MOTT MACDONALD | Sust Global.

Physical climate risks in investment processes

IPFA Energy transition special interest group (SIG) report

Led by equitix

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Introduction

As extreme weather events grow in both severity and frequency, infrastructure systems are increasingly exposed to climate-related risks. In private infrastructure markets, this exposure is amplified by the inherent vulnerability of real assets. With infrastructure damages and disruptions already costing up to $700 billion per year globally[1], adapting these systems is essential to protect economic development and sustain long-term value.

Yet, infrastructure is instrumental to climate action. Decarbonising the global economy hinges on significant investment in infrastructure to support the low-carbon transition. Concurrently, evolving climatic conditions are reshaping demand for infrastructure services, with rising temperatures accelerating needs in sectors such as cooling, energy, and water management.[1]

Despite growing exposure, translating climate hazards into financial impact remains a major challenge. There is no universally accepted method to convert physical climate risks into financial metrics. In parallel, integrating these risks into investment processes is equally complex. The absence of a standardised framework for embedding physical climate risk into investment lifecycles hinders consistent decision-making and impedes accurate pricing of climate risk.

In fact, The FCA Adaptation Report[2] identifies persistent challenges in accessing and applying climate risk data, which limit firms' ability to quantify exposure. It also highlights the need for enhanced risk management practices as physical climate risks increasingly threaten financial stability and portfolio resilience.

Yet, the economic case for adaptation is compelling. UNEP estimates that every $1 spent on resilient infrastructure avoids $4 in damage[3]. Reinforcing this, the U.S. Chamber of Commerce finds that every $1 not invested in disaster resilience today can cost communities up to $33 in lost future economic activity[4], underscoring the financial upside of proactive investment in resilience.

$1
Spent on **resilient infrastructure**

Avoids
$4
in **damage**

$1
not invested in disaster resilience

$33
in **lost future economic activity**

Regulatory momentum is beginning to address these gaps. For example, in the UK, the Financial Conduct Authority (FCA) mandates disclosures aligned with the Task Force on Climate-related Financial Disclosures (TCFD) for premium and standard listed companies, asset managers, life insurers and FCA-regulated pension providers.[5]

While global frameworks such as the TCFD and the International Sustainability Standards Board's (ISSB's) International Financial Reporting Standard (IFRS) S2 are driving improved integration of climate risks into reporting, practical guidance remains limited.

At the same time, political and macroeconomic factors are shifting the landscape. Fiscal constraints are reducing public capacity to fund adaptation, creating opportunities for private capital to play a more active role. While the investment case for adaptation is still emerging, industry efforts are underway to better define and quantify it.

These dynamics underscore the urgent need for investors to proactively assess, quantify, and manage physical climate risks. This White Paper explores potential solutions while highlighting the key challenges and enabling factors involved.

Background

Infrastructure's unique climate risk profile

Infrastructure investments are particularly exposed to climate-related factors due to their:

- **Physical nature:** Assets are geographically fixed, making them susceptible to localised climate hazards
- **Long-term horizons:** Infrastructure's long-term investment horizons may lead to increased exposure to climate risks that intensify over time
- **Ownership:** Tend to have direct or majority ownership of investments with greater ability to assess climate-related risks and advocate for, or directly implement, adaptation measures to build resilience[6]
- **Economic and regulatory sensitivity:** Infrastructure is subject to evolving climate-related regulations, insurance pressures, and stakeholder expectations

Defining physical climate risks

The International Energy Agency's (IEA's) definition of a climate hazard refers to the potential occurrence of climate-related physical events or trends that may cause damage and loss.

These hazards can be understood through several key dimensions:

Hazard types – Acute vs. chronic

Climate hazards are typically classified as either:

Image 1: Types of climate hazards and associated modelling trade-offs. Source: Verschuur et al. (2024).

Acute hazards: Sudden, event-driven occurrences such as storms, floods, wildfires, and heatwaves. These can cause immediate and severe damage to infrastructure assets.

Chronic hazards: Gradual, long-term changes in climate trends, including rising sea levels, increasing temperatures, and shifting wind patterns. These exert a continuous impact on infrastructure over time.

Multi-hazard interactions

Climate hazards rarely occur in isolation. Such interactions can amplify or dampen impacts. For example, in California, the 2021 wildfire season was driven by extreme heat alongside severe drought conditions and strong winds, contributing to over 2.5 million acres burned across nearly 7,400 fires.[78]

Impact pathways – Direct vs. indirect

To evaluate the full spectrum of climate risks to infrastructure, Verschuur et al. (2024) propose a four-tier framework that reflects increasing complexity and systemic impact[9]:

Asset-level: Focuses on individual asset vulnerabilities and impact to the site itself.

Network-level risk: Refers to climate impacts within a single infrastructure system (e.g. electricity, transport). It focuses on how hazards affect the assets and operations of that specific network.

Cross-network dependencies: Capture how disruptions in one system cascade into others. For example, a flood damaging power infrastructure may also disable water treatment facilities.

Systemic risk: Captures broader socio-economic consequences, such as indirect economic losses and societal disruptions resulting from infrastructure failure. In fact, climate change and disaster-related losses threaten up to 14% of global GDP growth annually, with critical systems, such as power, transport, and communications, bearing 80% of this risk.

As the tier increases, so does the spatial scale and complexity of modelling required, making validation more challenging but essential for understanding systemic vulnerabilities.

Traditional risk assessments often overlook these interdependencies. To build resilience, planning must account for both direct impacts and the complex web of interconnections.

Climate risk and financial performance

Climate risk is now a recognised driver of financial performance[10]. By adopting increasingly quantitative assessments, investors are more likely to identify potential disruptions, evaluate asset exposure, and identify opportunities for adaptation in order to protect returns.

Potential cash flow impacts

Climate events have the potential to disrupt operational and financial performance, leading to cash flow impacts. Studies[11] [12] show firms in high-risk areas experience:

Revenue disruption

Asset downtime, reduced demand, and contractual penalties

Cost increases

Elevated O&M expenses, insurance premiums, emergency CAPEX, and utility costs

Liquidity pressures

Short-term working capital constraints and reduced financial flexibility

Insurability

Climate risk can affect insurability and investor confidence. Higher perceived risk can lead to exclusions, higher deductibles, and self-insurance requirements. Rising premiums and exclusions are well-documented in high-risk areas.[13]

Credit ratings

Climate risk is increasingly integrated into credit risk models. Poor management can lead to downgrades.[14]

Financing and capital structure

Climate risk has the potential to significantly influence both the cost and availability of capital.

There is mounting evidence that infrastructure investments exposed to physical climate risk could face tightened lending standards, higher risk premiums, and increasing requirements for resilience.

For instance, a study by the Federal Reserve Bank of Chicago[15] found that U.S. banks significantly curtailed lending in counties with high climate risk exposure. Specifically, in areas with large loan balances, a one standard deviation increase in climate risk was associated with a 4.7% reduction in bank lending.

Similarly, the Basel Committee on Banking Supervision[16] has observed that banks are increasingly rationing credit to sectors and geographies vulnerable to physical climate risks. Loan-level analyses indicate that climate risk exposure has a more pronounced effect on financing for operational and capital expenditures, underscoring the growing sensitivity of credit markets to climate-related vulnerabilities.

Despite these developments, the current financial system does not yet fully reflect the economic implications of physical climate risks. The Coalition for Climate Resilient Investment (CCRI) has identified a persistent "market failure"[17] in which these risks remain underpriced in investment decisions, potentially leading to misallocated capital and underinvestment in resilience.

Moreover, there is a lack of consistency in how financial institutions are integrating climate risk into credit assessments. An EY study of UK and European banks[18] found that while many institutions are beginning to incorporate climate risk into credit risk models and expected credit loss (ECL) calculations, the depth, transparency, and methodological consistency of these efforts vary widely.

Refinancing risk

As climate risks increasingly materialise over the lifecycle of infrastructure assets, refinancing may become the critical juncture at which these risks are most visible.

What were once theoretical exposures, such as vulnerability to extreme weather or chronic climate stressors, may have manifested in ways that directly affect asset performance and financial viability.

This can lead to:

- **Stricter insurance and lending terms:** Including premium increases, coverage limitations, and tighter loan covenants
- **Enhanced technical scrutiny:** With lenders and advisors placing greater emphasis on the assessment of climate resilience and adaptation measures
- **Asset devaluation:** Where unmitigated risks reduce asset value, potentially making refinancing more expensive or even unfeasible

Climate risk quantification

The Expected Annual Loss (EAL) model is a widely used framework by the financial services industry for quantifying climate-related financial risks, particularly in the insurance industry.

The model estimates the average annual financial loss by analysing both the probability and severity of climate events over a defined period. This section will also explore how the EAL model can be applied to changes to insurance premiums.

Developing a climate risk outlook

To understand how climate risk could impact financial performance, a clear view of climate conditions is needed. Global climate models offer physics-based simulations that provide regional insights into future conditions, and recent advances in machine learning have enabled advisors to provide high resolution data to investors.

Many different modelling solutions and approaches exist with different trade-offs on many dimensions, including the number of hazards, accuracy, resolution, scientific rigor, and cost, with the optimal degree on each dimension varying situationally.

Additionally, it's important to use climate models in the context of what they are: Probabilistic models to predict far off future events. Applying data in this context and leveraging relevant uncertainty metrics is critical for a holistic climate risk outlook.

Site-level impacts

Quantifying an acute climate impact

To accurately assess site-specific climate impacts, it's essential to engage with management teams who have operational expertise. Their insights into structural, behavioural, and ecological dependencies are critical to fully understanding and costing the effects of specific climate hazards.

Using the example of a hurricane, if there's a 10% chance of a 'Category Five' hurricane hitting a site resulting in a 50% loss of asset value, the expected annual loss is 5% of the asset value. This methodology can then be extrapolated to other hurricane categories.

Build a damage function: To predict the physical damage a hazard is expected to inflict on an asset, teams use building damage functions, which are constructed using historical data from previous hazard events.

These damage functions are built by creating a curve that predicts expected damage for different hazard severity levels. For example, a wind farm might be expected have 5% of turbines damaged in a Cat 1 hurricane, 15% in a Cat 2 hurricane, etc.

This aggregated curve across all severities can be used to predict damage for each discrete severity level. The American Society of Civil Engineers provides a useful example of how damage functions can be constructed with historical claims data.[19]

Predict the aggregate financial impact: This step combines the losses from all severity levels to estimate the total expected loss due to hurricane damage for a given year at a specific asset.

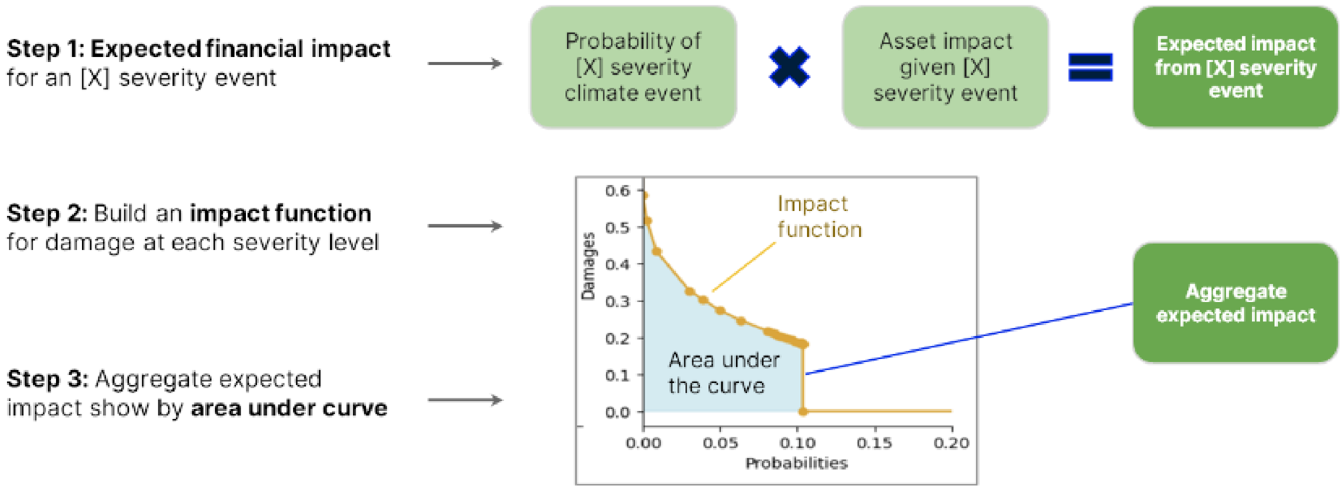


Image 2: Framework for calculating expected annual loss from climate-related events. Source: Sust Global

Quantifying a chronic climate impact

The solar energy generation industry is an example where chronic climate hazard can result in significant financial impacts.

On average, solar panels lose ~0.5% of efficiency per degree of warming when conditions are above 25°C[20], so temperatures over 40°C can result in significant efficiency losses (while heat is often correlated with sunshine, which is beneficial for solar assets, research shows that future warming isn't always correlated with increased sunshine).

Instead of focusing on the probability of a single event, it's more effective to consider the number of days in a year that exceed 40°C. Estimating the financial impact of heat waves on solar assets is likely to be more accurate as a result.

Case study – Climate-adjusted wind forecasting: Enhancing investment resilience

Equitix, in partnership with Sust Global, secured UK Space Agency funding through the *Unlocking Space for Business* programme to integrate the latest satellite data into climate risk analysis.

The project focuses on modelling the impact of climate-adjusted wind speed patterns on Equitix's operational wind portfolio, aiming to integrate climate considerations into long-term forecasting and resilience considerations.

Industry context

Traditionally, wind investment decisions rely on historical wind data, assuming patterns to continue in future. However, emerging evidence suggests that chronic climate shifts, such as changes in wind speed and direction, could materially affect energy output and asset performance.

Methodology

Using satellite-derived data and AI, the project developed:

- **High-resolution wind speed models** and **forward-looking analytics** for long-term energy yield and performance variability

These tools cover all operational wind sites in the Equitix portfolio, with projections extending to 2050, supporting strategic planning and climate resilience.

This approach draws on the framework from the EAL model by leveraging wind predictions, including both median predictions and uncertainty metrics, as well as projected future power prices, to estimate the financial impact that changing wind speeds could have on asset-level financial performance.

Climate model insights

The analysis incorporates both **raw** and **debiased** climate model outputs:

- **Raw data** provides baseline projections for wind generation variability
- **Debiased data** integrates historical performance from Equitix Asset Management to calibrate forecasts and improve reliability

Analytical outputs

Each dataset includes:

- **Geospatial maps** of forecasted wind generation (2025–2044), benchmarked against historical averages (2000–2024)
- **Forecast tables** for 5-, 10-, 15-, 20-, and 25-year horizons
- **Variability graphs** showing annual generation trends relative to long-term averages

This analysis has allowed Equitix's asset management team to engage with the data in a meaningful way, and it has the potential to identify where performance expectations may need to be adjusted.

Quantifying indirect financial impact – Insurance example

Climate events like wildfires can drive significant shifts in insurance premiums and coverage. To quantify these impacts:

- **Historical analysis:** Examine past insurance data to assess financial effects of climate events
- **Regional extrapolation:** Apply insights from one area to others with similar risk profiles
- **AI & machine learning:** Use advanced tools to integrate diverse datasets and enhance predictive accuracy
- **Local context:** Incorporate region-specific factors—regulations, asset values, income levels—to refine assessments

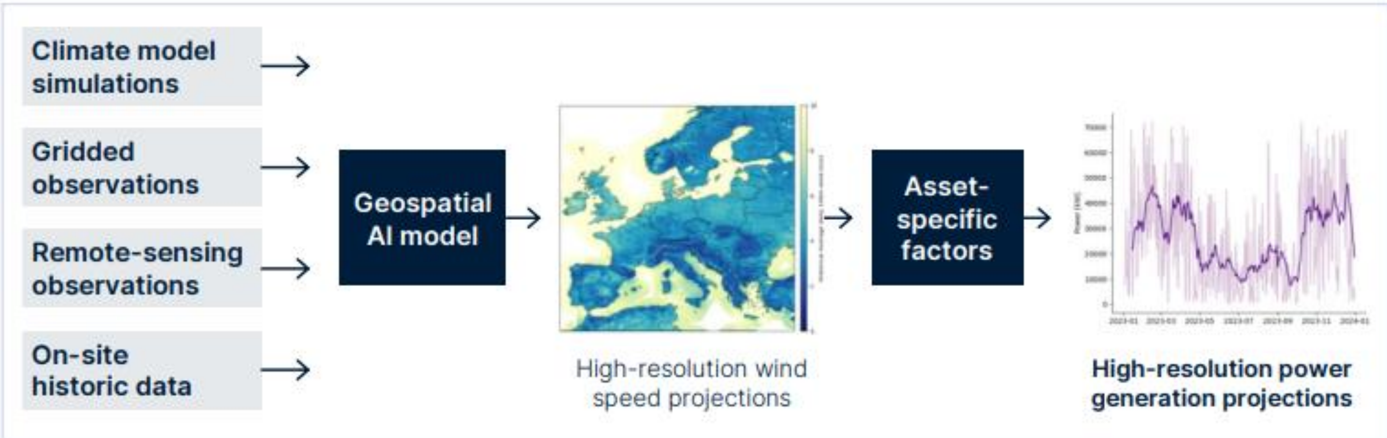


Image 3: Workflow illustrating the process for generating high-resolution power generation projections. Source: Sust Global

Quantifying network-level risks and interdependencies

Assets may exhibit low direct exposure to climate hazards yet remain financially vulnerable due to dependencies on surrounding infrastructure such as transport networks, utilities, and supply chains that are highly exposed. These indirect risks often lack visibility in conventional assessments, potentially leading to an underestimation of impacts.

To address this, it is essential to map and analyse the broader network, identify critical "chokepoints" or "bottlenecks", single points of failure, and assess climate risk exposure across the system. The following methodology outlines a structured approach to doing so.

1 System simplification

To effectively model climate risk across a complex network, the system can be first simplified into a series of representative nodes and components. These are grouped based on shared characteristics such as asset type and surrounding environmental conditions. This abstraction allows for scalable analysis while maintaining operational relevance.

The simplified model can be calibrated against current performance data and runs dynamically to reflect real-time flows of goods or services.

Climate hazards can then applied to this framework to simulate their impact on network operations.

2 Independent hazard analysis

Each node undergoes a standalone hazard assessment to evaluate its exposure to specific climate risks. This analysis considers the effects on maintenance requirements, operational performance, and asset lifecycle. By quantifying impacts across these dimensions, the model produces a comprehensive risk profile for each component. These profiles are then integrated into the dynamic system to generate risk-adjusted flow rates under various climate scenarios.

3 Risk scoring and dynamic modelling

For each node hazard probabilities and associated impact ranges are established for relevant hazards. These ranges of probabilities and impacts are aggregated to simulate system-wide impacts, including potential downtime and disruptions. The model calculates risk-adjusted performance metrics, such as lost shipments or reduced throughput, and identifies interdependencies between nodes.

This enables the detection of critical vulnerabilities or redundancies within the network, offering a more nuanced understanding of systemic risk.

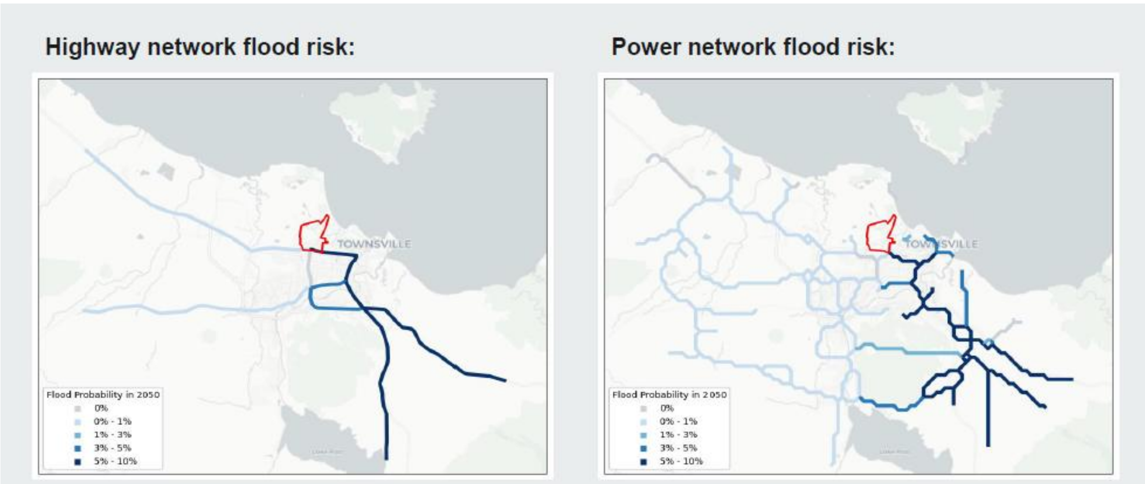


Image 4: Mapping the critical interdependencies between networks and sites for climate risk understanding. Source: Sust Global

The macro view of climate risk

Traditional risk assessments often focus on asset-level exposures, overlooking the broader interdependencies that shape financial outcomes.

Systemic climate risk analysis treats climate change as a global economic force. It integrates climate science with macroeconomic and financial models to assess how physical hazards affect growth, inflation, interest rates, and asset returns.

This approach is particularly relevant for institutional investors, such as pension funds, where strategic asset allocation is the primary driver of long-term portfolio performance.

Multimodal analysis and network dependencies

Multimodal analysis integrates climate data with infrastructure, demographic, and regulatory information to assess these risks.

Case study – Insurance premiums

For example, Sust Global's Populous model, developed in collaboration with Google Research, has shown how climate risk in one region (e.g. wildfire-prone California) can influence insurance pricing and financial outcomes in other, less exposed areas, highlighting the interconnected nature of systemic risk.[21]

Advances in geospatial AI are enabling teams to process data in novel ways, enabling investors to see relationships and insights that were previously missed.

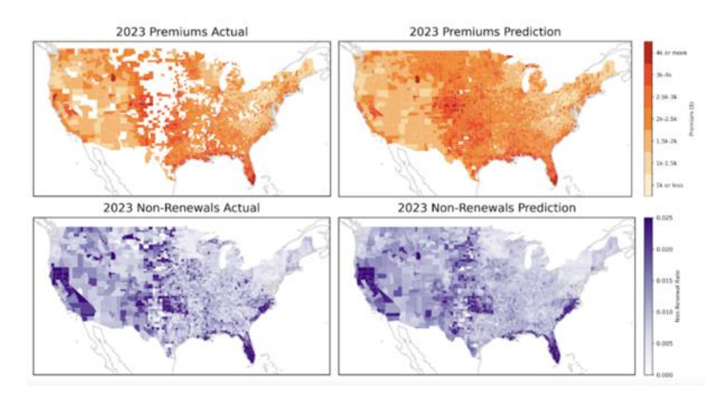


Image 5: Comparative analysis of insurance rate renewals and premium trends in the US. Source: Sust Global

Scenario-based stress testing

Scenario-based stress testing can be a key tool for assessing systemic climate risk. By simulating abrupt market-wide shocks, such as a sudden repricing to a 4°C or 6°C world, investors can evaluate how climate-related disruptions might cascade across asset classes and geographies. These short-term simulations complement long-term forecasts, helping investors understand portfolio resilience in the face of rapid regulatory shifts, tipping points, or changes in market sentiment.

Integration of physical climate risk into investment processes

As climate change becomes ever more relevant to financial performance, investors are recognising the need for structured approaches to embed climate risk into decision-making.

This is particularly critical during the due diligence phase, where understanding and managing exposure to physical climate risks can significantly influence long-term asset resilience and value.

Investment screening and due Diligence – A phased approach

Phase 1 – A screening approach

Adopting phased approaches—starting with a broad screening and advancing to detailed analysis, can help to assess exposure efficiently throughout the investment lifecycle.

Early-stage screening can be supported by a range of open-source platforms. These tools are particularly useful for identifying potential risk hotspots and initiating stakeholder engagement.

Case study – GRI climate risk viewer

The GRI climate risk viewer, developed by the Global Resilience Index Initiative (GRII) was created in collaboration with the University of Oxford, the UN Office for Disaster Risk Reduction (UNDRR).

A data and analytics portal that overlays hazards, exposure, vulnerability, and risk across infrastructure and populations globally. It supports climate adaptation decision-making by visualising spatial vulnerabilities under current and future climate scenarios.

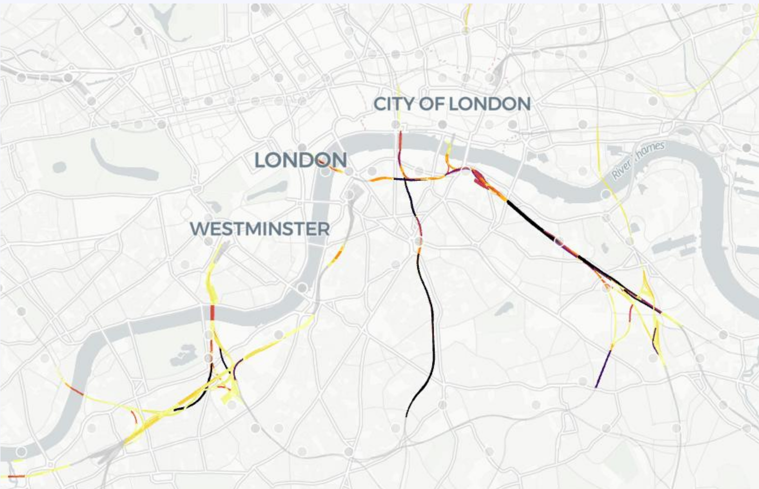


Image 6: GRI Climate Risk Viewer: Under an RCP 8.5 scenario (a worst-case emissions pathway), major aqueduct flooding zones are projected along the Thames by 2050. When overlaid with rail infrastructure, the tool highlights high-cost risk hotspots, particularly south of the river.

These tools are not intended to replace detailed analysis but serve as a first-pass filter to flag assets or regions that may warrant deeper investigation.

Phase 2 – Third-party assessment using proprietary tools

For assets flagged during initial screening, proprietary climate risk models offer more granular and actionable insights.

Advantages of proprietary tools[6]

- **Multi-model harmonisation:** Combines outputs from multiple climate models using consistent assumptions to improve reliability and reduce uncertainty
- **Asset-level resolution:** Provides detailed insights specific to individual assets, which is critical for investment decisions
- **Industry-native outputs:** Translates climate data into investor-relevant metrics such as expected annual losses, insurance premium impacts, or asset impairment risks
- **Integration with financial and demographic data:** Enables modelling of downstream effects, such as insurance non-renewal, premium increases, or changes in asset desirability

These tools help bridge the gap between climate science and financial decision-making, making complex data more accessible and actionable for non-specialists.

Case study – Rockefeller foundation

To support early-stage investment decisions for its Urban Resilience Fund, the Rockefeller Foundation commissioned a rapid climate screening tool through its 100 Resilient Cities initiative[22]. The tool addressed inefficiencies in traditional due diligence by introducing a two-stage assessment:

- **Stage 1 – Screening:** Binary questions filtered out proposals lacking basic climate risk considerations (e.g., absence of a risk assessment)
- **Stage 2 – Scoring:** A resilience quotient evaluated the depth of climate integration, including scenario use, time horizons, and design implications

Projects exceeding a defined threshold advanced to full due diligence; others received feedback for resubmission. The approach accelerated climate risk integration and built a scalable framework for prioritizing resilient infrastructure.

Cost-benefit analysis

To evaluate the economic benefit of resilience, cost-benefit frameworks can be applied that compare the financial implications of adaptation versus inaction.

A typical approach includes:

1. **Baseline scenario:** Estimating damage costs over an asset's lifetime without adaptation, including repair, disruption, and social impacts, for example, by using the EAL model

2. **Adaptation scenario:** Assessing the cost of resilience measures such as flood barriers, heat-resistant materials, and early warning systems
3. **Avoided damages:** Calculating the difference between baseline and residual costs
4. **Benefit-Cost Ratio (BCR):** Quantifying the return on adaptation investment

Quantifying impacts in financial terms empowers decisions on whether to avoid, mitigate, or transfer climate-related risks within the investment process.

A more detailed overview of this process can be found in the Physical Climate Risk Appraisal Methodology (PCRAM) first launched by the Coalition for Climate Resilient Investment with support from Mott MacDonald.[23]

Version 2.0[24] of the methodology is now part of Institutional Investors Group on Climate Change (IIGCC) Climate Resilience Investment Framework (CRIF). Mott MacDonald continues to support the IIGCC in PCRAM 2.0 development and launch activities.

PCRAM enables its users to better harness multi-disciplinary services to achieve better results, including climate science, engineering, and finance. By providing a consistent and evidence-led approach to assessing and quantifying climate risk, PCRAM is enabling investors, asset owners and operators to better align their practices and metrics and establish a more confident case for investing in infrastructure and real estate resilience.

Investment decision making

One proposed method is to adapt the classic risk management hierarchy to guide climate-integration for physical assets.

Rather than prescribing a single solution, this framework offers a flexible and scalable methodology for assessing and managing climate-related risks across sectors and geographies.

Avoidance

Exclude assets with high exposure to physical climate risks (e.g. flood-prone sites)

Mitigation

For assets with manageable exposure, invest in resilience-enhancing measures

Transfer

Employ financial instruments to shift residual risk

Acceptance

Budget for residual risks that cannot be avoided or transferred

Monitoring

Implement ongoing risk assessments and integrate climate data into asset management systems by tracking changes in hazard exposure and updating risk models

Avoid

Investments may be avoided when the potential costs of the exposure evidentially outweigh the potential returns. Examples could include where:

- Assets are highly exposed with limited adaptive capacity and
- Risks cannot be transferred by insurance mechanisms

Risk mitigation

If the cost-benefit analysis highlights value from investment in resilience, mitigation of the risk might be appropriate. A wide variety of mitigation measures could be deployed.

Tools such as the Physical Climate Risk Assessment Methodology (PCRAM) categorises mitigation measures as follows:

Structural measures

- **Engineering:** Traditional infrastructure upgrades (e.g. drainage, sea walls)
- **Nature-based:** Enhancing natural systems (e.g. green infrastructure, ecosystem restoration

Non-structural measures

- **Maintenance:** Reducing downtime through upkeep
- **Performance:** Safeguarding asset functionality
- **Life cycle:** Adjusting repair and replacement schedules
- **Other:** Context-specific actions identified during assessment

The feasibility and appropriateness of these measures can be analysed leveraging the cost-benefit analysis approach applied during investment due diligence.

Cross-disciplinary collaboration is essential to evaluate and implement the full range of resilience options.

Risk transfer

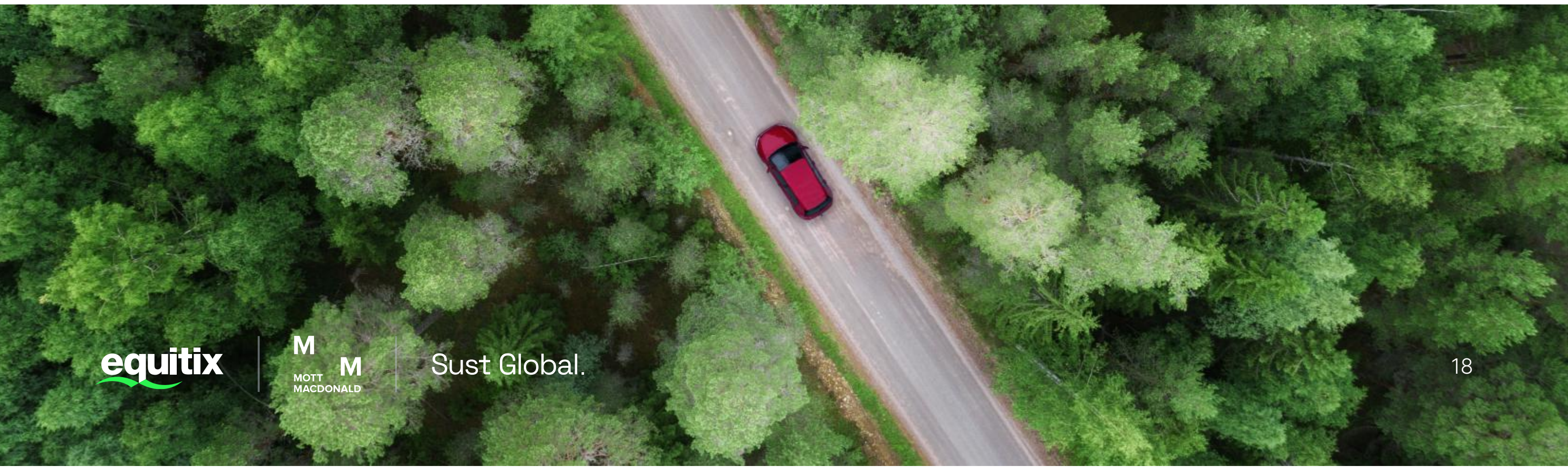
Risk transfer involves shifting the potential financial burden of climate-related losses to third parties.

Examples could include insurance measures, catastrophe bonds or protection through operational provisions in contracts.

Parametric insurance: Parametric insurance is a novel approach where payouts are triggered by predefined thresholds (e.g., temperature, wind speed, rainfall) rather than actual loss assessments.[25]

This method offers:

Rapid payouts	Enables faster recovery by avoiding lengthy claims processes
Quantifiable coverage	Simplifies underwriting and pricing
Partial protection	Ideal for covering high-frequency, low-severity events



Catastrophe bonds

Catastrophe bonds are risk-linked securities that transfer disaster risk to investors. If a specified event occurs, the bond issuer can use the principal to cover losses, reducing reliance on traditional insurance.[26]

Operational provisions in contracts

Contractual mechanisms can embed climate risk transfer within project delivery and operations. Examples could include:

- **Performance-based contracts:** Link payments to climate-resilient outcomes
- **Force majeure clauses:** Account for climate-induced disruptions
- **Climate-indexed maintenance schedules:** Adjust asset upkeep based on climatic conditions
- **Shared savings/risk pools:** Distribute risk among stakeholders

Integrating climate risk into asset management

Post-acquisition integration

Mitigation efforts do not end at financial close. Post-acquisition processes ensure that climate resilience measures are implemented, monitored, and refined over time.

Contractual provisions: Climate-related recommendations should be embedded into agreements with the investee company and master service agreements (MSAs). This step is critical for establishing clear expectations from the outset.

Transition to asset management: The asset management team is engaged to ensure continuity and execution of climate-related measures.

Implementation and monitoring: Resilience measures, such as physical upgrades, operational adjustments, and contractual changes, are executed. Climate-related KPIs are tracked, scenarios are periodically updated, and governance structures are maintained to ensure accountability.

Disclosure: Residual risks are documented and reported in alignment with frameworks such as TCFD and IFRS S2.

Managing legacy assets

Legacy assets can lack robust climate risk assessments. For these assets, mitigation is retrospectively embedded during the asset management phase.

- **Retrospective assessment:** Climate risks are identified and quantified using updated models and site-specific data
- **Adaptation planning:** Measures are developed to address vulnerabilities, often requiring stakeholder engagement and operational adjustments where applicable

Engagement as a catalyst for action

Engagement with asset operators and management teams is critical to translating top-down assessments into bottom-up action.

The Equitix initiative, developed in collaboration with Mott MacDonald and recognised by the PRI Awards 2024[27], illustrates a data-driven approach to managing climate risk across legacy infrastructure assets. By engaging directly with asset operators to collect site-specific climate data, the project enables retrospective risk assessments and supports the development of portfolio-wide monitoring frameworks.

Case study – Equitix engagement with Viridor Energy

Viridor Energy is a UK-based company that converts non-recyclable waste into energy through its network of Energy from Waste (EfW) facilities. Equitix, an infrastructure investment firm, has progressively acquired stakes in Viridor Energy, starting with a 20% share in 2021 and increasing its ownership to 35% by 2023.

Equitix carried out a top-down physical climate risk assessment of Viridor Energy, sharing the findings with the company's sustainability team. The assessment identified potential vulnerabilities under a worst-case climate scenario and included an initial review of existing and planned mitigation measures, informed by feedback from Viridor Energy's management.

Thereafter, consultants were engaged by Viridor Limited to conduct a physical climate change risk assessment and to develop a climate change adaptation plan. This aligned with the recommendations of the TCFD.

This led to:

- Coverage of 10 operational Energy from Waste sites, 3 under construction, and a carbon capture project
- 15 workshops and site visits to ensure operational realities were captured
- Scenario analysis under SSP2-4.5 and SSP5-8.5 for 2035 and 2065
- Financial modelling with a materiality threshold established in line with existing risk management policy

Outcome: Equitix's initial top-down screening helped identify key areas of potential vulnerability, but it was the subsequent engagement with Viridor's sustainability team that enabled a more granular, site-specific understanding. This level of insight, particularly around operational realities and practical mitigations could not have been achieved through desktop analysis alone.

Challenges in implementation

Despite growing awareness, several barriers hinder consistent integration of climate risk mitigations.

Data complexity and decision-making

The global proliferation of climate risk tools and frameworks has led to significant data overload and methodological fragmentation which makes it difficult to integrate into investment processes.[28]

At the same time, adaptation decisions are inherently site-specific which makes it difficult to apply standardised approaches across assets or portfolios.

The complexity places a growing burden on asset managers, who often lack the tools needed to ask targeted questions and interpret climate data effectively.

The absence of streamlined engagement mechanisms further complicates decision-making, limiting the ability to translate technical insights into actionable strategies.

Reporting and modelling gaps

Climate risk models often lack transparency around their underlying assumptions and confidence levels, which creates uncertainty in decision-making.[29] Despite growing awareness of future climate impacts, climate-adjusted data is rarely embedded into asset performance projections. As a result, investors continue to rely heavily on historical data, which may no longer be reliable under changing climate conditions.

This creates a feedback loop: Limited adoption of forward-looking climate data reduces trust in its accuracy and relevance, while low trust slows further adoption.[30] Breaking this cycle requires improved modelling transparency, clearer communication of uncertainty, and broader integration of climate-adjusted metrics into financial analysis.

Effective governance and mandates

Effective governance is central to embedding climate risk into asset-level decision-making. Boards play a critical role in setting the tone and expectations for climate resilience across the investment lifecycle:

In infrastructure deals, climate risk tends to only be addressed if explicitly required by financial institutions.

Three technical entities would determine how resilience is embedded:

1 Owner's engineer

Sets technical standards during early design and permitting. Climate resilience is only included if mandated by the asset owner

2 EPC contractor

Delivers the asset to specification. Will not address climate risk unless it is part of the project brief

3 Technical advisor

Reviews risks during due diligence. Can flag climate vulnerabilities, but only if climate is within their scope from lenders and shareholders

This highlights the importance of clear early-stage requirements and top-down mandates from investors to ensure climate resilience is built into asset design and delivery.

Portfolio-level integration

Applying a portfolio lens to climate risk is inherently challenging. While asset-level assessments are advancing, scaling these insights across diverse portfolios remains complex. Moreover, such an approach may not always be appropriate, as climate risks are often highly site-specific and cannot be uniformly extrapolated across a portfolio.

Prioritisation frameworks are needed to identify which assets warrant deeper analysis, based on factors such as investment duration, sectoral exposure, and geographic vulnerability.

For example, the FCA Adaptation Report[2] highlights that climate risk is most material in long-duration investments and sectors reliant on natural systems.

However, the absence of standardised criteria and thresholds makes it difficult to compare risk across assets or allocate resources effectively.

This challenge underscores the need for robust, scalable frameworks that support strategic climate risk integration at the portfolio level.

Conclusion

Climate risk is no longer a distant concern, it's a material factor shaping infrastructure investment today. While tools and frameworks are evolving, integration remains uneven due to data complexity, modelling gaps, and fragmented governance.

Rather than waiting for a universally accepted solution, investors should take a pragmatic approach: Leveraging existing data, frameworks, and industry standards to embed climate risk across the investment lifecycle—from screening and due diligence to asset management and disclosure.

Progress doesn't require reinventing the wheel. By tapping into established forums and decision-making structures, investors can assess, monitor, and report climate risk in ways that are both context-specific and operationally feasible.

Proactive steps taken now will help protect long-term value, meet rising regulatory expectations, and build more resilient infrastructure.

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References

[1]Verschuur, J., Fernández-Pérez, A., Mühlhofer, E., Nirandjan, S., Borgomeo, E., Becher, O., et al., 2024. Quantifying climate risks to infrastructure systems: A comparative review of developments across infrastructure sectors. *PLOS Climate, 3(4), e0000331. https://doi.org/10.1371/journal.pclm.0000331*

[2]Financial Conduct Authority (2025) FCA Adaptation Report 2025. [online] Available at: https://www.fca.org.uk/publications/corporate-documents/fca-adaptation-report-2025

[3]United Nations Environment Programme (2023) *Adaptation Gap Report 2023: Underfinanced. Underprepared – Inadequate investment and planning on climate adaptation leaves world exposed.* Nairobi: UNEP.

[4]U.S. Chamber of Commerce, Allstate & U.S. Chamber of Commerce Foundation (2025) *Beyond the Payoff: How Investments in Resilience and Disaster Preparedness Protect Communities.* [online] U.S. Chamber of Commerce.

[5]Financial Conduct Authority (2021) PS21/24: *Enhancing climate-related disclosures by asset managers, life insurers and FCA-regulated pension providers.* [online] Available at: https://www.fca.org.uk/publications/policy-statements/ps-21-24-climate-related-disclosures-asset-managers-life-insurers-regulated-pension

[6]Principles for Responsible Investment, 2025. Assessing physical climate risk in private markets: A technical guide

[7]CAL FIRE (2021) *2021 Fire Season Incident Archive.* [online] Available at: https://www.fire.ca.gov/incidents/2021/

[8]National Oceanic and Atmospheric Administration (2023) *Wildfire climate connection.* [online] Available at: https://www.noaa.gov/noaa-wildfire/wildfire-climate-connection

[9]Verschuur, J., Fernández-Pérez, A., Mühlhofer, E., Nirandjan, S., Borgomeo, E., Becher, O., Voskaki, A., Oughton, E.J., Stankovski, A., Greco, S.F., Koks, E.E., Pant, R. and Hall, J.W., 2024. Quantifying climate risks to infrastructure systems: A comparative review of developments across infrastructure sectors. *PLOS Climate*, 3(4)

[10]Bank of England and Financial Conduct Authority (2020) *Climate Financial Risk Forum Guide: Session 1.* [online] Available at: https://www.bankofengland.co.uk/climate-change/climate-financial-risk-forum

[11]United Nations Environment Programme Finance Initiative (2025) *Bridging Climate and Credit Risk.* [online] Available at: https://www.unepfi.org/wordpress/wp-content/uploads/2025/07/Bridging-Climate-and-Credit-Risk.pdf

[12]Fitch Ratings (2025) *Climate Change & Credit Ratings: Climate Risk in Debt Capital Markets.* [online] Available at: https://www.fitchratings.com/topics/climate-change

[13]Sousounis, P.J. (2024) *Availability, Affordability, and Adequacy of Insurance in Areas Impacted by Climate-related Risks.* Society of Actuaries Research Institute. [online] Available at: https://www.soa.org/resources/research-reports/2024/ins-availability-climate-risk-areas/

[14]Tan, S.X. (2025) *Climate Risks Underplayed in Recent Credit Rating Actions.* Institute for Energy Economics and Financial Analysis (IEEFA). [online] Available at: https://ieefa.org/resources/climate-risks-underplayed-recent-credit-rating-actions

[15]Meisenzahl, R.R. (2023) *How Climate Change Shapes Bank Lending: Evidence from Portfolio Reallocation.* Federal Reserve Bank of Chicago Working Paper No. 2023-12. [online] Available at: https://www.chicagofed.org/publications/working-papers/2023/2023-12

[16]Basel Committee on Banking Supervision (2022) *Principles for the Effective Management and Supervision of Climate-related Financial Risks.* Bank for International Settlements. [online] Available at: https://www.bis.org/bcbs/publ/d532.pdf

[17]Coalition for Climate Resilient Investment (CCRI), 2021. *Risk and Resilience: A framework for investment decision-making.* [online] Available at: <https://resilientinvestment.org/risk-and-resilience-report/

[18]Fabiani, F. (2025) *Impact of climate risk on banks and expected credit losses. Ernst & Young Global.* [online] Available at: https://www.ey.com/en_gl/insights/ifrs/impact-of-climate-risk-on-banks-and-ecl

[19]Porter, J., Marston, M., She, E., Bauer, M., Lai, K., Wilson, B., Pope, M., 2022. Estimating Pluvial Depth–Damage Functions for Areas within the United States Using Historical Claims Data, https://ascelibrary.org/doi/10.1061/NHREFO.NHENG-1543

[20]Bamisile, O., Acen, C., Cai, D., Huang, Q., Staffell, I., 2025, The environmental factors affecting solar photovoltaic output, Renewable and Sustainable Energy Reviews, Volume 208, https://doi.org/10.1016/j.rser.2024.115073.

[21]Ballard, T., Erinjippurah, G., Sierks, M., Sousounis, P., 2025, Populous: A Multimodal Geospatial AI Model for Understanding the Climate-Driven Insurance Crisis in the U.S., ICLR 2025 Workshop on Tackling Climate Change with Machine Learning, https://www.climatechange.ai/papers/iclr2025/61

[22]The Rockefeller Foundation (n.d.) *100 Resilient Cities.* Available at: https://www.rockefellerfoundation.org/100-resilient-cities

[23]Coalition for Climate Resilient Investment (2021) *Physical Climate Risk Assessment Methodology (PCRAM).* Available at: https://resilientinvestment.org/pcram/

[24]Mott MacDonald (n.d.) *PCRAM: The industry methodology for climate resilient infrastructure investment.* Available at: https://www.mottmac.com/en/insights/topics/pcram-the-industry-methodology-for-climate-resilient-infrastructure-investment/

[25]Horton, J.B. (2021) ‘Parametric insurance as an alternative to liability for compensating climate harms’, *Ethics, Policy & Environment*, 24(3), pp. 333–350. Available at: https://www.jstor.org/stable/26554652

[26]Grantham Research Institute on Climate Change and the Environment (2024) *What role do catastrophe bonds play in managing the physical risks from climate change?* London School of Economics and Political Science. Available at: https://www.lse.ac.uk/granthaminstitute/explainers/what-role-do-catastrophe-bonds-play-in-managing-the-physical-risks-from-climate-change/

[27]UN PRI (2024) *Equitix: Bridging the climate data gap in private infrastructure.* [online] Principles for Responsible Investment. Available at: https://www.unpri.org/climate-change/equitix-bridging-the-climate-data-gap-in-private-infrastructure/12849.article

[28]Steehouwer, H. (2023) *From climate risk analysis to investment decision making.* Ortec Finance. Available at: https://www.ortecfinance.com/-/media/project/ortec/shared/files/whitepapers/ins-from-climate-risk-analysis-to-investment-decision-making-2023.pdf

[29]United Nations Environment Programme Finance Initiative (UNEP FI) 2022, *The Climate Risk Tool Landscape: 2022 Supplement,* UNEP FI, Geneva, viewed 16 September 2025, <https://www.unepfi.org/wordpress/wp-content/uploads/2022/03/The-Climate-Risk-Tool-Landscape-2022-supplement.pdf

[30]HGA and University of Minnesota Climate Adaptation Partnership (MCAP), 2023. *Climate Forward? How Climate Projections Are (n't) Used to Inform Design.* [online] Available at: <https://hga.com/climate-forward/

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