, even if it supports long-term risk reduction. Delayed transition could allow physical losses to accumulate, increasing the probability of persistent underwriting strain and regional market contraction. Transition-related investments in new products, building standard alignment, or portfolio adjustments could coincide with periods when capital buffers are already under strain from physical losses. Property and casualty insurers therefore operate in an environment where physical and transition risks evolve concurrently, requiring capital management frameworks that account for their interaction.

Feedback Dynamics and Non-linear Effects

Large loss events could reduce capital and underwriting appetite, while regulatory responses and policy adjustments may increase compliance costs and pricing scrutiny. This means that capacity constraints tighten while demand for coverage rises, particularly in high-exposure regions. This reinforcing cycle can become self-sustaining as physical losses trigger regulatory tightening, which constrains capacity, which increases uninsured exposure, which amplifies the impact of subsequent physical events.

Insurance Brokers

Revenue and Demand Pressures

Insurance brokers are affected by both physical and transition risks through their role as intermediaries, even though they do not carry underwriting risk on their own balance sheets.

Physical risk increases the overall demand for coverage, particularly for catastrophe, property, and business interruption products, expanding commission and fee revenue opportunities. However, as physical risks intensify, insurer appetite contracts and coverage becomes harder to place in high-exposure regions, requiring more time and effort per placement.

Transition dynamics could also reshape the market. New technologies such as electric vehicles, green buildings, and renewable energy systems require coverage structures that many traditional products may not address well, creating an opportunity for brokers who develop the necessary expertise early. High-carbon companies facing stranded assets or reputational pressure may shift or reduce their insurance footprint, altering the commission base.

Cost and Capital Pressures

Brokers must invest in understanding evolving risks through higher data and assessment expenses precisely when market disruption makes traditional placement models less effective. Compliance costs rise as brokers face their own climate reporting obligations, including emissions attributable to client portfolios. New green building standards may require novel coverage structures, stranded asset concerns create liability exposures that insurers might be reluctant to underwrite, and regulatory uncertainty could make product pricing volatile.

A detailed breakdown of physical and transition risk impacts across revenue and cost items for insurance brokers is provided in the Appendix.

Interplay and Strategic Trade-offs

Brokers occupy a unique position in the feedback cycle: they neither bear underwriting risk directly nor hold significant investment portfolios, yet they can amplify or dampen the cycle's effects through their intermediary role. The transition's pace determines whether brokers can adapt profitably. Gradual transition allows brokers to develop expertise in green technologies, parametric structures, and emerging risk assessment methodologies, positioning them as value-add intermediaries. Abrupt transition may create whiplash as product needs change faster than brokers can develop expertise, clients face urgent coverage gaps, and compliance requirements proliferate before standardised solutions emerge.

Feedback Dynamics and Non-linear Effects

The feedback cycle creates operational pressure through timing compression. When physical events trigger rapid policy responses, brokers could face surges in client requests for coverage modifications or new products, but insurers may simultaneously tighten underwriting and reduce capacity, making placements more difficult and time-consuming. This dynamic intensified in California after the 2020–2023 wildfire seasons: brokers saw unprecedented demand for wildfire coverage modifications, but insurer capacity contracted sharply, forcing brokers to expend significantly more effort per placement while facing pressure to maintain service levels.

Reinsurance

Revenue and Demand Pressures

Reinsurers occupy a critical position in the risk transfer chain, absorbing losses when primary insurer retentions are breached while also carrying significant investment portfolios sensitive to transition-driven repricing. Rising physical loss ratios could increase demand for reinsurance as primary insurers seek to manage volatility, applying across both property & casualty lines and life & health lines where sustained mortality and morbidity deterioration generates cession pressure. New product lines, including parametric instruments, technology lifecycle coverage, and carbon market products, generate additional cession activity, often at higher initial margins but with greater loss uncertainty.

Cost and Capital Pressures

On the investment side, exposure to real estate, corporate bonds, and equity holdings means that both physical damage and transition-driven repricing can affect non-technical income. These pressures may arrive concurrently during periods of elevated catastrophe activity, when investment capital is most needed to support underwriting capacity. Underwriting costs rise as more granular climate data becomes necessary for accurate risk assessment, and reinsurers operating across multiple jurisdictions face growing compliance and reporting obligations linked to expanding climate disclosure frameworks.

Global insured catastrophe losses reached approximately US$107 billion in 2025, marking the sixth consecutive year above the US$100 billion threshold. Sustained elevated loss levels reinforce higher baseline volatility and constrain capital flexibility, particularly when transition policies accelerate across multiple jurisdictions.

A detailed breakdown of physical and transition risk impacts across revenue and cost items for reinsurers is provided in the Appendix.

Interplay and Strategic Trade-offs

Reinsurers face compounded exposure through both underwriting losses and investment portfolio sensitivity to climate-driven repricing. When catastrophe losses exceed primary insurers' retention levels, claims cascade upward, often with amplified severity due to aggregation across cedents and geographies. At the same time, policy responses and market adjustments could affect asset valuations, placing pressure on capital from both channels simultaneously. Reinsurers cannot selectively underwrite only low-carbon transition risks while avoiding physical risks in vulnerable geographies, as these exposures are generally embedded within cedent portfolios.

Feedback Dynamics and Non-linear Effects

These dynamics are amplified by correlation and concentration risks. A severe catastrophe season can erode capital through claims while broader market repricing affects investment portfolios, constraining capacity for subsequent renewals. Participation in regional facilities such as the Southeast Asia Disaster Risk Insurance Facility can support diversification and risk pooling, but requires disciplined capital management during periods when both physical and transition risks remain elevated.

Regulators & Policymakers

Prudential and Fiscal Pressures

Regulators and policymakers are affected by physical and transition risks both as supervisors of the insurance sector and as stewards of broader fiscal and economic stability. From a regulatory perspective, rising claims and more volatile loss patterns pressure insurer solvency positions and may require updated capital frameworks. Tighter global reinsurance markets, driven by sustained elevated catastrophe losses, transmit additional pressure into domestic markets as primary insurers retain more net risk. Transition dynamics add a second dimension: as carbon-intensive sectors face tightening standards, insurers' corporate bond holdings face rising credit risk, and rapid asset repricing can affect sector-wide solvency positions. Disclosure obligations under IFRS S2, ISSB standards, and regional taxonomies continue to expand, increasing supervisory complexity and data requirements.

From a macroeconomic and fiscal policy perspective, physical risks generate direct spending pressure through disaster relief, reconstruction, and infrastructure repair. These demands consume fiscal space that might otherwise fund adaptation investments. Energy price volatility during transition, labour market disruptions in carbon-intensive industries, and competitiveness pressures from carbon border adjustments create additional policy management challenges. The protection gap widens as physical risks outpace private coverage availability, increasing pressure on public finances.

Social and Systemic Impacts

Physical climate impacts disproportionately affect vulnerable communities through uninsured losses, displacement, and public health strain, increasing demand for social protection precisely when fiscal resources are most constrained. Coordinating the timing and pace of transition policies to manage these social impacts alongside the physical risk trajectory is a central challenge for policymakers.

A detailed breakdown of physical and transition risk impacts across prudential, macroeconomic, and social indicators for regulators and policymakers is provided in the Appendix.

Interplay and Strategic Trade-offs

Regulators and policymakers navigate the most complex position in the feedback cycle: their actions directly influence transition risk timing and magnitude, while physical risks constrain their policy options and create fiscal pressures that limit their capacity to respond. Physical risks create immediate fiscal pressures through disaster relief obligations, forcing governments to choose between emergency response and long-term decarbonisation. Delaying transition to prioritise disaster response could worsen future physical risks, creating a larger fiscal burden over time.

Transition policies, particularly if implemented abruptly after severe physical events, can create their own fiscal and financial stability risks. Rapid coal phase-outs generate stranded assets and employment disruption requiring fiscal support; sudden carbon pricing creates inflationary pressures; accelerated renewable energy mandates may strain grid stability. These transition costs arrive precisely when fiscal resources are constrained by physical event response needs.

Feedback Dynamics and Non-linear Effects

The non-linear dynamics become visible through threshold effects and tipping points. California provides a clear illustration. After several years of escalating wildfire losses, including the severe early 2025 events, cumulative physical risk crossed a threshold at which major insurers reduced exposure or withdrew from high-risk areas, prompting regulatory intervention. That intervention, which requires insurers to continue offering coverage while permitting forward-looking climate models in pricing, may stabilise availability in the near term but can entrench higher premiums that intensify affordability concerns, potentially generating political pressure for premium caps and restarting a cycle of underwriting contraction. The Palisades fire illustrates this interaction sharply. Many affected homeowners had already been dropped by their insurers before the fire, so the binding damage ran less through the hazard itself than through the second-order effects it set off: a prior pricing-driven withdrawal of coverage, a widening protection gap, and the political and affordability pressures that followed. Framing such episodes as the second- or later-order effects of physical risk, rather than as isolated catastrophe losses, captures how a physical event propagates into transition and market responses that loop back onto insurability. Supervisors are beginning to adopt this lens; the Reserve Bank of New Zealand’s 2023 climate stress test, built on a combined high-physical, high-transition “Too Little Too Late” scenario, traced precisely these cascading effects, including accelerated repricing and the withdrawal of cover from the most exposed properties.

For Asian regulators, these compounding pressures are particularly acute. Rapid urbanisation has concentrated population and asset exposure in coastal areas, increasing vulnerability to sea level rise and storm surge[16]. Vietnam illustrates this tension. The Mekong Delta is already experiencing salinisation and subsidence linked to climate change, threatening agricultural output and livelihoods[17].. At the same time, coal fired power remains central to the country's energy mix, reflecting industrial demand and energy security considerations[18]. Accelerating coal phase out may reduce long term physical vulnerability but creates near term economic adjustment pressures. Delaying transition, however, increases long term adaptation costs and fiscal exposure.

[16] IPCC. (2023). Climate change 2023: Synthesis report. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/report/ar6/syr/

[17] World Bank. (2022). Vietnam country climate and development report. World Bank. https://www.worldbank.org/en/country/vietnam/publication/vietnam-country-climate-and-development-report

[18] International Energy Agency. (2025). World energy investment 2025: Southeast Asia. https://www.iea.org/reports/world-energy-investment-2025/southeast-asia

From Protection to Resilience

Climate change is reshaping the operating environment for insurance. Loss patterns are becoming more volatile, hazard distributions are shifting across regions, and the assumptions underpinning traditional risk models are becoming increasingly uncertain. In this context, sustaining insurability should not rely solely on the traditional model of post-event financial protection.

In the face of this changing risk environment, it is increasingly important that the insurance sector leverage its expertise beyond being a provider of financial protection after risk events, toward one that also supports risk reduction and resilience before losses occur. This shift does not replace the core function of risk transfer. Instead, it expands the role of insurers, reinsurers, brokers, regulators, and public institutions in strengthening the conditions under which insurance markets continue to function effectively in a changing climate.

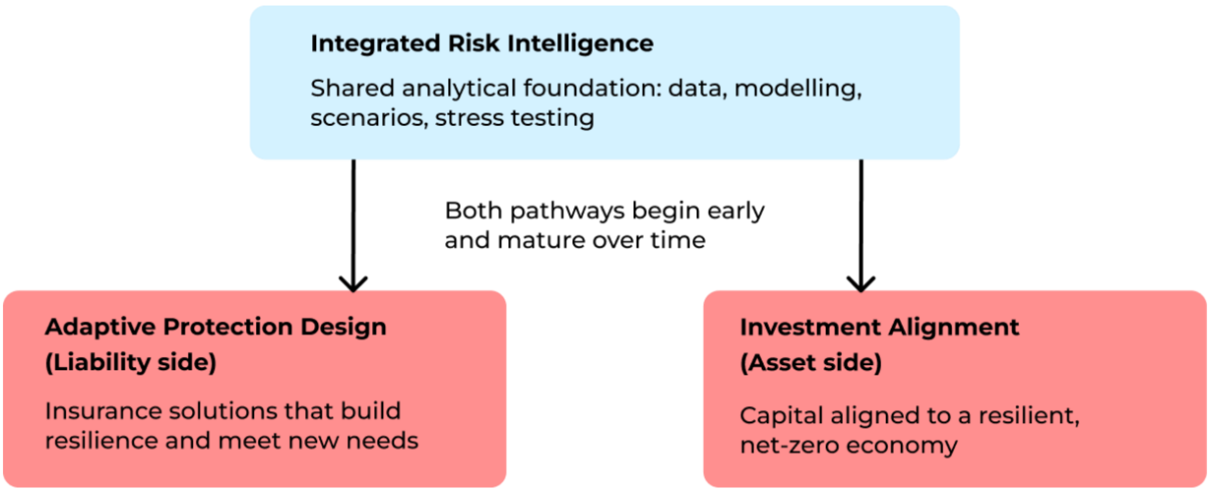
A single enabling foundation and two implementation pathways can support this transition. The foundation is integrated risk intelligence: improving climate risk modelling, data, and scenario analysis so that underwriting, investment, and supervisory decisions reflect forward-looking climate information rather than historical loss patterns alone. Because the same forward-looking view informs both sides of the balance sheet, it underpins everything that follows. Building on that foundation, two complementary pathways put the intelligence into practice. On the liability side, adaptive protection design enhances protection mechanisms that respond to climate-driven volatility, including faster liquidity instruments and products that reward verified resilience investments. On the asset side, investment alignment, supported by public–private coordination, directs capital towards resilience so that insurance markets can continue to function in regions facing rising physical risks and accelerating transition pressures.

Together, these efforts aim to reduce the reinforcing feedback cycle described in earlier sections of this report, where escalating physical losses and abrupt transition adjustments can weaken insurance capacity and widen protection gaps.

In operational terms, the framework translates into concrete actions across the insurance value chain. Integrated risk intelligence is embedding within underwriting, pricing, reserving investment governance and capital allocation through the systematic use of forward-looking climate scenarios and consistent assumptions across both sides of the balance sheet. The two pathways then advance in parallel. On the liability side, adaptive protection design moves from pilots to scaled, including parametric triggers calibrated for rapid post-event liquidity, resilience-linked pricing tied to independently verified mitigation, and lifecycle cover for low-carbon infrastructure. On the asset side, investment alignment starts with scenario-consistency assessment, governance enhancements, and portfolio stress testing, while progressively increasing allocations to adaptation and resilience investments that match the duration profile of long-tail liabilities. Clarifying the responsibilities and timeline for underwriting, capital, and investment functions can help translate the framework from a strategic concept into an actionable implementation roadmap.

The diagram below illustrates this structure: integrated risk intelligence as the enabling foundation, with adaptive protection design on the liability side and investment alignment on the asset side rising from it as two parallel pathways. The pathways draw continuously on the foundation and advance concurrently rather than being handed off in sequence, with the early, governance-oriented work on each beginning at broadly the same time.

Figure 5: From Protection to Resilience: A Strategic Roadmap for Insurers



Integrated Risk Intelligence

Climate change weakens the assumption of stationarity that some traditional insurance risk models have long relied on. Historical loss records alone are becoming less reliable as a guide to future hazard patterns. In response, integrated risk intelligence that brings together forward-looking modelling, expanded climate data infrastructure, and coordinated scenario analysis across the insurance ecosystem could help enable both the private and public sectors to adapt risk assessments as climate conditions evolve.

Private Sector

Insurers, reinsurers, and brokers should view climate intelligence integration as an ongoing journey. As data quality and availability improve over time, those leading the transition will continue to advance, while others will need to begin embedding climate insights deeper across underwriting, pricing, reserving, and investment processes rather than maintaining climate analysis as a parallel function. Three operational capabilities are central to this transformation: real-time data integration, scenario-based risk analysis, and strengthened model governance.

Real-Time Data Integration

Traditional insurance datasets tend to rely heavily on historical claims records and periodic catastrophe model updates. Climate volatility requires more dynamic data inputs capable of capturing rapidly evolving hazard patterns. Satellite observation, remote sensing, and Internet of Things sensors are increasingly used to monitor environmental conditions such as flood exposure, wildfire risk, and coastal erosion. These technologies could enable insurers to update risk classifications more frequently and manage accumulation exposure in vulnerable regions. For example, Zurich Insurance's regional innovation hub in Singapore developed and deployed a commercial insurance agentic AI platform in 2025 that assists underwriters in assessing risk in real time, demonstrating how advanced analytics can be embedded directly into underwriting operations rather than operating solely as separate risk reporting tools.[19].

Scenario-Based Risk Analysis

Single-point forecasts could be insufficient for managing long-horizon balance sheets. Scenario analysis using shared frameworks, already adopted by many regulators and private companies, such as Network for Greening the Financial System pathways tests resilience across plausible futures and structures trade-offs between transition costs and

[19] Monetary Authority of Singapore. (2025, November 3). Unlocking opportunities in a changing risk landscape [Speech by Managing Director Chia Der Jiun at 21st Singapore International Reinsurance Conference]. https://www.mas.gov.sg/news/speeches/2025/unlocking-opportunities-in-a-changing-risk-landscape

physical impacts. This prevents situations where underwriting assumes 3°C warming while investment strategy prices 1.5°C transition pathways, which could create simultaneous under-reserving for physical risks and suboptimal investment. Aon's Impact Forecasting team, comprising members from Singapore and four other global offices, developed an AI algorithm to create stochastic event sets for tropical cyclones applied to the Asia-Pacific region, including cyclone-prone countries such as Japan and Vietnam[20]. This approach enhances catastrophe modelling and generates new insights for more accurate pricing.

Scenario users should also be alert to a structural limitation in many transition pathways themselves. The integrated assessment models underpinning widely used frameworks, including the Network for Greening the Financial System scenarios, represent physical damages only partially in their equilibrium output, and the NGFS has acknowledged that its damage function omits material channels such as sea-level rise, tropical cyclones, climate tipping points, and non-market damages to health and ecosystems. A decarbonisation pathway can therefore appear orderly on the transition axis while understating the physical losses insurers will actually carry, reinforcing the case for treating transition scenarios as a floor on physical risk rather than a complete account of it.

Model Governance and Validation

Governance for climate model risk, covering both traditional catastrophe models and AI-based systems used in risk assessment, should aim to ensure transparent documentation, periodic validation, and independent review, supporting more coherent risk assessments and capital strategies. Frameworks like IFRS S2 and the International Association of Insurance Supervisors guidance provide foundations for integrating modelling into disclosure and solvency analysis.

Implementation across Asian markets remains uneven. Zurich's AI underwriting platform and Aon's catastrophe modelling represent sophisticated approaches concentrated in Singapore and regional hubs. Beyond major international players concentrated in Singapore, Hong Kong, and Japan, enhanced climate data integration is at an earlier stage of adoption across the region, and public disclosure of underwriting outcomes remains limited. Supervisory pressure is accelerating. For example, Singapore's MAS and

[20] Monetary Authority of Singapore. (2025, November 3). Unlocking opportunities in a changing risk landscape [Speech by Managing Director Chia Der Jiun at 21st Singapore International Reinsurance Conference]. https://www.mas.gov.sg/news/speeches/2025/unlocking-opportunities-in-a-changing-risk-landscape

Japan's Financial Services Agency (FSA) increasingly expect climate risk to be embedded in prudential frameworks, rather than isolated in environmental reporting.

Public Sector

Governments occupy a unique position in the insurance ecosystem. They generate and have access to foundational datasets that markets cannot replicate at scale, including meteorological observations, exposure inventories, loss records, land use maps, and infrastructure registries. They also possess regulatory authority to convene the industry around common standards. This combination of data ownership, coordination power, and rule-setting authority makes the public sector a critical enabler of insurability.

Through open data infrastructure, regional risk pooling platforms, and clear data governance protocols, governments could reduce information asymmetry, lower modelling costs, and improve the speed and reliability of financial protection. These measures do not replace private underwriting but strengthen the conditions under which risk-based insurance markets can function.

Open Data Infrastructure

Open data infrastructure refers to systems that enable consistent, shared risk understanding across the market, rather than purely the open release of granular datasets. It functions as a form of public infrastructure that supports market coordination. Japan's Financial Services Agency provides an example of how supervisory coordination can contribute to such infrastructure in practice. In 2024, the FSA conducted its second climate risk scenario test with 19 non-life insurers and the General Insurance Rating Organisation of Japan. The exercise indicated that acute physical risks would intensify as global temperatures rise, requiring updates to risk models. In response, the General Insurance Rating Organisation increased its fire insurance reference rate by 13 percent in June 2023 and introduced more granular flood risk classifications in late 2024 that vary premiums by location[21] [22]. While the underlying datasets are not fully open, this sequence of supervisory scenario analysis, pooled industry data, and pricing-relevant outputs illustrates how coordinated public frameworks can generate shared market intelligence that individual insurers may not be able to develop independently.

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[21] Gallagher Re. (2025, November 11). Japan's non-life insurance in 2025 gains strength through reform. *Beinsure*. https://beinsure.com/japans-non-life-insurance-gains-strength/

[22] Green Central Banking. (2025, September 18). Insurance in Japan: Keeping the climate protection gap at bay. https://greencentralbanking.com/2025/09/18/how-japanese-insurers-are-keeping-the-climate-protection-gap-at-bay/

Regional Risk Pooling Platforms

Regional platforms can help amplify national efforts. The Southeast Asia Disaster Risk Insurance Facility illustrates the potential of regional pooling. According to the World Bank, pooling catastrophe coverage across ASEAN countries could reduce premiums by up to 25% compared to individual purchases, through diversification benefits and improved loss estimation from pooled exposure data[23].

Operational performance reinforces this value. In 2024, SEADRIF delivered $3 million to Laos within six days following Typhoon Yagi, reaching more than 350,000 people through pre-agreed parametric triggers[24]. The Caribbean Catastrophe Risk Insurance Facility demonstrates sustained execution, with 78 payouts totalling $390 million since 2007, all within 14 days of each event[25].

Regional pooling improves pricing efficiency and access to rapid liquidity, but effective participation requires domestic institutional readiness. The Philippines joined a sovereign parametric disaster insurance programme, yet it required six years from 2011 to 2017 to develop catastrophe models to international standards, navigate procurement frameworks, and build technical expertise within government. The binding constraint was institutional capacity rather than physical infrastructure. Once operational, the programme delivered three payouts between 2017 and 2019 totalling $28 million within contractual timelines, doubled coverage to $389 million in its second year, and by 2019 enabled the country's first sovereign catastrophe bond issuance[26]. Regional platforms can enhance resilience, but institutional foundations determine whether risk pooling translates into scalable and credible financial protection.

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[23] World Bank. (2024). Strengthening financial resilience against climate and disaster impacts: Key insights from UR24. https://www.financialprotectionforum.org/news/strengthening-financial-resilience-against-climate-and-disaster-impacts-key-insights-from-ur24

[24] SEADRIF. (2025). Steady ground, secure futures: Disaster risk insurance for a stronger Southeast Asia — 2024 annual report. https://seadrif.org/annual-report/

[25] CCRIF SPC. (2025, November 6). CCRIF announces 2nd payout of US$21.1 million to Jamaica following Hurricane Melissa. https://www.ccrif.org/news/ccrif-announces-2nd-payout-us211-million-j34-billion-jamaica-following-hurricane-melissa

[26] World Bank. (2021). The Philippines parametric catastrophe risk insurance program pilot: Lessons learned. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/600081624863743116/

Data Governance and Sharing Protocols

Data sharing arrangements between public and private actors, as well as across industry participants, should be clearly defined. Effective collaboration requires clarity on data contributions, usage terms, and governance safeguards. Governments play a central role in this. Where direct data sharing might be constrained by confidentiality, regulators could play a coordinating role by standardising disclosures so that aggregated outputs function as market infrastructure rather than fragmented reporting. Singapore's MAS illustrates this approach by pairing climate disclosure expectations with standardised templates and industry stress testing, rather than facilitating direct sharing of granular firm-level data, this enables the aggregation of risk insights across the market while preserving proprietary information.

In many emerging markets, however, exposure inventories, loss records, and insurance-grade hazard products remain uneven and difficult to combine, even where underlying meteorological observations are available. Continued public investment in these layers, alongside digital infrastructure, remains essential for credible risk assessment and scalable parametric solutions.

Joint Action: Scenario Alignment and Regional Coordination

Integrated risk intelligence requires common analytical baselines. Across ASEAN, climate scenario approaches remain uneven. Singapore integrated NGFS scenarios into industry-wide stress testing from 2022, and Malaysia adopted NGFS frameworks in its 2024 climate risk stress testing exercise. Progress across other markets, including Indonesia, the Philippines, Thailand, and Vietnam, continues to develop. For insurers operating regionally, greater convergence on shared scenario frameworks would improve comparability and reduce compliance complexity.

This is where public and private roles converge. Insurers can benefit from participating in public and private risk intelligence initiatives, that provide shared analytical baselines and comparable scenario work across markets, while keeping company-level decisions and proprietary information appropriately protected. Greater coordination on core scenario selections and modelling parameters would reduce duplication and strengthen cross market consistency.

Adaptive Protection Design

Climate volatility could expose gaps in the speed, suitability, and affordability of conventional indemnity insurance. Traditional indemnity models function effectively when losses can be verified through established claims assessment processes and when financial impacts emerge gradually. However, climate-related shocks increasingly include rapid-onset disasters and income disruptions that require faster liquidity and alternative protection structures.

Adaptive protection design reflects a shift in how insurance products are structured to align more closely with evolving risk characteristics and customer needs. Rather than relying solely on post-event loss compensation, insurers are developing approaches that provide timely financial support, incorporate incentives for risk reduction, and address emerging risks associated with low-carbon transition.

The examples below should be understood as illustrations of evolving design approaches, rather than fully scaled solutions. Many remain at varying stages of development, with practical challenges related to data, pricing, regulation, and distribution that may affect their scalability across markets.

Private Sector

Private insurers are expanding beyond traditional indemnity structures by developing products and services that better align with changing risk dynamics. These include mechanisms that provide rapid liquidity, integrate resilience into pricing, and address new and evolving risk categories. Taken together these approaches extend the role of insurance while maintaining core risk-transfer principles.

Parametric and Index-Based Liquidity

Parametric and index-based insurance represents an established approach that is becoming more relevant in the context of climate-related risks. These products provide payouts when predefined triggers are met, reducing the delay between event occurrence and financial support.

While not developed specifically for climate risks, such structures are increasingly applied where climate-related shocks create a need for rapid liquidity and where traditional claims assessment may be too slow or complex. This is particularly relevant for livelihoods, micro-enterprises, and public entities requiring immediate post-event funding.

The Women's Climate Shock Insurance initiative in India exemplifies the approach[27]. Workers receive payouts when temperature thresholds exceed predefined levels, enabling income support without requiring traditional loss documentation. Payments can be delivered within days, providing immediate financial relief for workers whose earnings are disrupted by extreme heat.

The relevance of parametric approaches lies not in their novelty, but in their ability to address timing and liquidity gaps that are becoming more pronounced under changing climate conditions. However, these instruments are not universally applicable. Scaling remains uneven, with challenges including basis risk, data requirements for trigger design, and distribution constraints across different markets.

Resilience-linked Pricing

Climate risks are also prompting greater integration of risk reduction into insurance design. Resilience-linked pricing aligns premiums with verified mitigation measures, moving beyond treating risk reduction as external to the insurance contract.

Climate Insurance-Linked Resilient Infrastructure Financing (CILRIF) illustrates this shift. It links municipal insurance pricing to completed resilience investments such as flood walls, drainage systems, and early-warning networks. As communities invest in protective infrastructure that meets specified standards, risk premiums decline. Resilience shifts from rhetorical commitment to financial reality. Premium reductions are triggered only when flood defences meet completion and performance criteria, verified by independent assessment[28].

This approach aligns incentives across stakeholders by linking financial outcomes to measurable risk reduction. Communities can reduce risk and lower insurance costs. Insurers can improve portfolio quality and reduce claims frequency. Governments can strengthen public assets while managing contingent liabilities. However, implementation can be complex. Scalability depends on the availability of reliable resilience metrics, verification mechanisms, and coordination across public and private actors, which may limit adoption in some markets.

[27] Climate Resilience for All. (2024). Women's Climate Shock Insurance (programme information). https://www.climateresilienceforall.org/

[28] UNCDF. (n.d.). Climate Insurance-Linked Resilient Infrastructure Financing (CILRIF). United Nations Capital Development Fund. https://www.climatefinancelab.org/ideas/climate-insurance-linked-resilient-infrastructure-financing-cilrif/

Technology Lifecycle Coverage

Low-carbon infrastructure creates new risk profiles not well captured in historical loss curves. Construction risks are evolving, operational performance is uncertain, and loss histories remain limited. This uncertainty creates pricing friction and reinsurance challenges. Integrated solutions that span construction through operation, combining insurance with engineering assessment, monitoring, and operational support, reduce loss frequency and improve insurability. SOMPO's offshore wind service pairs coverage with risk assessment and operational guidance, narrowing the gap between engineering reality and underwriting assumptions[29]. Rather than pricing based on sparse historical loss data, insurers leverage expert assessment of actual construction and operational practices. Services justify higher premiums through measurable loss reduction.

Carbon Risk and Insurance

As carbon markets expand, new forms of risk are emerging, including non-delivery of credits, invalidation, and verification challenges. Insurance solutions are being developed to address these risks.

For example, carbon credit insurance pairs coverage with rigorous third-party validation, creating enforceable policy triggers tied to defined failure modes rather than subjective carbon outcomes. This approach could support market credibility by ensuring that carbon credit transactions operate within transparent, verifiable frameworks. Regulatory bodies including Singapore's Monetary Authority are increasingly recognising carbon credit insurance as essential infrastructure for scaling transition finance[30]. By embedding verification and clear triggers, insurers help prevent fraud and quality degradation that could undermine market confidence in carbon finance.

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[29] SOMPO Holdings Inc. (2022). Climate-related disclosure (TCFD). UNEP FI. https://www.unepfi.org/wordpress/wp-content/uploads/2023/11/Sompo-Holdings-Inc._2022_disclosure.pdf

[30] Business Times. (2025). Carbon credit insurance gets MAS boost; Sustainable loans draw scrutiny. ESG Insights Newsletter. https://www.businesstimes.com.sg/newsletters/esg-insights/issue-169-carbon-credit-insurance-gets-mas-boost-sustainable-loans-draw-scrutiny

What Is Carbon Insurance and Why It Matters

Carbon insurance refers to insurance products designed to protect participants in carbon markets from financial losses linked to carbon credits and decarbonisation projects. Carbon credits represent verified reductions or removals of greenhouse gas emissions and are bought by companies to meet compliance obligations or voluntary climate commitments. Because credits depend on complex methodologies, long-term project performance, and regulatory recognition, they carry integrity risks. Insurance addresses these risks by providing compensation if credits are later invalidated due to methodological errors, fraud, non-delivery, or regulatory changes. By defining clear policy triggers tied to third-party verification and regulatory determinations, carbon insurance transforms uncertainty into contractually manageable risk. For example, brokers such as WTW[31] have structured carbon credit invalidation insurance that protects buyers if issued credits are cancelled after purchase.

Public Sector

Regulatory frameworks designed for traditional indemnity insurance may not be well suited to product innovation. Public sector enablement is therefore essential to facilitate private sector innovation in adaptive protection. This requires targeted reforms in model authorisation, capital treatment, and consumer protection standards.

Forward-Looking Authorisation

Many regulatory frameworks for insurance pricing and product approval remain designed for traditional indemnity models, relying heavily on historical loss data, post-event loss verification, and established risk classifications. These requirements can constrain parametric innovation by limiting the use of forward-looking catastrophe models and scenario analysis for trigger design, particularly where historical data are insufficient to capture emerging climate risks. Enabling innovation therefore requires regulatory mechanisms that allow controlled testing of model-based pricing and alternative data while maintaining supervisory oversight.

Regulatory sandbox frameworks provide such a pathway. For example, Thailand's Office of Insurance Commission (OIC) established an insurance regulatory sandbox that allows insurers and insurtech firms to test innovative insurance products and digital solutions

[31] Willis Towers Watson. (n.d.). Carbon credit insurance. https://www.wtwco.com/en-gb/solutions/services/carbon-credit-insurance

under temporary regulatory flexibility. The sandbox admitted Singapore-based insurtech Vouch, operating in Thailand through its FairDee platform, to test digital insurance solutions under supervisory oversight, illustrating how controlled regulatory experimentation can support new insurance business models[32]. By allowing experimentation in a supervised environment, such frameworks enable regulators to evaluate risks, refine policy responses, and reduce barriers to product development while maintaining consumer protection safeguards.

Consumer Protection Standards

Consumer protection frameworks should reflect the characteristics of evolving insurance designs.

Where payout conditions, verification mechanisms, or coverage structures differ from conventional models, clear communication becomes particularly important. Policyholders should be able to understand how payouts are determined, under what conditions coverage is triggered, and in what situations outcomes may differ from actual losses.

Strengthening disclosure requirements can help improve transparency and support informed decision making, while preserving space for innovation. Greater consistency in disclosure standards across global markets could further enhance comparability across products and providers, supporting market development alongside consumer protection.

Joint Action: Scaling Adaptive Protection

Adaptive protection requires coordinated public and private implementation to function at scale. While insurers design products and regulators can support in enabling innovation, effective deployment will also depend on institutional arrangements that help align protection with development policy, financing mechanisms, and risk reduction practice.

Protection Embedded in Public Programmes

Adaptive protection instruments are more effective when they are integrated into existing public programmes that already reach vulnerable populations. Governments can support in providing distribution channels through social protection systems, disaster response mechanisms, and development programmes, while insurers can contribute to product design and risk pricing. Embedding parametric protection or climate risk

[32] Schellhase, J., & Warden, N. (2018). Singapore-based insurtech launches in Thailand. Insurance Business Asia. https://www.insurancebusinessmag.com/asia/news/breaking-news/singaporebased-insurtech-launches-in-thailand-106372.aspx

coverage within public schemes can expand coverage rapidly, help reduce administrative costs, and help ensure that rapid liquidity reaches affected households and small enterprises during climate shocks. This approach shifts insurance from a standalone product to a component of broader resilience policy.

Financing Structures for Emerging Risk Solutions

Many adaptive protection products face early-stage demand uncertainty and limited historical experience, particularly for climate related risks and low carbon technologies. Joint financing arrangements can support market development by sharing early-stage risk and reducing entry barriers for new products. Public participation through co financing, risk sharing arrangements, or transition support mechanisms can help stabilise demand while markets mature. These structures enable insurers to develop new coverage areas while maintaining pricing discipline and financial sustainability.

Incentive Alignment for Risk Reduction

Adaptive protection is most effective when financial protection and physical risk reduction reinforce each other. Governments shape exposure through land use planning, building standards, and infrastructure investment, while insurers translate risk outcomes into pricing and coverage conditions. Further alignment between the public and private incentives and more coordinated approaches could allow risk reduction measures to generate measurable financial benefits through improved insurability, expanded coverage availability, or reduced loss volatility. This alignment strengthens incentives for adaptation and reduces long term fiscal and insurance sector exposure.

Investment Alignment

Insurers and reinsurers often function as both risk carriers and long-term institutional investors. This dual role can introduce inconsistencies when underwriting might reflect forward-looking climate assumptions, while investment decisions may be based on different assumptions or time horizons.

Addressing this may require more than traditional asset–liability matching. It means aligning underwriting and investment around a coherent set of forward-looking climate assumptions, so that the way risks are assessed and priced over time is consistent with the way investment decisions are made, especially where climate-related exposures unfold over multi-decade horizons.

Private Sector

Investment strategy for the insurance sector players is beginning to reflect the climate assumptions underlying underwriting decisions. This typically involves three areas of focus: investing in, engaging portfolio companies on transition risk management, and strengthening scenario consistency across the balance sheet.

Adaptation Infrastructure Investment

Adaptation assets, such as water security systems, cooling infrastructure, flood defences, grid-integrated renewable energy and nature-based solutions like mangrove restoration, are typically structured over multi-decade horizons. For insurers or reinsurers to align the investment with their liabilities, risk assessment frameworks should extend over comparable timeframes. This means insurers could evaluate and price climate-related exposures not just over annual policy cycles, but over the 20- to 30-year periods across which both the underlying risks and the investment returns could actually materialise.

This duration match is the investment case for holding adaptation infrastructure. Where an insurer is carrying climate-related liabilities over multi-decade horizons, such as long-tail reinsurance treaties, annuity books, or long-term disability lines, adaptation assets can fit more naturally on the asset side of the balance sheet. Their cash flows tend to be long-dated and, in some cases, inflation-linked, broadly corresponding to the period over which the related physical risks are being priced and reserved. Depending on project structure and jurisdiction, these assets may also offer some diversification against equity and corporate-bond volatility, though infrastructure returns are not themselves immune to policy-driven repricing and should be sized accordingly.

For example, a municipal flood defence project generating stable, predictable returns over 20 to 30 years could be seen as well-matched to an insurer that is assessing flood risk across that same horizon, not merely reserving for next year's claims. This alignment reduces the need for short-term portfolio turnover and supports a more stable, forward-looking approach to climate risk management. Collaboration with development banks or blended finance platforms can further improve investability by reducing initial risk concentration and enabling private investors to participate at acceptable risk-adjusted returns.

Case Study: Blended Finance in Practice – IDF Infrastructure Investment Blueprint

GAIP and Convergence's *Playbook on the Insurance Sector's Roles in Blended Finance at the Climate Health Nexus*[33] highlights the Insurance Development Forum (IDF) Infrastructure Investment Blueprint as a model for mobilising insurance capital into resilient infrastructure.

The Blueprint was developed to address a structural gap: climate resilient infrastructure in emerging markets offers long duration, stable cash flows, yet project level and sovereign risks often prevent insurers from allocating capital at scale. To overcome this, the platform invests through senior and mezzanine secured debt within a diversified portfolio structure. Concessional capital and recognised credit enhancement mechanisms are embedded to absorb higher risk layers and elevate the overall credit profile to levels compatible with insurers' solvency and rating requirements.

The model demonstrates why blended finance works. Risk is not removed but redistributed across the capital stack, allowing development capital to improve investability while preserving commercial return discipline. In doing so, adaptation infrastructure becomes aligned with insurers' long tail liabilities rather than remaining outside mandate thresholds.

Active Portfolio Engagement

Divestment from high-emission sectors alters portfolio exposure, whereas portfolio engagement can influence the underlying risk dynamics. Insurers can embed climate assumptions into bond covenants, investment mandates, and stewardship protocols. Requiring a portfolio company to disclose Scope 1, 2, and 3 emissions and set science-based reduction targets, it reduces the likelihood of stranded-asset surprises in the insurer's and reinsurer's portfolio and encourages the company to internalise transition risk. Exclusion removes the company from the portfolio but does not change its behaviour whereas engagement does both as it reduces portfolio risk and influences company behaviour toward transition.

[33] Convergence Blended Finance and GAIP (2025). Playbook on the Insurance Sector's Roles in Blended Finance at the Climate Health Nexus. https://www.gaip.global/wp-content/uploads/2025/11/Convergence_Insurance-Playbook_V3.pdf

Scenario-Consistent Asset Allocation

Investment strategy should use similar climate scenarios that drive underwriting assumptions. If catastrophe models assume intensifying physical risks under delayed transition, investment portfolios could also be stress-tested against corresponding transition shocks. Scenario inconsistency could create a false sense of balance sheet resilience: underwriting may reserve adequately for physical risks while investment strategy could fail to account for the transition volatility those same physical risks will ultimately trigger. Board-level oversight of scenario consistency across both functions can also play an important role in strengthening overall governance.

Public Sector

Public sector investment alignment requires governments and sovereign institutions to manage climate risk systematically rather than reactively. Sovereign asset portfolios, contingent liabilities from disaster obligations, and development bank mandates are all levers for directing investment toward climate resilience while managing fiscal exposure.

Sovereign Climate Risk Management

Governments face climate risks across multiple dimensions: direct asset exposure (infrastructure and buildings), contingent liabilities (disaster relief obligations), and fiscal volatility from revenue disruption during climate events. Strategic risk transfer moves beyond ad hoc disaster relief to pre-arranged financial instruments with embedded mitigation requirements. Without pre-arranged mechanisms, post-disaster fiscal pressure can force governments to divert development budgets to emergency response, undermining the long-term investments in resilience that would reduce future disaster costs.

Sovereign Wealth Fund Climate Integration

Sovereign wealth funds and national pension funds manage trillions in assets globally. These institutions face similar climate risks to private insurers, including physical damage to real assets and transition repricing of carbon-intensive portfolios, yet integration of climate risk into sovereign investment mandates has, in many cases, lagged leading private sector practice[34]. Public sector investment alignment should also contain explicit climate scenario integration into investment mandates, portfolio stress testing aligned with national climate commitments, and disclosure practices that are aligned to private sector standards.

[34] Bortolotti, B., Loss, G., & van Zwieten, R. W., "The times are they a-changin'? Tracking sovereign wealth funds' sustainable investing," Journal of International Business Policy 6(3) (2023), https://doi.org/10.1057/s42214-023-00161-4

Development Bank Catalytic Capital

Development banks can play catalytic roles. By providing first-loss capital or credit enhancement for adaptation infrastructure, they enable private capital participation at acceptable risk-adjusted returns. The Asian Development Bank, World Bank, and regional development institutions can structure blended finance vehicles designed to attract insurance capital for climate resilience projects. Without this catalytic function, many adaptation assets remain below the risk–return thresholds at which institutional investors can participate commercially.

Joint Action: Blended Finance for Adaptation

Investment alignment requires coordinated action between public and private actors to mobilise investment at scale for climate adaptation and resilience. Many adaptation assets are commercially viable over the long term but face initial barriers including high upfront costs, uncertain revenue streams, and limited performance data. Public and private collaboration can address these constraints by improving project risk profiles and reducing transaction complexity.

Blended finance provides one mechanism for joint capital deployment. By combining concessional public capital with commercial investment, blended structures improve project risk and return characteristics and enable institutional investors, including insurers, to participate in adaptation infrastructure at investment grade risk levels. Public institutions may provide subordinated capital, credit enhancement, or technical assistance, while private investors contribute capital, underwriting expertise, and risk management capabilities. This arrangement enables capital to flow toward resilience investments that neither sector could support independently.

Standardisation can also help in scaling participation. Common project documentation, shared due diligence frameworks, and pooled technical assistance reduce transaction costs that often deter institutional investors more than modest return gaps. Development banks and public agencies can support market formation by establishing replicable investment structures, while insurers contribute long term capital and risk expertise. Together, these arrangements strengthen the conditions under which adaptation investments become commercially scalable.

Coordinated deployment of public and private investment also supports broader balance sheet resilience. Investments in adaptation infrastructure reduce underlying physical risk exposure, strengthen economic stability, and improve the long-term sustainability of both public finances and private insurance markets. Coordinated capital deployment therefore reinforces risk reduction, financial stability, and protection outcomes simultaneously.

Strategic Implications

The transition described in this chapter reflects a broader transformation in how insurance systems interact with climate risk. As physical hazards intensify and transition policies reshape economic activity, insurance markets are increasingly positioned at the intersection of risk assessment, financial protection, and broader reallocation of investment and activity that climate adaptation and transition require. Decisions about how risks are modelled, priced, and financed can influence not only the stability of insurance markets but also the pace and effectiveness of climate adaptation across economies.

Strengthening the operational foundations of the insurance ecosystem therefore can have implications beyond the industry itself. When insurers, reinsurers, and brokers improve risk intelligence, hazard signals become clearer for households, firms, and governments. When protection mechanisms reward verified resilience investments, financial incentives begin to support risk reduction rather than merely compensate for losses. When investment decisions align with long-term climate risk, insurance markets can help channel investment toward infrastructure and technologies that reduce future exposure.

At the same time, the evolution of insurance systems can be influenced by political economy constraints. Rising risk may push insurers toward higher premiums or reduced coverage in exposed regions, while governments may face pressure to maintain affordability and access to protection. Managing these tensions will require policy frameworks that balance market sustainability with social expectations of financial security, often through public–private partnerships, disaster risk financing arrangements, and incentives that encourage risk reduction.

Viewed in this broader context, insurance can be seen as a part of the institutional architecture through which societies respond to climate risk. Its analytical capabilities, contractual structures, and capital allocation decisions can influence how risks are understood and how resources are mobilised to manage them. Insurance therefore becomes not only a mechanism for transferring climate risk, but also plays a role in influencing how risks are priced, reduced, and financed across the broader economy.

Conclusion

Climate Change & Insurance: Physical Risks on the Insurance Industry and Climate Change & Insurance: Transition Risks on the Insurance Industry examined physical risks and transition risks separately in order to present the comprehensive impacts of climate change. In practice, however, the two should not be viewed or managed in isolation. Both originate in the accumulation of greenhouse gases in the atmosphere and interact through dynamics that can amplify volatility when action is delayed. Together, they can create a unified exposure across the underwriting and investment functions of the insurance sector.

Risk assessments, capital models, and supervisory frameworks designed around a single dimension of climate risk may underestimate the compounding pressures facing insurers, reinsurers, brokers, and public institutions. Integration is therefore not simply an analytical refinement. It is an important precondition for credible risk assessment in a changing climate.

Analysis across the insurance ecosystem illustrates how these combined risks can affect insurers, reinsurers, brokers, and regulators & policymakers. Life and health insurers face growing pressures from shifts in mortality and morbidity linked to physical hazards, while transition dynamics can alter income stability and reshape the affordability of coverage. Property and casualty insurers confront increasing loss volatility in regions where hazard intensification and delayed regulatory adjustment are already compressing the boundaries of insurability. Reinsurers absorb shocks across portfolios and geographies, which means integrated scenario analysis could have implications to capital adequacy and not just reporting. Brokers operate at the interface between insurance capacity and client demand, where pricing volatility and capacity constraints increasingly affect placements and advisory services. Regulators and policymakers face the task of maintaining market stability and access to protection while the underlying risk landscape evolves. Across all these players, the interaction of physical and transition risks reduces the margin for reactive management and increases the cost of delayed adjustment.

The following three strategic priorities provide a framework to support response. Integrated risk intelligence forms the analytical foundation. Without approaches that capture how physical and transition risks interact, pricing, reserving, and asset allocation are harder to calibrate effectively. Adaptive protection design represents the operational application of that intelligence. It helps translate improved risk understanding into protection mechanisms that function where traditional indemnity structures may struggle to operate, including parametric triggers that deliver rapid post event liquidity, resilience linked pricing that rewards verified risk reduction, and insurance solutions suited to the lifecycle risks of low carbon infrastructure. Investment alignment is the systemic lever. It determines whether private and public financial resources support long-term resilience or remain oriented toward compensating losses after they occur. These efforts are mutually reinforcing, and progress in one area will be constrained without progress in the others.

This paper completes the three-paper assessment of climate change on the insurance sector. Taken together, the three papers show that climate change is altering not only the scale of losses but could also impact the structural conditions under which insurance markets operate. Physical hazards are intensifying and shifting across regions, while transition dynamics are reshaping economic activity, regulatory frameworks, and asset valuations. Their interaction can create compounding exposures and non-linear dynamics that require integrated analysis and coordinated responses across insurers, reinsurers, brokers, regulators, and other key public institutions.

Sustaining insurability in a changing climate could be achievable, but it will require sustained coordination across the public and private sectors. It will depend on whether insurers, reinsurers, brokers, regulators, and governments act together to anticipate evolving risks, strengthen protection mechanisms, and align financial systems with long term resilience. Insurance cannot determine the trajectory of climate change. It can, however, help shape how societies understand risk, absorb shocks, and sustain economic resilience in an increasingly volatile climate system. In this sense, the future of insurability will depend not only on how risks are transferred, but on how effectively they are anticipated, reduced, and financed.

References

Bortolotti, B., Loss, G., & van Zwieten, R. W. (2023). The times are they a-changin'? Tracking sovereign wealth funds' sustainable investing. Journal of International Business Policy, 6(3). https://doi.org/10.1057/s42214-023-00161-4

Business Times. (2025). Carbon credit insurance gets MAS boost; Sustainable loans draw scrutiny. ESG Insights Newsletter. https://www.businesstimes.com.sg/newsletters/esg-insights/issue-169-carbon-credit-insurance-gets-mas-boost-sustainable-loans-draw-scrutiny

CBS News. (2025, January 20). Thousands of Los Angeles homeowners were dropped by their insurers before the Palisades Fire. https://www.cbsnews.com/news/fires-california-palisades-fire-homeowners-insurance-dropped/

CCRIF SPC. (2025, November 6). CCRIF announces 2nd payout of US$21.1 million to Jamaica following Hurricane Melissa. https://www.ccrif.org/news/ccrif-announces-2nd-payout-us211-million-j34-billion-jamaica-following-hurricane-melissa

Climate Resilience for All. (2024). Women's Climate Shock Insurance (programme information). https://www.climateresilienceforall.org/

Convergence Blended Finance and GAIP. (2025). Playbook on the insurance sector's roles in blended finance at the climate health nexus. https://www.gaip.global/wp-content/uploads/2025/11/Convergence_Insurance-Playbook_V3.pdf

Encyclopaedia Britannica. (2025, December 8). Asia Floods of 2025. https://www.britannica.com/event/Asia-Floods-of-2025

GAIP. (2023). Too hot to insure? The rising challenge of climate change and risk pricing. Global Association of Insurance Professionals. https://www.gaip.global/publications/too-hot-to-insure/

GAIP. (2024). Beyond protection: Steering towards a resilient net zero future. Global Association of Insurance Professionals. https://www.gaip.global/publications/beyond-protection/

Gallagher Re. (2025, November 11). Japan's non-life insurance in 2025 gains strength through reform. Beinsure. https://beinsure.com/japans-non-life-insurance-gains-strength/

Green Central Banking. (2025, September 18). Insurance in Japan: Keeping the climate protection gap at bay. https://greencentralbanking.com/2025/09/18/how-japanese-insurers-are-keeping-the-climate-protection-gap-at-bay/

Insurance.com. (2025, May 14). State Farm in California: What you need to know. https://www.insurance.com/home-insurance/state-farm-stops-selling-home-insurance-in-california

International Association of Insurance Supervisors (IAIS). (2025). 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

International Energy Agency. (2025). World energy investment 2025: Southeast Asia. https://www.iea.org/reports/world-energy-investment-2025/southeast-asia

IPCC. (2023). Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (H. Lee & J. Romero, Eds.). IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647

Liu, S., et al. (2025). Quantifying salinity and drought drive forces on paddy field loss in the Mekong Delta, Vietnam. Communications Earth & Environment. https://www.nature.com/articles/s43247-025-02271-0

Merlin Law Group. (2025, October 13). California fire insurance crisis: Why insurers are cancelling policies and how homeowners can respond. https://www.merlinlawgroup.com/insurance-companies-cancel-fire-insurance/

Monetary Authority of Singapore. (2025, November 3). Unlocking opportunities in a changing risk landscape [Speech by Managing Director Chia Der Jiun at 21st Singapore International Reinsurance Conference]. https://www.mas.gov.sg/news/speeches/2025/unlocking-opportunities-in-a-changing-risk-landscape

Munich Re. (2025). Climate change is showing its claws: The world is getting hotter, resulting in severe hurricanes, thunderstorms and floods. Munich Re. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-2024.htm

NBC News. (2025, January 12). Los Angeles wildfires magnify California 'insurance crisis' as homeowners face $10B in losses. https://www.nbcnews.com/news/us-news/los-angeles-wildfires-rage-as-homeowners-face-billions-losses

Oxford Institute for Energy Studies. (2025). Japan's energy transition: The interplay of renewables, nuclear and fossil fuels. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2025/02/Insight-163-Japans-Energy-Transition.pdf

Renewable Energy Institute. (2017). Feed-in tariffs in Japan: Five years of achievements and future challenges. https://www.renewable-ei.org/en/activities/reports/20170810.php

Schellhase, J., & Warden, N. (2018). Singapore-based insurtech launches in Thailand. Insurance Business Asia. https://www.insurancebusinessmag.com/asia/news/breaking-news/singaporebased-insurtech-launches-in-thailand-88060.aspx

SEADRIF. (2025). Steady ground, secure futures: Disaster risk insurance for a stronger Southeast Asia — 2024 annual report. https://seadrif.org/annual-report/

SOMPO Holdings Inc. (2022). Climate-related disclosure (TCFD). UNEP FI. https://www.unepfi.org/wordpress/wp-content/uploads/2023/11/Sompo-Holdings-Inc._2022_disclosure.pdf

Swiss Re Institute. (2026). Natural catastrophes in 2025: Insured losses exceed USD 100 billion for sixth consecutive year. https://www.swissre.com/institute/research/sigma-research/sigma-2026-01.html

Swiss Re. (2025, December 16). 2025 marks sixth year insured natural catastrophe losses exceed USD 100 billion, finds Swiss Re Institute [Press release]. https://www.swissre.com/press-release/2025-marks-sixth-year-insured-natural-catastrophe-losses-exceed-USD-100-billion-finds-Swiss-Re-Institute/b9f9b6d1-e25f-49c3-a7df-5bcf33c4bef7

UNCDF. (n.d.). Climate Insurance-Linked Resilient Infrastructure Financing (CILRIF). United Nations Capital Development Fund. https://www.climatefinancelab.org/ideas/climate-insurance-linked-resilient-infrastructure-financing/

Willis Towers Watson. (n.d.). Carbon credit insurance. https://www.wtwco.com/en-gb/solutions/services/carbon-credit-insurance

World Bank. (2021). The Philippines parametric catastrophe risk insurance program pilot: Lessons learned. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/600081624863749561/the-philippines-parametric-catastrophe-risk-insurance-program-pilot-lessons-learned

World Bank. (2022). Vietnam country climate and development report. World Bank. https://www.worldbank.org/en/country/vietnam/publication/vietnam-country-climate-and-development-report

World Bank. (2024). Strengthening financial resilience against climate and disaster impacts: Key insights from UR24. https://www.financialprotectionforum.org/news/strengthening-financial-resilience-against-climate-and-disaster-impacts-key-insights-from-ur24

Appendix

The tables below provide a detailed breakdown of how physical and transition risks affect revenue and cost structures for each major sector of the insurance ecosystem. These complement the integrated analysis in the main body of this paper.

Life & Health Insurance

	Physical Risks	Transition Risks
Revenue	**Life insurance:** Rising mortality and morbidity from heat stress, extreme weather events, and shifting disease patterns can increase demand for life cover. However, income disruption from climate-related losses can erode premium affordability, particularly among lower-income policyholders. **Health insurance:** Higher incidence of heat-related illness, respiratory conditions, and vector-borne disease elevates utilisation of health insurance and raises demand for coverage. As medical costs rise alongside broader economic disruption, affordability constraints intensify.	**Group policies:** Carbon-intensive employers facing stranded assets or falling revenues may reduce or discontinue group life and health schemes. Insurers may also choose to exit high-carbon relationships, directly reducing premium income. **Individual policies:** Transition-related cost-of-living increases compress disposable income and reduce premium affordability. Insurers repositioning toward green products may attract sustainability-oriented customers, partially offsetting volume declines.
Expenses	**Underwriting:** Climate-adjusted data — heat indices, disaster exposure maps — should be integrated into pricing. Premium loadings require more frequent revision as risk profiles shift. **Claims and reinsurance:** Physical risks directly affect mortality and morbidity through disasters and worsening health conditions. Earlier and larger claims raise cession volumes and reinsurance costs.	**Compliance and reporting:** Expanding climate disclosure requirements may increase data collection and documentation costs. Failures to comply may attract regulatory penalties. **Liability exposure:** Insufficient disclosure of climate-related risks to policyholders and investors creates growing legal exposure for life and health insurers. Directors and officers (D&O) claims linked to transition-related

		misstatements or greenwashing allegations can add materially to the expense profile. **Reputational positioning:** Maintaining credibility with ESG-conscious customers, investors, and rating agencies requires consistent climate commitment, transparent reporting, and alignment between stated sustainability objectives and actual underwriting and investment decisions.

Property & Casualty Insurance

	Physical Risks	Transition Risks
Revenue	**Property insurance:** Rising flood, storm, and wildfire risk intensifies demand for property cover. However, in areas of highest physical risk concentration, insurers face growing pressure to withdraw from the market, eliminating revenue streams while widening the protection gap for households and small businesses. **Catastrophe insurance:** Greater awareness of protection gaps — by governments, corporates, and individuals — drives demand for catastrophe cover and parametric triggers. Where physical risks reach insurability tipping points, coverage withdrawal creates hard limits on premium growth. **Agriculture insurance:** Changing temperature and precipitation patterns raise crop yield volatility, increasing demand for agricultural and livestock cover across the food supply chain. **New parametric products:** Climate-linked parametric triggers (extreme heat, rainfall index) create new revenue	**Existing product lines:** The shift to electric vehicles, green buildings, and renewable energy infrastructure creates demand for tailored new coverages — including battery replacement, inverter failure risk, and solar installation cover. Legacy product lines in fossil-fuel-linked sectors decline, and revenue may compress during the transition between product generations. **Corporate clients:** High-carbon companies with stranded assets reduce their insured asset base or lose coverage altogether. Insurers that choose to exit fossil-fuel-linked risks accelerate this revenue decline. **Individual clients:** Affordability pressures from transition reduce premium capacity at the household level. Insurers that develop affordable green products can capture demand from sustainability-oriented customers.

	opportunities, particularly in markets underserved by indemnity products.	
Expenses	**Underwriting and claims:** Higher frequency and severity raise loss ratios across property, agriculture, and cat lines. Adverse selection worsens as high-risk customers seek cover; more granular segmentation is needed to price accurately. **Reinsurance:** Increasing peak exposures drive greater cession volumes. Reinsurers responding to their own loss experience raise rates, compressing primary insurers' underwriting margins.	**Underwriting and claims:** Retrofitting and new technology (EVs, solar, green-certified buildings) raises rebuild values and claim amounts. More intensive renewals are needed to reflect changed risk profiles. **Compliance and reporting:** Climate disclosure obligations apply equally to P&C lines, adding data collection and regulatory filing costs. **Liability and greenwashing risk:** Insurers maintaining coverage for high-carbon activities face growing reputational and legal exposure. Misaligned sustainability claims can attract greenwashing litigation, while climate liability claims against policyholders are increasingly pursued by regulators and activist litigants, raising uncertainty in claims recovery. **Innovation:** Developing parametric products, transition-linked covers, and climate resilience incentives requires upfront modelling, data investment, and higher initial loss experience.

Insurance Brokers

	Physical Risks	Transition Risks
Revenue	**Commission revenue:** Greater demand for tailored and affordable coverage — driven by rising physical risk awareness — increases client engagement and commission income, especially for brokers offering a wide product range.	**Commission revenue:** New technology adoption creates coverage gaps (e.g. green buildings, EVs, clean energy assets) that brokers help clients navigate, generating additional commission opportunities. **Fee-based advisory revenue:** Demand for risk management and business interruption valuation services grows as companies in transition face more volatile cash flows and complex risk profiles.
Expenses	**Data and communications:** Insurers require more granular client risk data for underwriting. Rising claim frequency also adds submission, follow-up, and case management workload. **Distribution:** New climate-linked products (parametric, micro-insurance) require additional distribution effort and client education to reach end users effectively.	**Risk assessment:** Clients adopting new technologies and strategies develop more complex and evolving risk profiles, requiring deeper profiling and more intensive information exchange with underwriters. **Compliance:** Carbon contribution reporting obligations extend to brokers, adding measurement, documentation, and filing costs, particularly for downstream emissions. **Capability investment:** Building expertise in emerging climate risk areas — transition finance, ESG disclosure,

		parametric structures — may require specialist hires or in-house training.

Reinsurance

	Physical Risks	Transition Risks
Revenue	**Reinsurance premiums (L&H and P&C):** Higher cession volumes from primary insurers across both life/health and property/casualty lines as physical risks escalate. Reinsurers can command higher rates for peak exposures, supporting revenue growth in hard market conditions. **Parametric and new products:** Primary insurers cede larger initial shares of innovative climate products. Reinsurers willing to take early positions can earn premium margins, while gaining proprietary loss data. **Investment returns:** Physical risk-linked damage to real estate and business disruption can weigh on investment returns from property and equity holdings.	**Reinsurance premiums:** Adverse selection among primary insurers (as corporate clients shed coverage) may increase cession volumes and allow reinsurers to improve terms. New product lines for transition-exposed risks generate additional premium flow. **Investment returns:** Rapid reallocation of capital between high- and low-carbon sectors creates mark-to-market volatility in reinsurers' investment portfolios, particularly in credit and equity holdings.
Expenses	**L&H underwriting and claims:** Sustained mortality and morbidity deterioration from chronic physical risks generates persistent cession pressure. Large events (disasters, pandemics) require rapid and high-volume claims processing.	**Existing product line claims:** Greener and higher-specification assets carry greater rebuild values, raising claim amounts for property and liability lines. Reinsurers face less granular data on these assets than primary insurers.

	P&C underwriting and claims: Catastrophe, property, and agriculture lines face surging loss ratios. More granular climate and flood data is needed for accurate risk stratification at the reinsurance level.	**New product claims:** Novel climate-linked products carry higher initial loss volatility and limited actuarial depth, increasing uncertainty in ceded claims experience. **Innovation costs:** Developing pricing expertise for emerging risk categories — parametric triggers, transition liability, carbon credit insurance — requires specialist talent and modelling investment.

Regulators & Policymakers

	Physical Risks	Transition Risks
Prudential Supervisory	**Solvency and capital:** More frequent and severe climate losses drive higher and more volatile claims, straining insurers' capital buffers. Greater loss uncertainty makes traditional capital models less reliable, requiring higher reserve requirements over time. **Reinsurance market tightening:** As global reinsurance capacity tightens and coverage becomes more restrictive, primary insurers retain more risk on their own balance sheets. This amplifies net loss volatility and widens protection gaps domestically.	**Credit risk in transition-exposed sectors:** Insurers' corporate bond holdings in carbon-intensive industries face deteriorating creditworthiness as regulatory standards tighten, raising default risk and capital charges. **Asset repricing:** Rapid policy shifts can trigger sharp mark-to-market losses in investment portfolios. Broad-based repricing may weaken sector-wide solvency positions simultaneously. **Disclosure and supervisory burden:** Expanding requirements under ISSB, IFRS S2, and regional taxonomies demand stronger supervisory data infrastructure, clearer guidance, and closer engagement with regulated entities.
Fiscal & Macroeconomic	**Productivity and GDP:** Extreme heat, flooding, and chronic weather disruption lower labour productivity and business output, contributing to slower or more volatile economic growth.	**Labour market disruptions:** Workers in carbon-intensive industries face displacement and skills mismatches, requiring reskilling programmes and targeted social protection to ensure a just transition.

	Fiscal pressures: Disaster response and resilient infrastructure investment compete with other budget priorities, compressing fiscal space available for adaptation. **Supply chain and infrastructure:** Damage to transport networks, utilities, and logistics hubs raises operating costs and constrains economic output across affected regions. **Social vulnerability:** Uninsured losses disproportionately affect lower-income groups, increasing demand for social support and widening economic inequality.	**Energy price volatility:** Rapid changes in energy pricing and supply create short-term cost pressures for households and SMEs, necessitating targeted policy support. **Competitiveness:** Carbon border adjustments and industrial policy pressures require coordinated strategy to maintain economic resilience while decarbonising high-emission sectors.
Social Protection	**Protection gap:** More frequent and severe climate events widen uninsured losses, increasing reliance on government support and raising long-term pressure on public budgets. **Public health:** Chronic heat, air pollution, and climate-related disease outbreaks raise healthcare demand and pressure public health systems. **Social equity:** Physical climate impacts concentrate in vulnerable communities, amplifying spatial and income disparities and increasing the need for targeted protection.	**Evolving coverage needs:** As business models and assets evolve through the transition, new insurance products are required. Building actuarial data for accurate risk pricing in novel areas takes time, creating interim gaps in coverage availability.