Adaptation and Resilience: The New Investment Imperative

October 8, 2025

Of all the things a power system operator worries about, jellyfish are probably not one of them. But in August, a swarm of barrel jellyfish were sucked into the cooling system of Western Europe's largest nuclear power station, shutting down the plant for 10 days.[1] A marine heatwave had triggered a bloom of the jellyfish, who today have far fewer natural predators to keep their numbers in check.

Introducing BloombergNEF's Adaptation and Resilience research

BNEF is launching a new research stream on **adaptation and resilience**, designed to help clients understand how climate adaptation is reshaping strategy and creating new risks and opportunities. This paper summarizes the current state of progress and highlights BNEF's research priorities to fill key knowledge gaps in the market. BNEF clients can follow our library of Adaptation and Resilience research.

The cost of climate change

This curious example demonstrates how exposed human systems are to the physical impacts of climate change and nature loss, which are mounting rapidly. Climate-related damages from fire, flood and storms cost the world's largest economies $1.4 trillion in 2024, up from $150 billion in the year 2000.[2]

In 2024 alone, the damage bill in the US hit $924 billion, which equates to 3.5% of national GDP. With virtually every year breaking a temperature record,[3] these financial impacts are only going to get worse.

How much worse? In its latest update, the Network for Greening the Financial System estimated that GDP would be reduced by 15% in 2050 under current policies using a top-down methodology,[4] which falls within the range of other sources: a 1-19% reduction in GDP by 2050.[5] While these estimation techniques face criticism,[6] bottom-up methodologies that usually produce much lower totals are intuitively under-estimates – how can they anticipate the many unexpected impacts of warming, like the jellyfish?

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1 Bloomberg News, Jellyfish Shut French Nuclear Reactors as Heat Wave Builds, August 11, 2025.

2 Bloomberg Intelligence, Climate Damages Tracker, April 2025.

3 BBC, World breaks hottest day record twice in a week, July 2024.

4 Network for Greening the Financial System, NGFS long-term climate scenarios – Phase V, November 2024. The NGFS current policies scenario results in 3.0C of warming by 2100.

5 GDP impacts under the most equivalent "Current Policies" scenario. Studies include: Kompas et al., The Effects of Climate Change on GDP by Country and the Global Economic Gains From Complying With the Paris Climate Accord, 2018, Kalkuhl & Wenz, The Impact of Climate Conditions on Economic Production. Evidence from a Global Panel of Regions, 2020, Kahn et al., Long-term macroeconomic effects of climate change: A cross-country analysis, 2021, Waidelich et al., Climate damage projections beyond annual temperature, 2024.

6 The NGFS for example has faced scrutiny for its use of high impact damage functions. The paper (Kotz et al., The economic commitment of climate change, 2024), underpinning the Phase 5 scenarios is currently undergoing additional peer review. The NGFS has acknowledged this review and will incorporate any necessary updates into future iterations" of its scenarios.

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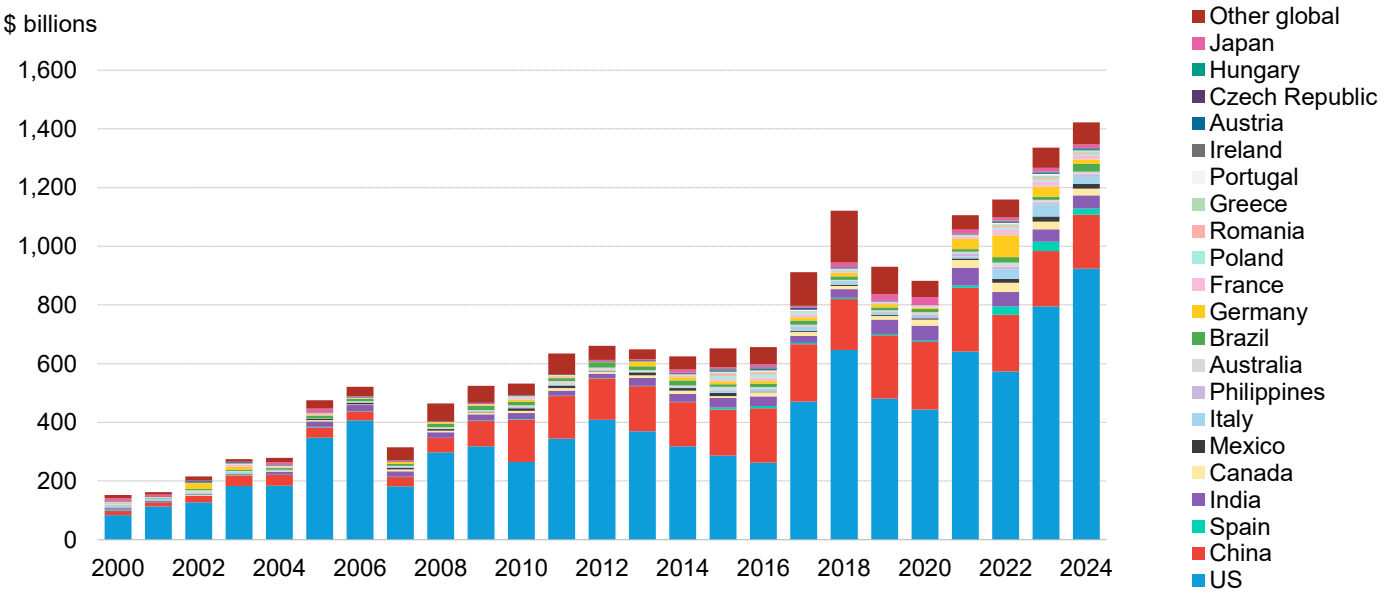
Even if you wish to be optimistic and plan for the world hitting net-zero by 2050, I'm afraid the impact is still stark – a 7% GDP impairment by 2050, according to the NGFS. None of these estimates include the impacts of nature-loss, which would likely add trillions more to the damage bill. Shielding the economy, businesses and people from these damages is the goal of climate adaptation.

Adapting to climate change will require hundreds of billions – and possibly trillions – of dollars of investment in everything from sea walls to seed science (Figure 2).[7] The best estimate is that we are currently spending only around $65 billion per year.[8]

The mounting damages bill we are already facing suggests that scaling this investment needs to be an imperative now.

The difficulty is that climate risk is mispriced – the market signals for investing in adaptation are absent, underdeveloped or weak. Political focus on adaptation has also always lagged mitigation, in part because focusing on adaptation can feel like an admission of defeat. But as the numbers above show, climate damages are already here, and the need for adaptation is not about giving up on reducing emissions: it is prudent risk management. The key question is: how do we scale the necessary investment? The answer is: by turning risk into opportunity.

Figure 1. Annual climate damages



Source: Bloomberg Intelligence Climate Damages Tracker, BloombergNEF. Note: Climate damages include insured and uninsured damages to property and climate-related government spending (including drainage grants, disaster prevention and recovery, environmental protection and agricultural insurance subsidies).

[7] There are no authoritative estimates of the global spending required on adaptation under different climate scenarios. The United Nations' 2024 Adaptation Gap Report estimates that developing countries alone require $387 billion per year of adaptation finance to 2030 (based on finance need reported in Nationally Determined Contributions and National Adaptation Plans). Including developed countries would substantially increase this figure.

[8] The Climate Policy Initiative estimates that $65 billion was spent on adaptation in 2023, although this largely consists of public finance and may be an underestimate. See: Climate Policy Initiative, Global Landscape of Climate Finance Data Dashboard, 2025.

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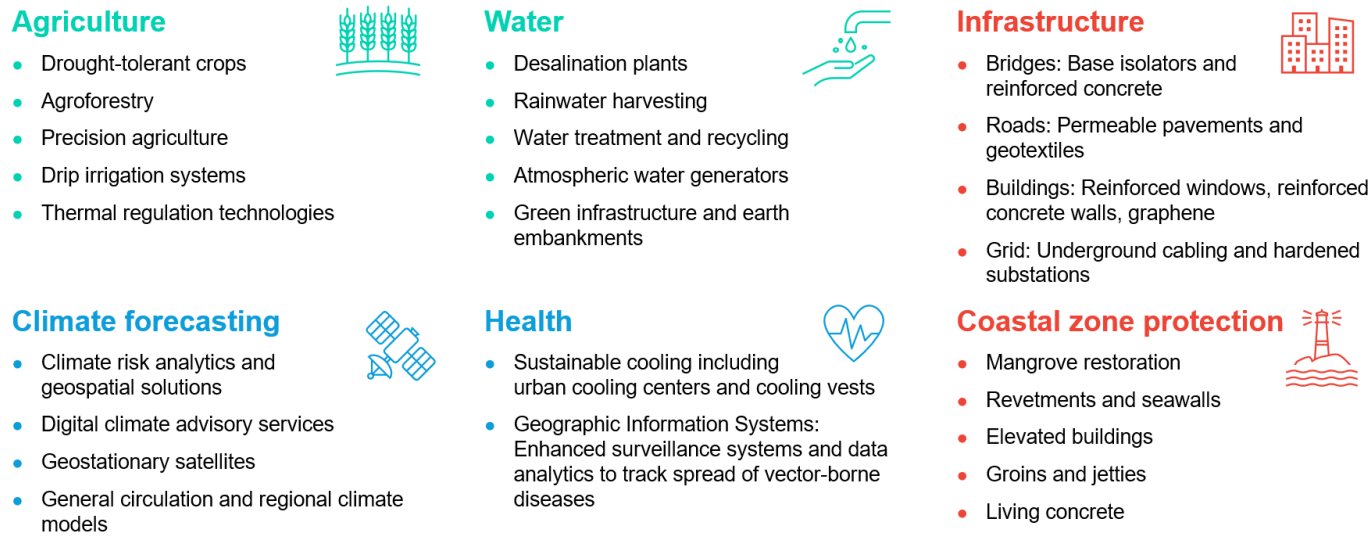
Figure 2: Examples of the adaptation technologies requiring investment



Source: BloombergNEF

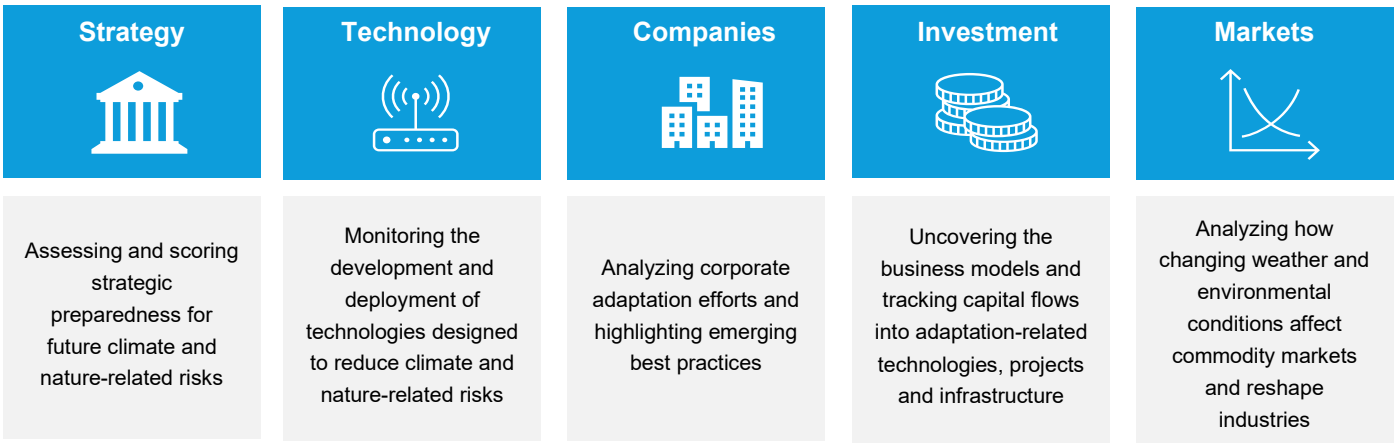
Who and what will make the money flow?

Investment in adaptation currently comes from four main sources: governments, corporations, financials and individuals. We'll unpack where each of them are on the adaptation journey, discuss what could change to make more money flow and highlight what research we will be doing to help you better understand the related risks and opportunities (Figure 3).

Governments – slowly getting into gear, but don't expect trillions

Public sources like governments and development finance bodies have so far contributed the lion's share of funding for adaptation, accounting for 90% of the total – or about $58 billion – in 2023.[8] Yet government's focus so far has mostly been on planning rather than implementation.

Figure 3: BNEF's Adaptation and Resilience research agenda



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According to the UN, 87% of governments have produced a National Adaptation Plan or some form of planning instrument,[9] as encouraged by the Paris Agreement. Leading countries, such as Canada and Singapore, have gone further, legislating National Adaptation Strategies and dedicating recurring budgets. However, many adaptation plans are flimsy or outdated.

This uneven progress should worry businesses and investors, because a country's preparedness for climate impacts will shape the probability of loss for the assets, companies and societies located in it. Many of the financial impacts of climate change are beyond any single entity's sphere of control. A firm can build the best flood defence in the world for its factory, but if the road leading to it is under water, it won't be able to move much product. To help investors understand the preparedness (or lack thereof) of the countries they operate in or depend on, BNEF will soon release a *Climate Adaptation Preparedness Framework and Country Scorecard*.

In our view, the outlook for significantly higher public spending is weak. Budgets will likely edge upward as disasters mount, but don't expect governments or the UN process to deliver the trillions required. As a case in point, the parties to the Paris Agreement haven't even been able to agree on what the key goals of its Global Goal on Adaptation actually are.

That said, some green shoots are emerging. City-level spending on nature-based solutions has reached a cumulative total of $48 billion by our count, and these local interventions often achieve positive returns.[10] A more significant step-up in government action could happen when rating agencies fully factor physical climate and nature risks into sovereign credit ratings, or when capital markets clearly treat climate resilience as a comparative economic advantage.

Perhaps more important than directly funding adaptation activities, however, is governments' role in catalyzing private finance. To date, their efforts have centered on soft levers like disclosure requirements. What's missing are hard, investible mechanisms – akin to those in mitigation[11] – that provide attractive risk-adjusted returns to mobilize investment from the private sector.

Corporations – quantifying risk, but missing the forest for the trees

Corporations disclose only about $4 billion a year in adaptation spending.[8] While some spending is likely buried in wider budgets, it's unlikely to be orders of magnitude more.

Our observation is that companies are thinking about climate risk but not yet spending much on reducing it.

The alphabet soup of climate regulations has spurred a flurry of physical risk analysis, but few real economy firms are moving from risk assessment to significant action. In fiscal year 2023, 37% of companies disclosed the potential impact of climate risks and opportunities on their business.[12] To do this, companies usually hire consultants to downscale the output of global climate models into site-level forecasts of precipitation, wind and temperature. Estimates of the damage and disruption these hazards would cause (to a typical structure at that address) are then used to calculate the value at risk.

Such analyses are a useful starting point, but they suffer major shortcomings: the models are opaque, results often conflict between providers, and – most importantly – they tend to focus narrowly on first-order

9 United Nations, Adaptation Gap Report, 2024.

10 BloombergNEF, *Nature-Based Solutions: Public Roots, Private Shoots*, 2025 (web | terminal).

11 For examples see: BloombergNEF, G-20 Zero-Carbon Policy Scoreboard, April 2024 (web | terminal).

12 IFRS, Progress on Corporate Climate-Related Disclosures, 2024.

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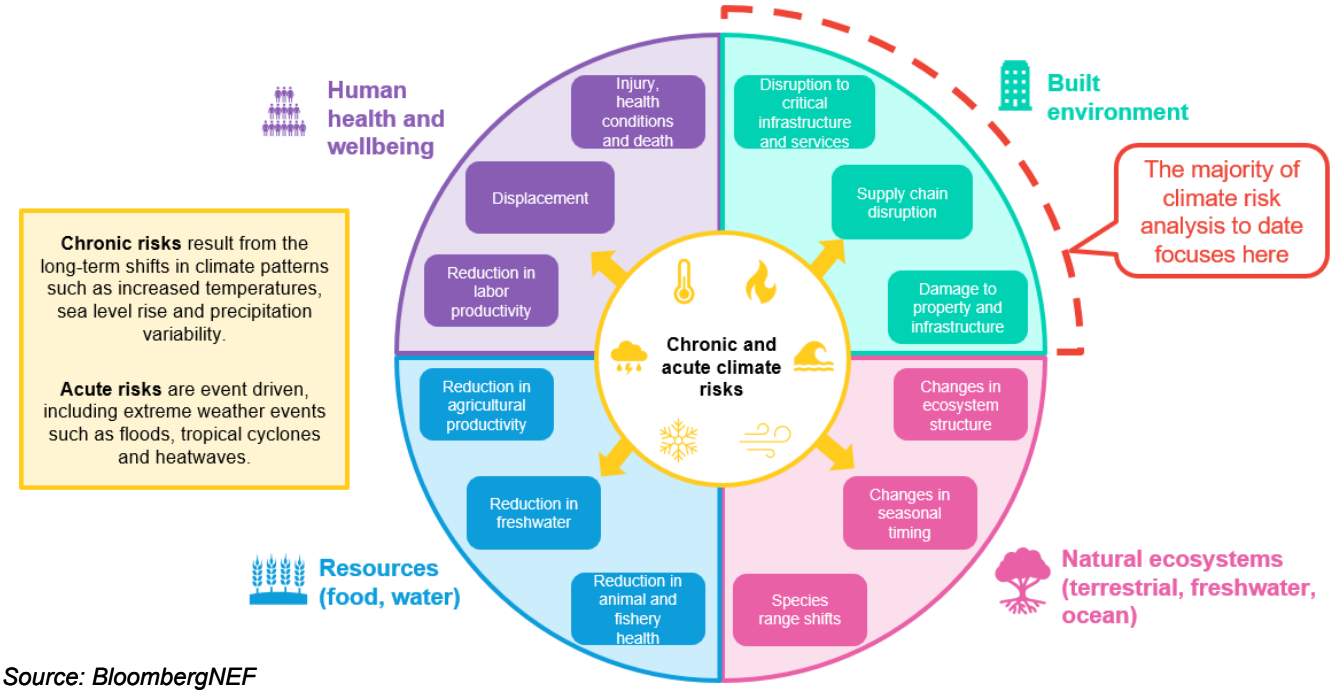
impacts in the built environment (Figure 4). These are the direct, predictable risks inside a property's boundaries, such as an increase in flood risk. These can seem like very manageable problems – a larger repair budget can cover the risk of an occasionally flooded foyer. However, that's like seeing only the tip of the iceberg.

The more serious threats are second-order, knock-on impacts that ripple through societies and economies (Figure 5), such as when a town floods repeatedly and falls into decline,[13] or when wildfire devastates tourism and halves the market capitalization of an airline,[14] or when you thought warmer outlet pipes were nothing to worry about, and then your nuclear plant is shut down by jellyfish.

Figure 4: First-order climate impacts



Source: BloombergNEF

Given the lack of disclosure around adaptation activities, it's hard to know what companies are doing to adapt and make themselves more resilient, what good looks like and what technologies and activities are being employed to reduce risk. Shining a light on corporate adaptation efforts and emerging best practice will be a focus of our future research.

Another poorly understood dimension of risk is how changes to the environment will impact commodity markets. From disruptions to oil supply from hurricanes to a decline in the supply of vulnerable agricultural goods, the physical impacts of climate change and nature loss will leave few industries unchanged. Understanding both the short-term weather shocks and the longer-term structural changes to business models will be another key focus of our analysis.[15]

[13] Northern Rivers Community Foundation, Flood Impact Report, 2023. Successive flood events in Lismore, Australia have left the population with ongoing homelessness, mental health issues and business closures.

[14] BloombergNEF, *Hawaiian Airlines' Wings Clipped: Nature Risk Case Study*, 2024 (web | terminal) and Maui Economic Development Board, 2023. The Maui 2023 wildfire resulted in $1 billion decline in tourism revenue and 25% reduction in tourism numbers even a year after the event. Permanent migration of residents also resulted in $50 million loss of income to the state.

[15] See for example BloombergNEF's theme page *US Commodities are Plagued by Extreme Weather Events* (web | terminal).

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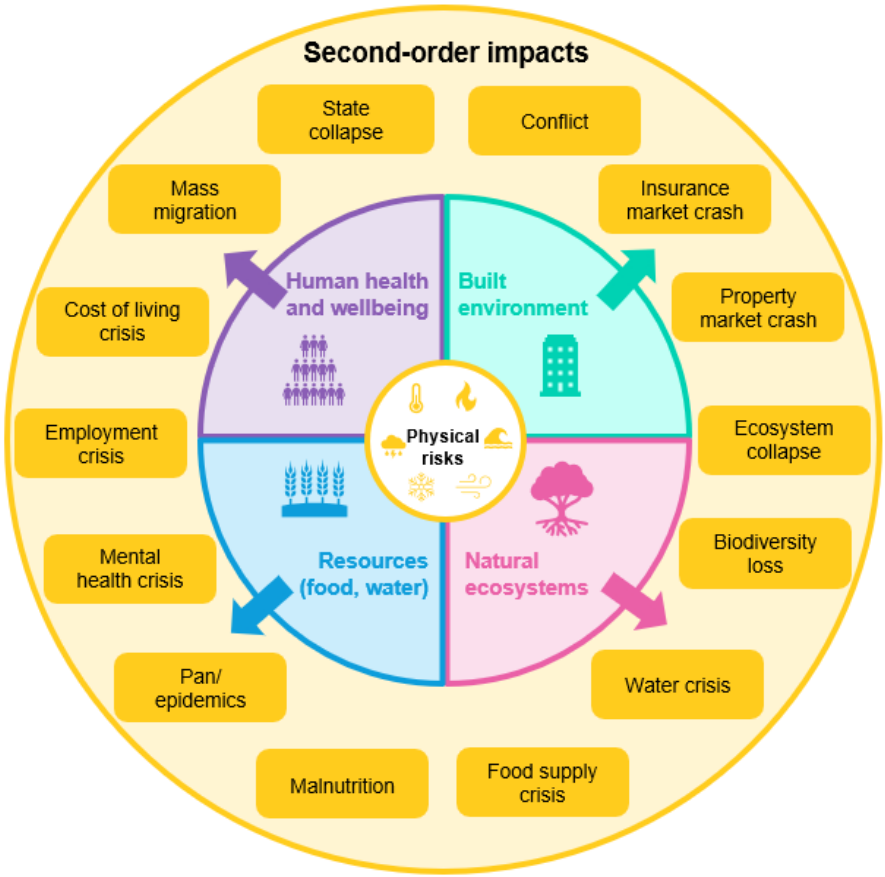
Figure 5: Second-order climate impacts



Source: BloombergNEF

What could start to change things? A better understanding of the risks can help to mobilize more corporate capital, particularly if insurance is repriced and credit ratings revised. But risks are never truly knowable, and fear alone is an incomplete motivator. For investment to scale, adaptation also needs to become an opportunity.

Signs of this are emerging. In the agricultural sector, the benefits of resilience are already a major motivator for producers. US landowners have converted over 4 million hectares of degraded pasture to regenerative farming, improving soil health, sequestering carbon, and stabilizing yields in volatile weather.[16] In California, wildfire liability has driven utilities to commit billions to undergrounding transmission lines and helped utility PG&E to achieve a credit rating upgrade.[17] The Bloomberg Intelligence Prepare and Repair tracker, which follows 110 firms in construction, building supplies, heating and cooling and other adaptive industries has outperformed the S&P 500 over the past

[16] BloombergNEF, Regenerative Agriculture Dashboard 1.0, 2025.

[17] BloombergNEF, US To Spend Billions Burying Power Lines Through 2030, 2025.

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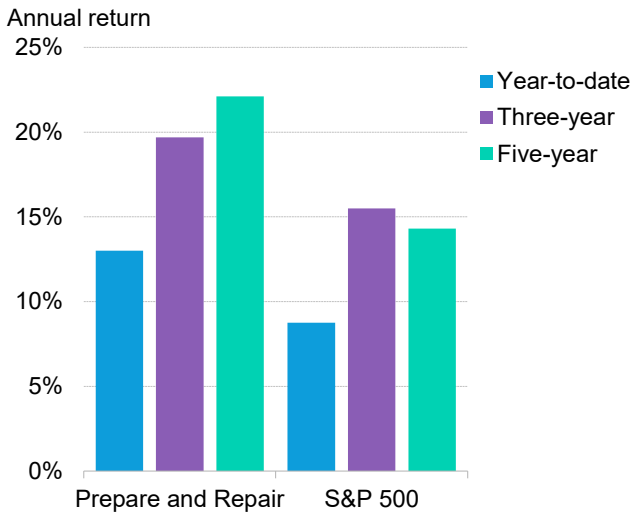
five years (Figure 6).[18] More broadly, global warming is expected to drive trillions in incremental demand for resilience-related goods and services.[19] Uncovering these opportunities will be another focus of our work on this topic.

Figure 6: Prepare and Repair theme vs. S&P 500



Source: Bloomberg Intelligence Prepare and Repair tracker

Financials – curious and waiting to act

Financial institutions have invested even less in adaption than corporates – under $1 billion in 2023 – although as with corporates, some activity is likely unreported.[8] However, stakeholders have told BNEF that they are eager to invest when business models become profitable.

Mostly motivated by evolving regulations, many institutional investors are also employing physical risk analysis to assess the exposure of assets in their portfolio. For some, this is a box-ticking exercise. Others use it to nudge exposed companies in their portfolio. The more advanced use it as a negative screen in due diligence, while the most sophisticated also apply it as a *positive* screen to identify assets well positioned for a warmer future. A few firms are already developing opportunity-based investment theses, such as real estate company Resilience Investments, which expect property price growth from internal migration towards "climate havens" in the US Great Lakes and Northeast. The opportunity to increase the resilience and natural capital value of farmland has also helped it achieve fourfold growth as an asset class.[20]

Banks are also being pressed by regulators and supervisors to evaluate climate risks, though no binding global standards exist yet (mostly due to US resistance). With balance sheets heavily exposed to real estate, lenders are especially at risk from cascading climate impacts. Leading banks now run quantitative analyses of climate risks across their mortgage portfolios, and some are beginning to act on the findings, such as through climate-risk-adjusted loan pricing. Progress is uneven, and many banks remain immature in their approach, but keen financiers are watching for the emergence of new business models and shifts in demand that create lending opportunities.

Insurers are heavily exposed to physical risks but also the most sophisticated in understanding them. For decades, insurers have refined tools to estimate climate damages, adjust pricing and manage exposure. Yet as risk aggregators and transferers, they will not fund adaptation directly. Instead, their critical role is to send the price signals that motivate others to invest. Rising premiums – or the withdrawal of coverage altogether – are already reshaping markets and will increasingly help make the business case for resilience. The challenge is ensuring that pricing engines reward adaptive actions with lower premiums and the restoration of coverage. At present, the global insurance protection gap is around 60%, and widening as more regions become uninsurable.[21]

[18] Bloomberg Intelligence, The Climate Economy 2025 Outlook

[19] GIC, Sizing the Inevitable Investment Opportunity: Climate Adaptation, 2025

[20] BloombergNEF, *Cultivating Capital: Institutional Farmland Investment*, 2024 (web | terminal).

[21] AON, Climate and catastrophe report, 2025

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Scaling up capital flows from financial institutions will mostly depend on the incentives for governments and corporates described above. More-exotic financial innovations are also being proposed. Catastrophe bonds could hypothetically be modified to help finance preventive infrastructure. Resilience bonds that explicitly monetize avoided losses from adaptation projects have also been proposed. And adaptation-linked debt swaps, such as Barbados' 2022 deal, restructure sovereign debt and earmark savings for funding resilience projects. None of these instruments are magic bullets: they remain complex, untested at scale, and reliant on a clearer articulation of risks and benefits. But they signal how adaptation and resilience could become new asset classes, a topic we will follow closely.

Individuals – adapting from the ground up

Individuals are ultimately the group that will shoulder the final burden of both the physical and financial impacts of climate change and nature loss.

Estimates of how much individuals are currently spending aren't available, but sales figures of key appliances show that individuals are already deploying capital to adapt. Backup generator sales have exceeded macroeconomic growth in the US and spike following cold snaps and hurricanes.[22] Studies show that in China, air conditioning sales increase 16% for every additional 30C day[23] – a trend set to accelerate as air conditioning electricity demand nearly double by 2050 in BNEF's Economic Transition Scenario.[24]

These examples demonstrate how climate change is likely to shift the sands on demand for many consumer goods. Identifying which products and services are likely to see upside as a result of the adaptation imperative will also be a focus of our future research.

Individuals are also heavily exposed to the price signals coming from insurance. In the US, homeowners' insurance has increased 8.7% faster than inflation in most states since 2018.[25] Bloomberg Intelligence estimates that this has caused a 4.6% average reduction in non-discretionary spending, particularly in low cost-of-living, high insurance-cost states such as Oklahoma and Texas.[26] Rising insurance costs in places like Florida and California are also providing a clear signal of the rising risks to real estate. This is already driving adaptive responses, such as homeowners fortifying roofs against hurricanes under Alabama's IBHS program,[27] or retrofitting properties in wildfire-prone areas to meet "Wildfire Prepared Home" standards.[28]

Spending by individuals on adaptation will almost certainly keep rising and may prove the most organic source of the "missing trillions." Much of it will be hard to track, since it is fragmented and difficult to attribute. Moreover, while households' propensity to respond is a sign that investment will eventually scale, such actions are likely to happen only after they have suffered damages. As such, it underscores the tragedy of climate change and nature loss: it is families who will shoulder the costs (where they can), while the poorest are left behind.

Realizing the imperative

There are growing signs that momentum is building in adaptation and that investment could begin to scale.

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22 Thompson and Pescaroli, Buying electricity resilience: using backup generator sales in the United States to understand the role of the private market in resilience, 2023.

23 Duan et al., China's adaptive response to climate change through air-conditioning, 2023

24 BloombergNEF, *New Energy Outlook*, 2025 (web | terminal).

25 US Treasury, Homeowners Insurance Costs Rising, Availability Declining as Climate-Related Events Take Their Toll, 2025

26 Bloomberg Intelligence, Deep Dive: The Climate Economy, 2025.

27 Insurance Institute for Business & Home Safety, Alabama Fortified Roof Endorsement.

28 Wildfire Prepared, Wildfire Prepared Home Certification.

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The current state of play and emerging green shoots suggest that this could happen through five main channels:

- **More accurate pricing of risk**: Clearer valuation of physical climate impacts, from more comprehensive risk analysis and recognition of second-order effects, to insurance pricing and eventually corporate and sovereign credit ratings.
- **Financial capture of benefits**: Instruments that monetize resilience outcomes, such as insurance premium reductions, municipal nature-based projects and resilience bonds.
- **Arbitrage**: Capital reallocating away from poorly priced, high-risk assets and toward those positioned to outperform, such as regenerative agriculture or real estate in climate havens.
- **Demand shifts**: Households and businesses increasing spending on resilience goods and services, from air conditioning to early warning systems.
- **Liability and regulation**: Government actions that set resilience standards and create financial accountability, such as building codes or liability for failures and disasters.

Of course, black swan events or sharper shocks could accelerate these dynamics. A reinsurer collapse, or a mortgage crisis triggered by climate-driven property devaluation, could reprice risk across markets and force more sweeping interventions. If physical risks continue to be mispriced, the “invisible” exposures concentrated on insurer and bank balance sheets could eventually trigger instability.

Whatever the trigger, the business case for adaptation is coming into focus. As it does, BNEF will track the bellwethers that matter and spotlight the models that work — helping clients navigate the adaptation imperative and turn climate and nature risk into opportunity.

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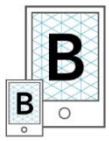

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