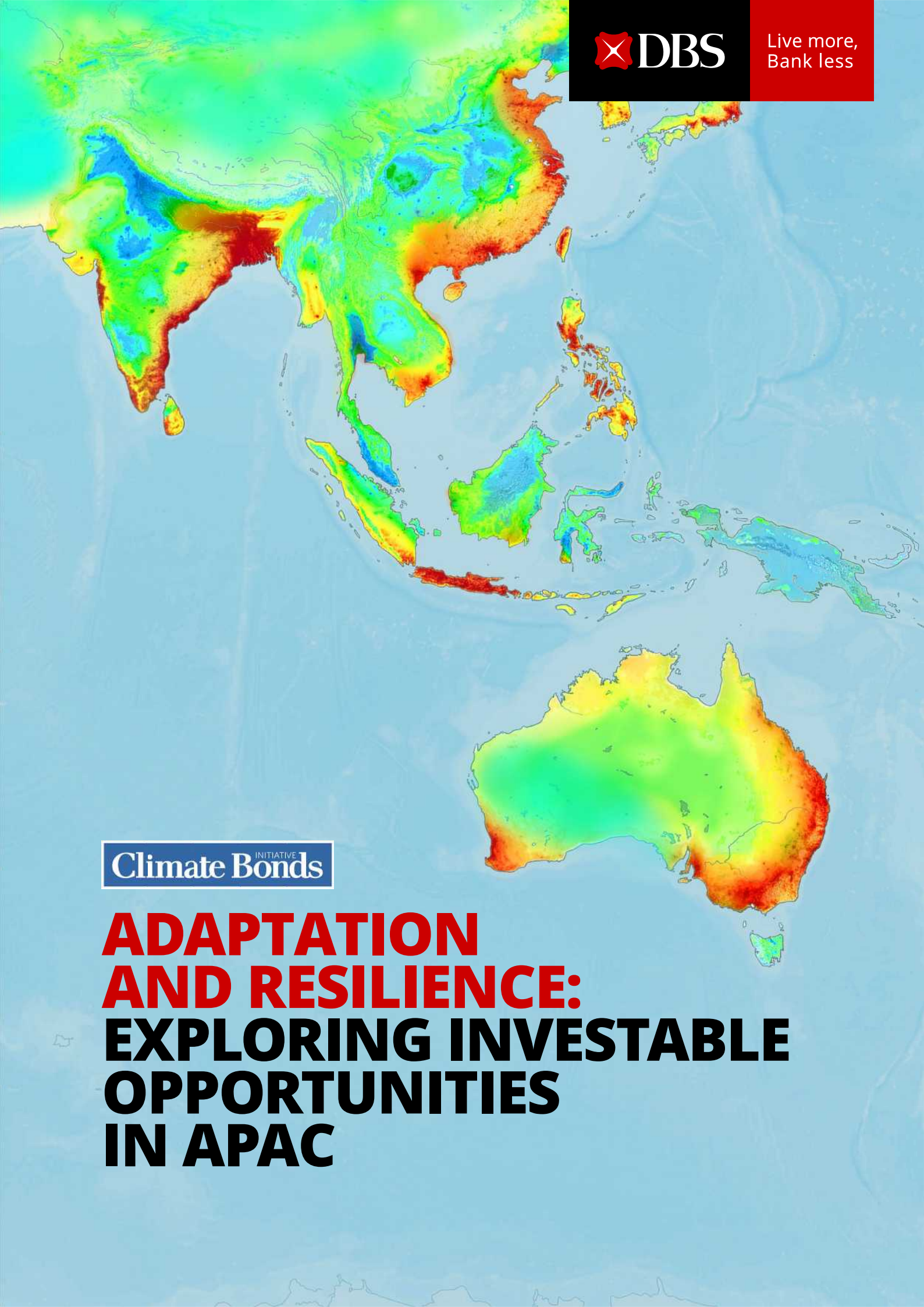

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Climate Bonds Initiative

ADAPTATION AND RESILIENCE: EXPLORING INVESTABLE OPPORTUNITIES IN APAC

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Executive Summary

Physical climate risks are increasingly shaping the economic and financing landscape across the Asia Pacific. The region is warming at approximately twice the global average and experiencing severe economic and social impacts from climate-related events, with seven Asian economies ranking among the twenty most affected globally.[1] Looking ahead, annual costs associated with physical climate risks for companies with significant operations in Asia are projected to reach USD 336 billion by the 2030s.[2]

Across the financial sector, physical climate impacts present challenges in the form of eroded collateral values, disrupted business operations, weakened borrower repayment capacities and rising credit losses following major climate events. For decision makers in commercial banks and corporates, the question is no longer whether physical climate risk is material. The evidence is clear. The more pressing challenge is understanding what constitutes a climate adaptation and resilience investment, how its credibility can be assessed, and which frameworks and tools can support consistent evaluation.

Coordinated action across corporates and banks is required to address the structural barriers in scaling adaptation and resilience investment. This report contributes to that discussion through an examination of four sectors and geographies across the Asia Pacific: commercial real estate exposed to heat stress in India, data centres subject to increasing water stress in Singapore and Malaysia, power infrastructure vulnerable to storm damage in coastal China, and transport corridors exposed to flooding and typhoons in Taiwan. Together, these examples illustrate how climate hazards are affecting critical sectors of the regional economy and where adaptation and resilience investments are beginning to emerge.

This report aims to provide a practical framework for exploring how physical climate risks manifest across the Asia Pacific, and how corresponding investment responses can be evaluated, rather than offering an exhaustive assessment of investment opportunities. It is not intended as a transaction-ready manual or a comprehensive technical standard, nor does it seek to provide asset-level risk assessments, comprehensive cost-benefit analyses, or universally applicable solutions. Instead, it illustrates how material climate hazards are already driving investable responses in various markets.

A defining characteristic of adaptation and resilience finance is that it is inherently context specific. Measures that reduce vulnerability in one location may prove ineffective, or even counterproductive, in another. Unlike many areas of green financing, adaptation and resilience financing cannot always be assessed through standardised checklists alone. Approaches that fail to account for local conditions risk overlooking the very factors that determine effectiveness.

At the same time, context specificity should not come at the expense of rigour. This report provides a structured approach for assessing adaptation and resilience financing, beginning with an understanding of local climate hazards and their implications for sectoral exposure and vulnerability. Building on this foundation, it introduces an assessment process that helps both market participants and businesses evaluate the types of activities, measures, and investments that may constitute a robust resilience response. While still evolving, this approach reflects the current state of market practice and provides a basis for greater consistency and transparency.

The report is organised as follows:

- Section 1 introduces the need for financing adaptation and resilience, and explains the framework applied for selecting key sectors and geographies for deeper analysis.
- Section 2 examines in detail the key climate hazards affecting each sector and highlights emerging responses from industry and other stakeholders.
- Section 3 explores what constitutes an adaptation and resilience response, including the two principal assessment pathways underpinning the Climate Bonds Resilience Taxonomy.
- Section 4 builds on this framework by presenting illustrative indicators across the four sectors examined.
- Finally, Section 5 situates these approaches within the broader Climate Bonds certification pathway and features a case study of the world's first Climate Bonds Initiative-certified resilience bond, issued by the Tokyo Metropolitan Government in October 2025.

A central conclusion emerging from this report is the need to balance two competing imperatives. On the one hand, effective resilience measures must be grounded in local conditions and tailored to specific risk contexts. On the other, without a degree of standardisation, including the use of comparable metrics wherever possible, significant barriers to scaling finance are likely to remain.

These tensions underscore the broader reality that adaptation and resilience finance remain a rapidly developing field. Methodologies, thresholds, and market conventions will continue to evolve as experience grows and data improves. This report therefore offers both a reflection of current market practice and a forward-looking framework for understanding how resilience finance can develop in the years ahead.

Moving forward, this report will use the terms adaptation and resilience interchangeably. For consistency, the term "climate resilience" will be used preferentially, except when explicitly referencing external sources that use the term "climate adaptation", e.g., in the case of ASEAN Taxonomy. This is consistent with Climate Bond Initiative's Climate Resilience Principles (2019),[3] reflecting a view that the term climate resilience is more intuitively understood.

How to read this report

This report is designed for both corporate professionals aiming to credibly embed adaptation and resilience investments within their businesses, and banking professionals seeking to finance such initiatives. It assumes a working familiarity with climate-related concepts but does not require access to detailed asset-level modelling or transaction-ready data.

Its purpose is to provide practical guidance on assessment frameworks: to provide clarity on how corporates and banks can credibly identify investable opportunities and demonstrate robustness through the process. It achieves this by outlining pathways to enable decision-making, and indicators to ensure robust outcomes.

The report begins from a simple premise: climate risks in Asia Pacific are highly uneven, and so are the responses they require. A heat-related challenge in commercial real estate, a water-stress issue in data centres, and a flood exposure problem in transport infrastructure may all sit within the broader category of adaptation, but they do not call for identical solutions or identical levels of confidence.

Section 1: Introduction

Why adaptation and resilience finance is becoming relevant in Asia Pacific

Physical climate risks are no longer a future concern for Asia Pacific. They are an increasingly material financial reality. The region is warming at approximately twice the global average, with sea surface temperatures rising at around 0.24°C per decade compared with a global average of 0.13°C.[4] Seven Asian economies rank among the twenty most affected globally by severe economic and social losses from climate-related events over the past two decades. In 2025 alone, floods and storms across Southeast Asia caused an estimated USD 20 billion in damages, making it the region's deadliest year on record for natural disasters.[5]

For commercial banks, the consequences are direct and specific. Physical climate risks can translate into financial risks through borrower's repayment ability, the value of collateral pledged against loans, and the operational continuity of businesses especially those with dependencies. Research by the World Bank suggests that non-performing loans rise by 0.7 percentage points in high-income countries three years post-disaster, and 5.8 percentage points in low-income countries within one year of a major climate disaster in affected markets.[6]

Credit rating agencies are beginning to factor physical climate risk into sovereign and corporate assessments, increasing the cost of capital in precisely the markets most exposed. And by the 2030s, annual costs from physical climate risks for companies with material Asian footprints are projected to reach USD 336 billion, part of a global figure of USD 1.3 trillion that falls disproportionately on Asia-based operations in information technology and industrial sectors.[7]

Against this backdrop, climate adaptation and resilience (A&R) finance is gaining prominence as a key component of climate finance. Its objective, while distinct from mitigation finance's goal of reducing greenhouse gas emissions and slowing climate change, is nonetheless complementary, focusing on managing climate change across a broader spectrum of areas. Resilience finance addresses the risks that are already locked in. Even under ambitious mitigation scenarios, past and current greenhouse gas emissions have committed the world to continued warming and associated physical climate impacts. While future emissions trajectories will influence the severity of those impacts over time, strengthening resilience to the risks already locked into the climate system is now an essential complement to mitigation efforts.

While mitigation finance has developed relatively standardised taxonomies, thresholds and market definitions over the past decade, resilience finance remains at an earlier stage. Globally, less than 10% of climate finance flows support A&R, and less than 11% of that comes from the private sector.[8] The gap between financing need and financing flow is large and concentrated: Asia accounts for approximately 69% of global adaptation financing needs and 75% of the global financing gap by 2030.[9]

This creates both a risk management imperative and a financing opportunity. Realising this opportunity will require a clearer understanding of the resilience investments that are credible today, how to assess them, and what level of evidence and judgement is still required.

How we identified where to focus

Not all climate hazards create accessible financing opportunities, and not all sectors present the same readiness for private capital. Identifying where to focus requires a systematic process of triangulation across three dimensions: the materiality of physical climate hazards in selected markets, the exposure and vulnerability of specific sectors to those hazards, and the availability of commercially ready measures that can attract private financing and align with emerging market standards.

This triangulation, moving from risk identification through hazard contextualisation to opportunity assessment against national priorities and capital flow potential, is illustrated in Figure 1.

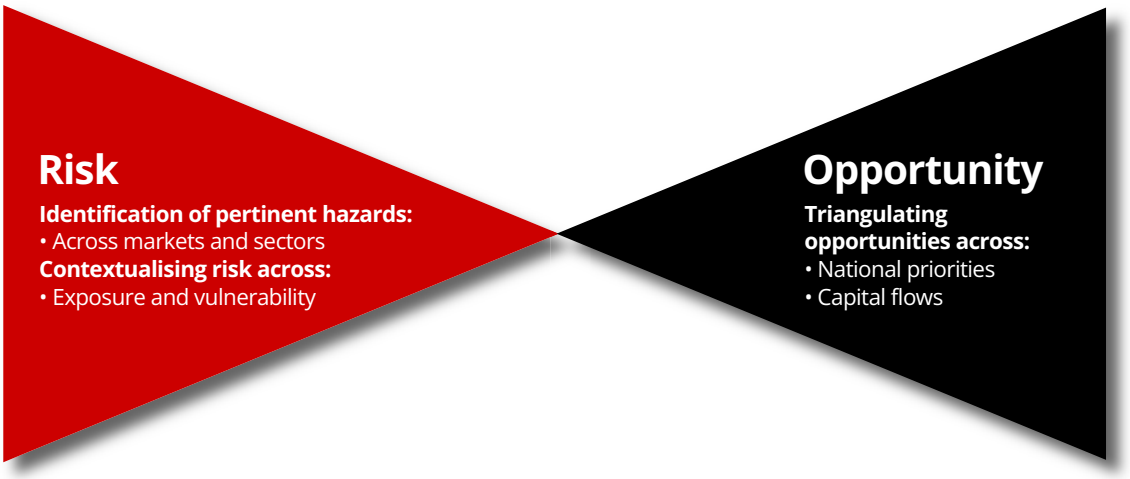

Figure 1: The systematic way to narrow down the gap between risk and opportunity to key markets and sectors

The infrastructure and real estate sectors were chosen given their significant financing needs in the Asia Pacific region. While multiple geographies were assessed, the combinations presented here represent those where the link between material hazard and credible investable response was clearest and best evidenced at the time of writing.

Applying this framework across Asia Pacific's major climate-exposed markets and sectors produced a set of combinations where the alignment between hazard severity, sectoral exposure, and financing readiness was sufficiently clear to support grounded illustration, alongside a larger set of combinations where one or more of these conditions were not yet met.

It produced four focus areas that represent contexts where the link between material physical risk related hazards and credible investable responses to such hazards can be examined with sufficient robustness to support a financing conversation.

Those four focus areas are:

Focus Areas	Physical Risk	Impact
Commercial real estate in India	Heat stress	Affects operating costs, cooling energy intensity, tenant comfort, and asset valuation across major urban centres
Data centres in Singapore and Malaysia	Water stress	Emerging as a material constraint on operations, expansion, and regulatory compliance in one of Southeast Asia's most critical digital infrastructure corridors
Power infrastructure in coastal China	Typhoon and storms	Damage to transmission and distribution networks creates a sustained and measurable pipeline of grid resilience investments
Transport corridors in Taiwan	Floods	Recurring damage to road and bridge infrastructure, driving public and private financing opportunities to address localised adaptation responses through engineering, procurement, and construction (EPC) contracts

These four sectors were selected because they allow the clearest and most grounded illustration of how the logic from hazard identification to measurement, assessment and certification can be applied in practice, setting the tone for discussion across other sectors that present a similar impact to the region.

The nature of A&R finance today

While mitigation finance has traditionally focused on whether an investment reduces emissions or delivers a measurable environmental benefit, A&R finance requires demonstrating that the investment effectively reduces vulnerability to a specific climate hazard.

This demonstration matters because the effectiveness of A&R measures is highly dependent on local conditions. Assessing A&R nevertheless requires a more nuanced understanding of local hazards, exposure, vulnerability, and adaptive capacity. An intervention that successfully reduces risk in one geography may have limited impact, or even increase vulnerability, in another. As a result, A&R finance cannot always rely on the standardised, checklist-based approaches that have become common in other areas of sustainable finance.

It is also important to recognise that many investments financed through the green finance market today already deliver A&R benefits alongside their mitigation outcomes, even if these co-benefits have not historically been identified, assessed, or labelled as such. Water infrastructure, nature-based solutions, energy system upgrades, and resilient transport networks can all strengthen A&R objectives while contributing to broader environmental priorities.

At the current stage of market development, investments that deliver both mitigation and A&R outcomes may represent the most scalable pathway for mobilising private capital. Building on established green finance frameworks can help accelerate market growth while creating greater recognition of the A&R benefits already embedded within many investment activities.

Section 2: Identifying resilience financing opportunities

This section examines practical resilience financing opportunities across four selected sectors and geographies in the Asia Pacific: commercial real estate in India, data centres in Singapore and Malaysia, power infrastructure in coastal China, and transport corridors in Taiwan. These opportunities were identified through a systematic process of triangulating material climate hazard severity, sectoral exposure, and the availability of investible opportunities, a process described in Figure 1.

The approach aims to be consistent and specific, with each sector assessed with one primary illustrative example and, where relevant, an additional secondary reference.

The financial case for resilience is already visible across Asian real assets

The following examples provide a clear signal that various actors across the financial sector are beginning to price climate risk. Impacts to operating costs, as well as insurance pricing, asset values and financing terms across multiple sectors and markets are beginning to intensify. The evidence, while still uneven, is accumulating. For banks, this creates both a risk management imperative and a financing opportunity.

Link REIT's investment in flood resilience

In Hong Kong, Link REIT, one of Asia's largest listed real estate investment trusts, has begun to see direct financial benefits from flood exposure at the asset level. Targeted resilience investments including physical flood protection measures and site-level risk mitigation, contributed to a reported 11.7% reduction in insurance premiums,[10] providing a concrete signal that adaptation can influence risk pricing in ways that are measurable and financially material.

Losses attributed to climate events

A recent survey of Singapore REITs similarly found that 58% of assets had seen increased expenses for cooling and heating driven by temperature changes, and 47% had increased capital expenditure for resilience measures against future risks.[11] In Hong Kong, the HKMA's climate risk stress test found that extreme climate events could increase expected credit losses by 47% over five years, while more than 30% of property pledged as collateral to Hong Kong banks sits in areas vulnerable to climate risks.[12]

The sections that follow examine what this looks like in practice across four selected segments – commercial real estate in India, data centres in Singapore and Malaysia, power infrastructure in coastal China, and transport corridors in Taiwan. Each represents a context where the link between material climate hazard and credible investable response can be examined with sufficient clarity to support a financing conversation.

Heat stress and its impact on the commercial real estate sector in India

India's commercial real estate sector is facing intensifying heat stress, particularly in major cities. Over the last four decades, heat extremes have increased linearly across the country, with close to 60% of Indian districts, home to 76% of the population, currently assessed as being subject to high to very high heat risk.[13]

For commercial real estate, the exposure is acute: dense urban development, glass-heavy building designs, and limited natural shading concentrate heat loads in the exact locations where office and retail assets are most heavily concentrated.[14]

Vulnerability varies by city and asset grade, but even well-managed Grade A portfolios face rising cooling energy costs, increasing peak load pressure, and growing tenant sensitivity to thermal comfort during heatwave periods, all of which translate directly into operating cost pressure, lease risk, and, increasingly, asset valuation.

The question for asset owners and their lenders is therefore not whether heat stress is material, but what can credibly be done about it.

India's heat emergency of April 2026

Woman shields herself against the heat in India, published 2022

On 27 April 2026, an event happened with no modern precedent. Every single one of the planet's top fifty hottest cities was located in one country: India. According to AQI, the global air quality and weather monitoring platform, the average peak temperature across these fifty cities that day reached 44.7°C (with Brahmapuri in Maharashtra recording the country's highest temperature at 47.2°C). Uttar Pradesh alone accounted for twenty-six of the fifty cities.[15]

This was not an isolated spike. India's 2026 heatwave arrived earlier, lasted longer, and penetrated further into central and eastern states than comparable events in previous years. The India Meteorological Department has forecast below-average monsoon rainfall for 2026, raising concerns about water availability, agricultural output, and grid stability during peak cooling demand periods.[16]

For commercial real estate, the consequences are immediate, impacting operations. Buildings reliant on conventional cooling systems face cascading load pressure. Nighttime temperatures, a critical factor in building thermal recovery, remained dangerously elevated across affected cities, reducing the overnight cooling window essential for managing the following day's occupant conditions. The economic consequences, in terms of lost productivity, increased energy costs, accelerated equipment wear, are real and recurring, not projected for something that might occur in the future.

Reducing heat gain through the building envelope	Passive cooling to reduce dependence on mechanical systems
Cool roofs with high solar reflectance	Cross-ventilation design
External shading systems	Thermally massive construction
Optimised glazing ratios	Green roofs
Improved insulation	Urban vegetation

High-efficiency heating, ventilation, and air conditioning (HVAC) systems with smart controls are increasingly being deployed alongside these envelope measures, recognising that passive strategies alone are rarely sufficient in India's most heat-stressed cities.[17,18]

Taken together, these measures aim to reduce indoor operative temperatures, lower cooling energy intensity, and maintain asset functionality and tenant comfort during peak heat periods - outcomes that are increasingly relevant to both operating performance and financing conversations.

Godrej Properties, one of India's largest listed real estate developers, with over 60 active and upcoming projects across 12 cities, illustrates how a major institutional player is beginning to embed resilience measures systematically. The company has conducted extensive climate risk assessments across its construction sites, identifying heat stress, flooding, and water scarcity as material vulnerabilities, and has used these assessments to design site-specific mitigation strategies tailored to local conditions.[19] What distinguishes this example is less the specific measures deployed, but rather the process behind them - a systematic, portfolio-wide approach to identifying where risk is material and what response is proportionate. For a bank financing a developer of this scale, such process discipline is itself a signal of resilience readiness.

A complementary approach is visible at Lodha Group's Palava City development in Maharashtra, where passive design interventions - including cool roofs, reflective materials, and integrated green cover - are reported to have reduced ambient temperatures by 2-3°C compared to neighbouring areas, illustrating that design-led outcomes can deliver measurable results even where operational monitoring data is limited.[20]

Water stress and data centre investment in Singapore and Malaysia

Data centres are amongst the most water-intensive facilities in the modern economy. Across Asia, water stress is emerging as a material constraint on their operation and expansion. Singapore's high cost of land, water and energy resources, together with its 2019-2022 moratorium on new data centres,[21] has fuelled a data centre boom in the neighbouring region of Johor in Malaysia. By 2024, Johor had become Southeast Asia's fastest growing data centre market and accounted for 79% of Malaysia's data centre capacity.[22]

Malaysia is now attracting growing interest from data centre investors, owing to factors such as strong regional connectivity and a growing digital economy.[23] Yet, this expansion has the potential to create localised tension between water demand for cooling and available supply. While the country is not water-scarce at a national level, the rapid concentration of hyperscale facilities is already exceeding local infrastructure capacity in key clusters.[24] Johor, Selangor, and Negeri Sembilan collectively house 101 data centres, with Johor alone accounting for 72 of these facilities. This concentration creates a significant water demand of 808 million litres per day (MLD) across these states, yet existing infrastructure can only supply 142 MLD. Notably, only 17 data centres in Johor have secured water demand approval from Malaysia's water regulator.[25]

One data centre = A small town's water use

A 100 MW data centre consumes approximately **4.16 million litres of water per day** for cooling

This is equivalent to the daily water use of a town of between **8,000 and 15,000 people**, depending on location.

As AI workloads drive higher rack densities, cooling demand is increasing faster than efficiency improvements can compensate.

This growing reliance on water heightens the vulnerability of data centres to disruptions in local water supply.[26, 27]

The financial consequences of water supply disruptions are direct and severe: operating a data centre requires stable, uninterrupted 24/7 cooling, and any curtailment of IT load due to water constraints translates immediately into contractual and revenue risk.

Snapshot of Data Centre Water Efficiency Targets

Singapore

The National Water Agency, PUB, has introduced mandatory water efficiency targets under the IMDA Green Data Centre Roadmap, requiring large facilities to follow Water Efficiency Management Practices enforced by PUB.[28]

Malaysia

Proposed dedicated water tariffs for data centres, tightened approval requirements related to water management, and supported the development of the country's first reclaimed water facility for data centre cooling at Bridge Data Centres' Ulu Tiram campus.[29,30]

Other Jurisdictions

Regulatory authorities are progressively strengthening water conservation requirements for data centre operators.

Measures to improve water resilience in the data centre sector generally fall into three categories. First, cooling system optimisation measures, such as non-chemical anti-scaling treatment, increased cycles of concentration in cooling towers, and blowdown water recycling, can reduce freshwater withdrawals from existing evaporative cooling systems without requiring major infrastructure replacement. Second, water source diversification, including the use of NEWater or seawater for cooling, can reduce reliance on constrained freshwater resources while supporting broader water security objectives.[31, 32] Third, next generation cooling technologies, such as direct liquid cooling and immersion cooling, are being adopted to accommodate increasing rack densities and can significantly reduce water consumption, although their higher capital costs may limit uptake. However, the benefits of reduced water consumption must be considered alongside potential impacts on energy use and emissions.[33]

Digital Realty SIN10:

Digital Realty's SIN10 facility in Singapore illustrates what embedded water resilience looks like in practice. The installation of DCI (DeCalon) electrolysis units to treat cooling tower blowdown water eliminated the need for chemical dosing, prevented mineral build-up, and allowed cooling water to circulate approximately three times as often before discharge. The result was a reported reduction in monthly blowdown discharge of around 90% and a site-level improvement in water usage effectiveness that outperformed Singapore's industry Water Usage Effectiveness (WUE) benchmark of 2.6 m^3/MWh by approximately 30%.[34, 35]

What distinguishes this example is the clarity and measurability of the outcome. The metrics utilised were quantifiable, repeatable, and directly linked to operational performance over time, enabling comparison against both internal baselines and the national benchmarks set by Singapore's Public Utilities Board. **This represents the more robust end of the resilience spectrum in that it is operationally embedded, independently benchmarkable, and directly aligned with the regulatory targets that data centre operators in Singapore are now required to meet.**

Category 4 and 5 storm exposure and power infrastructure resilience in coastal China

China's coastal power infrastructure faces one of the most concentrated storm exposure profiles of any electricity system in the world. On average, seven to eight typhoons make landfall annually along China's southern and eastern coastlines. The provinces of Guangdong, Hainan, Fujian and Zhejiang - home to dense concentrations of generation capacity, transmission infrastructure, and industrial load - sit directly in the path of the Northwest Pacific's most active typhoon corridors.[36]

The **exposure** of the power sector is structural: transmission towers, distribution poles, substations, and generation assets are fixed in place, cannot be relocated, and must remain operational especially when typhoon conditions are most severe.

Vulnerability is compounded by the scale of power networks - a major typhoon event can damage countless distribution poles, transmission towers, and transformers disrupting service for millions of customers, with cascading consequences across water supply, communications, healthcare, and industrial production beyond the immediate power outage.

This vulnerability was clearly highlighted by Super Typhoon Yagi, China's strongest autumn typhoon since 1949, which hit Hainan in September 2024. It caused widespread power outages across the province and required the deployment of extensive emergency repair crews from multiple provinces.[37]

Roadside obstruction from fallen trees and damaged road barriers after Super Typhoon Mangkhut in China, published 2018

China Southern Power Grid

China Southern Power Grid, the state-owned enterprise responsible for transmission, transformation and distribution across Guangdong, Guangxi, Yunnan, Guizhou and Hainan, serving over 280 million customers, illustrates how grid resilience investment is being systematically pursued at scale in response to repeated typhoon exposure.

Following years of storm-related outage experience, the company has progressively built out what it describes as urban disaster-proof power grids across its coastal service areas, reinforcing cable lines and indoor station channels in Class I strong-wind cities including Guangdong and Hainan, accelerating the reconstruction of indoor guaranteed power transformer stations, and laying dedicated route maps for cabling disaster-proof grid infrastructure.[39, 40]

At the generation asset level, a complementary resilience story is emerging in offshore wind - where Mingyang Smart Energy has developed a systematic multi-generation engineering programme specifically designed around typhoon survival, with turbine models engineered for wind speeds exceeding 150 km/h and floating platforms capable of operating in deepwater environments exposed to super-typhoon conditions.[41] This illustrates that storm resilience is becoming a product differentiator as well as an operational necessity across China's coastal energy sector.

Typhoon and flood risk across Taiwan transport corridors

Taiwan's transport corridors face some of the most severe typhoon and flood exposures of any road and rail network in the Asia Pacific. The island sits directly in the Northwest Pacific's most active typhoon track, with an average of three to four typhoons making direct landfall or close passage annually. These bring extreme rainfall intensities, strong winds, and storm surge to coastal and mountainous terrain that is inherently prone to flooding and landslide.[42, 43]

The exposure of Taiwan's transport infrastructure is defined by the local geography and cannot be avoided - roads and bridges must cross the river valleys, mountain passes, and coastal plains that define the island. This leaves the most economically productive areas also highly 'climate-exposed' and, in doing so, creates a network in which a single damaged bridge or washed-out road section can sever access to entire communities, ports, and logistics hubs for days or weeks at a time.[44]

The vulnerability of that network is compounded by its age and design heritage - much of Taiwan's road and bridge stock was built to standards that did not anticipate the intensity of rainfall events now being recorded, and in mountainous corridors the combination of saturated soils, unstable slopes, and high river flows creates cascading failure risks that go well beyond the immediate point of damage.

Temporary barriers line a wet mountain road in Taiwan to enforce road safety after a heavy storm, published 2026

Typhoon Morakot in 2009 remains the benchmark event - damaging or destroying more than 600 kilometres of highway and 196 bridges, with reconstruction costs running to billions of dollars and connectivity to southern communities severed for months[45] - but more recent events including Typhoons Danas, Kong-rey and Gaemi, have demonstrated that the hazard is recurrent, intensifying, and already driving a substantial public investment response.[46]

The adaptation measures being deployed - and increasingly required - across Taiwan's transport network span physical infrastructure upgrading, network redundancy investments and early warning and preparedness systems. Physical measures include elevating road sections above projected flood levels, improving drainage capacity through upsized culverts and bioswales, strengthening bridges with higher freeboard and improved scour protection, and stabilising vulnerable slopes with retaining walls, rockfall protection, and vegetation reinforcement. Network redundancy measures focus on reducing dependence on single chokepoint bridges and road links for critical destinations - ensuring that hospitals, emergency services, ports, and logistics hubs retain at least one open connection during major storm events. Early warning and monitoring systems - including road and traffic sensors, rainfall gauges, and river level monitoring integrated with emergency response protocols - are increasingly being deployed to manage network performance dynamically during typhoon events rather than simply reacting after damage has occurred.

Taiwan government flood control programme

The scale of public investment in transport and flood resilience in Taiwan has reached a level that creates a substantial and sustained pipeline of private financing opportunities. In 2025, the Taiwan government increased systematic flood control funding to TWD 55.1 billion, up TWD 15.9 billion from the previous year - with significant allocations directed at drainage improvements, elevated roadways, and bridge strengthening in southern and central corridors most exposed to typhoon and extreme rainfall.[47]

This is not a one-off reconstruction response but a multi-year programmatic commitment, building on earlier investments such as Tainan's TWD 20 billion five-year flood control programme running from 2018-2023 that delivered six detention basins, eight pumping stations, 22 kilometres of embankments, and 20 kilometres of stormwater drainage systems.

Banks will support the private sector in charge of the execution layer of these public programmes via contractor lending, EPC financing, equipment and materials supply chain financing, and working capital facilities.

Firms such as BES Engineering, listed on the Taiwan Stock Exchange and actively engaged in flood mitigation projects in Tainan, represent the kind of financing counterparty through which a bank can engage with this investment pipeline in a commercially grounded way.

A comparable implementation logic is visible at Changi Airport in Singapore, where flood barriers protecting ground-based aircraft navigation systems and increased airfield drainage capacity illustrate how the same physical resilience measures - elevated critical equipment, enhanced drainage, flood protection - apply across transport asset types beyond road and bridge infrastructure.[48]

Across these four sectors and geographies, a consistent pattern is visible: material climate hazards are already driving real adaptation responses, which are in turn, beginning to attract financing attention. The measures described here - from grid hardening in coastal China to passive cooling in Indian commercial real estate - are not theoretical. These are actions already being taken by real asset owners and operators, credibly enough to support a financing conversation.

Although locally designed, these approaches are not necessarily unique to the geographies in which they arose. As the Climate Bonds Resilience Taxonomy (CBRT) continues to evolve and expand into new sectors, these are some of the challenges being explored further: When can regional standardisation be introduced and for what sectors, and when is this harder to do?

What these preceding examples cannot reliably answer, however, is whether any specific measure genuinely constitutes a credible resilience investment. This involves assessing if the measure is well-designed, technically robust, free of maladaptation risk, and capable of being evidenced to the standards increasingly required by regulators, financiers, and their internal credit committees. Addressing this requires a structured assessment framework, which Section 3 starts to explore, with indicative indicators provided in Section 4.

Section 3: Assessing credible resilience investments

Dealing with the reality that 'adaptation is local'

The assessment approach outlined here provides a structured basis for identifying and evaluating A&R measures. It is designed to support consistent, reasoned judgement across sectors and contexts.

However, translating these judgements into measurable indicators is not a direct, linear or complete process. Adaptation outcomes are inherently context-specific, and in many cases, do not lend themselves to standardised or consistently quantifiable metrics. As a result, the indicators presented in the following section should be understood as partial proxies rather than comprehensive measures of effectiveness.

Their inclusion is intended to support transparency in how decisions are evidenced and enable structured comparison across similar cases where feasible. This provides an initial basis for engagement with clients and investments. The guidance does not seek to capture all dimensions of resilience or adaptation outcomes, nor to provide a complete or uniform basis for assessing performance. As such the guidance is no substitute for context-specific analysis, should this deeper data be available and the circumstances warrant it.

The examples presented in Section 2 demonstrate that adaptation measures are already being deployed across a range of sectors in Asia Pacific. These include passive cooling strategies in commercial real estate, water efficiency improvements in data centres, flood resilience upgrades for transport infrastructure, and grid hardening within the power sector. However, a key challenge for banks remains determining which investments can be credibly classified as making a substantial contribution to climate A&R.

As physical climate risks become increasingly material across sectors and geographies, additional guidance from market standards, taxonomies and technical thresholds are likely to emerge to support more consistent assessment of resilience investments. In the meantime, this report presents two structured approaches to help commercial banks assess whether borrowers and issuers of A&R financial products, including bonds, loans and structured financing, can be considered to make a substantial contribution to climate resilience.

Given the relatively early stage of A&R finance markets, this report sets out two structured approaches that may help decision makers assess whether an investment contributes substantially to climate resilience. The appropriate pathway will typically depend on the maturity of the measure, the availability of recognised technical standards or certifications, and the extent to which resilience outcomes can already be evidenced through existing market practice. Nonetheless, the first step is the same for either pathway.

Step 1: Has a material climate risk been identified?

The assessment should demonstrate that the asset, operation or wider system faces a material physical climate risk. The level of analysis should be proportionate to the nature of the financing activity and the information available to the lender or investor.

Where project level information is available, assessments should consider future climate conditions over the operational lifetime of the asset using forward looking and geographically relevant climate analysis, rather than relying solely on historical climate patterns. For other financing activities, evidence of material climate risk may be obtained through recognised third-party climate risk analytics, client commissioned assessments, or insurance-based risk evaluations. Decision makers may assess whether:

- The relevant climate hazards have been clearly identified (e.g. heat stress, flooding, water scarcity, storm surge);
- The assessment considers future climate conditions through recognised climate risk datasets, or equivalent third-party analysis;
- The time horizon assessed is aligned with the expected lifetime of the asset, investment or financing exposure;
- The geographic scope and exposure of the asset, operation or wider system have been clearly defined; or
- The source of climate risk information is verified and appropriate to the nature of the investment.

Supporting evidence may include climate projections, flood modelling, heat stress assessments, hydrological studies, catastrophe models, asset level vulnerability assessments, recognised third party climate risk analytics, or independent assessments commissioned by the client. Evidence from insurers or insurance brokers demonstrating the impact of physical climate risks on insurance coverage, pricing or risk premiums may also be considered. Examples of this are illustrated in Section 4.

Once a material climate risk has been identified, investments may then be assessed through one of two pathways, as seen in Figure 2 below.

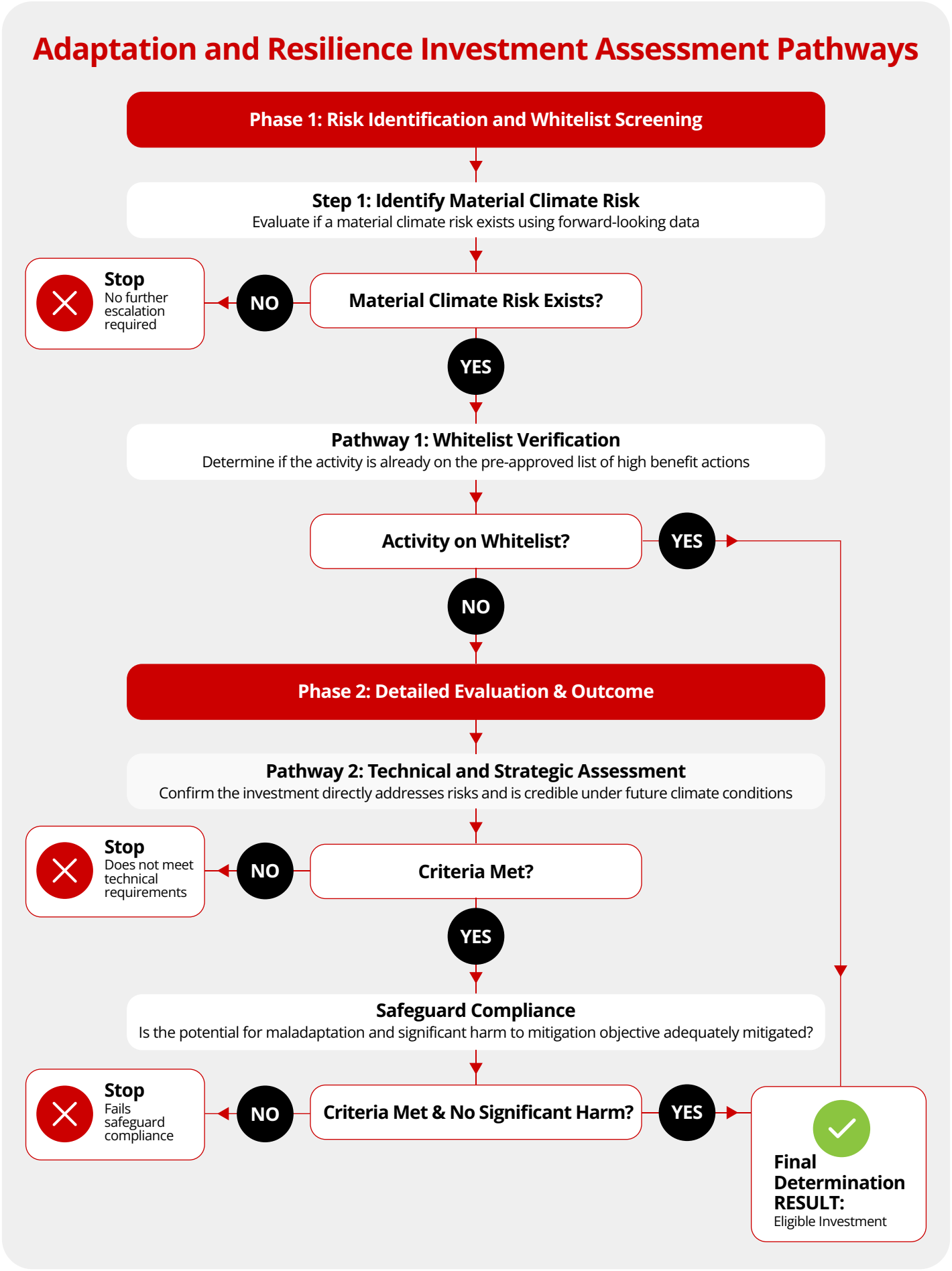

Figure 2: Assessment pathways for determining contribution to A&R

Pathway 1: Whitelist verification

For clarity, this 'whitelist' refers to a publicly maintained CBRT investment list where several investments have been pre-assessed to automatically qualify and do not require a detailed process-based assessment. Decision makers need only confirm that the proposed investment is relevant to the climate risks faced by the asset or borrower.

The whitelist has been developed by drawing on existing resilience related frameworks, standards and certifications that already incorporate consideration of physical climate risks and adaptation outcomes, where available. For real estate, these include internationally recognised standards such as ISO 14090 on climate adaptation, infrastructure rating systems such as Envision and CEEQUAL, building certifications such as BREEAM and LEED resilience credits, and sector-specific technical guidance, including CIBSE overheating guidance and green roof design standards.

Illustrative examples of automatically aligned resilience investments are included in Annex 1.

Pathway 2: Process-based assessment

For non-whitelisted investments, decision makers may need to apply a more detailed process-based assessment to determine whether the investment is expected to deliver resilience benefits over the lifetime of the asset. Under this approach, we should assess four key questions.

Question 1: Does the proposed investment directly address the identified risk?

The proposed investment should demonstrate a clear and supported link to the material climate risk identified in Step 1. The measure should be expected to reduce exposure, sensitivity or vulnerability to the relevant climate hazard.

Decision makers may assess whether:

- The measure targets the identified climate hazard or vulnerability;
- The measure is expected to materially reduce climate related disruption, damage or loss;
- Sufficient evidence is available to demonstrate the link between the measure and the identified climate risk.

Evidence may include technical studies, engineering assessments, recognised industry guidance, third party reviews, insurance risk assessments, operational data, or other documentation demonstrating how the measure reduces climate vulnerability.

Question 2: Is the proposed response technically credible under future climate conditions?

The proposed response should be designed with consideration of future climate risks and be expected to remain effective over the lifetime of the asset, investment or financing exposure.

Decision makers may assess whether:

- Future climate conditions have been considered in the design, selection or implementation of the measure;
- Evidence demonstrates that the measure is expected to remain effective under projected future climate conditions;
- The assessment period is aligned with the expected life of the asset, investment or financing exposure.

Evidence may include climate risk assessments, climate projections, recognised climate risk analytics, engineering studies, resilience plans, insurance assessments, or other documentation demonstrating that the measure remains fit for purpose under future climate conditions.

Questions 1 and 2 are intended to establish whether an investment makes a substantial contribution to climate A&R.

However, a measure that reduces climate risk may still result in unintended negative consequences. The following safeguards are therefore included to ensure that resilience outcomes are not achieved by creating new climate vulnerabilities or causing significant environmental or social harm.

Safeguard 1: Avoids maladaptation

Assessing maladaptation remains an evolving area of practice, and there is currently no universally accepted methodology for identifying all potential unintended resilience impacts. As the market matures, additional guidance, standards and assessment tools are expected to emerge to support more consistent evaluation of these risks.

In the meantime, this safeguard is intended as a practical screening exercise rather than a detailed technical assessment. The objective is to identify any material resilience related concerns that may reasonably be expected based on the information available. Decision makers may consider whether there are any indications that the investment:

- Increases exposure to other climate hazards;
- Relies on assumptions that may not remain valid under future climate conditions;
- Transfers climate risks to other assets, operations, communities or ecosystems; or
- Creates new dependencies or vulnerabilities that could undermine long term resilience outcomes.

Evidence may be drawn from available climate risk assessments, technical studies, environmental and social assessments, insurance reviews, third party analyses, or expert judgement.

Safeguard 2: Avoids significant harm (DNSH)

An investment may contribute to climate resilience while also creating unintended environmental or social impacts. While detailed DNSH methodologies continue to evolve, it is important to consider whether any material adverse impacts are apparent based on the information available. This safeguard is intended as a proportionate review of potential environmental and social risks rather than a comprehensive impact assessment. Decision makers may consider whether there are any indications that the investment:

- Achieves resilience outcomes through activities that materially increase greenhouse gas emissions;
- Results in significant adverse impacts on water resources, biodiversity, ecosystems or local communities;
- Creates environmental or social risks that are disproportionate to the resilience benefits delivered; or
- Has been identified as presenting significant environmental or social concerns through available assessments or reviews.

Evidence may be drawn from environmental and social impact assessments, climate risk assessments, insurance reviews, third party analyses, company disclosures, or other relevant documentation. The recommendation is that DNSH thresholds will be set out within banks, with monitoring and measurement agreed on a risk proportionate basis.

Use of Proceeds and Linked Instruments

This report offers insight into assessment of a variety of A&R use of proceeds relevant for banks, borrowers and issuers, with the aim of mobilising more capital that contributes towards A&R outcomes.

However, we recognise that investment opportunities are not always linearly related to transaction structures and use of proceeds. Sustainability-linked instruments continue to be a dynamic tool for the market when structured in line with the International Capital Markets Association (ICMA) and Asia Pacific Loan Market Association (APLMA) principles and guidance.

Resilience-linked instruments, in the context of the needs of emerging markets and developing economics for A&R finance, may be a powerful enabler for driving capital to where it matters. To the extent that private lending and capital market raises are structured in a manner that ties the achievement of pre-defined A&R outcomes, with clearly defined, material and ambitious Key Performance Indicators (KPIs) and Sustainability Performance Targets (SPTs) laid out in a manner consistent with the process-based principles above, credibility could be ensured as the market develops.

Unlike regular sustainability-linked instruments, resilience-linked instruments require a **material demonstration of awareness and investment towards climate-related risks that goes beyond the business-as-usual scenario, with outcomes ideally centred around increased capacity of the asset(s) or system to respond to material physical climate risks,** backed by robust climate scenario analyses or implementation of interventions that reduce vulnerability or increase adaptive capacity over time. The transaction could also consider how the impact of these measures could be measured and reported on to catalyse further action amongst the industry, with examples such as reduction in expected annual losses from climate hazards, implementation of flood protection infrastructure, improvement in water security, enhancement of supply-chain resilience, or reduced downtime from extreme weather events.

Section 4: Impact indicators, measures and metrics

The assessment framework presented in Section 3 is intended to support informed and consistent decision making regarding whether an investment makes a substantial contribution to climate A&R. The assessment questions, safeguards and pathways should be considered together, recognising that resilience outcomes are often context specific and may not be fully captured through standardised metrics alone.

The indicators presented in this section are therefore intended to support, rather than replace, professional judgement. They provide practical examples of the types of evidence that may be used to demonstrate reduced climate vulnerability, improved resilience, or enhanced adaptive capacity. In many cases, these indicators should be viewed as proxies for resilience outcomes rather than comprehensive measures of effectiveness.

As A&R markets continue to mature, more consistent metrics, technical thresholds and reporting practices are likely to emerge. In the meantime, the indicators set out below are intended to support transparency, comparability and engagement with borrowers, while remaining flexible enough to accommodate different sectors, geographies and financing contexts.

4.1 How to use this section

The indicators presented in this section are intended to guide users in applying the assessment process outlined in Section 3, particularly Assessment Pathway 2. They should not be applied as a checklist or used in isolation. Instead, they are designed to help decision makers ask better questions, identify relevant sources of evidence, and assess the credibility of resilience claims. The indicators may be interpreted according to the type and maturity of evidence available:

- Early-stage evidence helps establish whether there is a plausible link between the proposed investment and the identified climate risk. This type of evidence is most commonly used during screening, origination, or early due diligence.
- Deeper-stage evidence helps establish technical credibility, likely effectiveness and robustness over time. It becomes more important once a transaction has progressed, when the bank needs greater confidence in design assumptions, implementation quality, expected resilience outcomes, and the adequate management of maladaptation or DNSH concerns.
- Indicators can be split into four key categories:

  A: Hazard and exposure indicators: Indicators at this level are primarily used to establish that a material climate hazard exists and that the asset or activity is exposed to that risk. For early-stage screening, evidence may be drawn from recognised climate risk analytics, Climate Change Risk Assessments (CCRAs), or equivalent geospatial tools, with more localised evidence added as due diligence progresses.

  B: Vulnerability and adaptive capacity indicators (baseline): These are typically baseline indicators for the asset before intervention. Baselines should be defined for a clear reference period. At screening stage, only a small subset may be available; deeper analysis may draw on building data, tenant information, and technical studies if the transaction progresses.

  C: Implementation and activity indicators provide greater confidence that the proposed measure has been appropriately designed, commissioned or deployed in a manner to address the identified climate risk and is expected to remain effective over time, consistent with the intended resilience objective. This may include engineering studies, technical specifications, climate-informed design assumptions, resilience plans, or other evidence demonstrating that resilience considerations have been incorporated into project design and delivery.

  D: Outcome and impact indicators demonstrate whether resilience benefits have been achieved in practice. Such evidence may include operational performance data, avoided losses, service continuity metrics, insurance outcomes, or other indicators that provide insight into the effectiveness of the measure over time. While often the most robust form of evidence, these data may not be available for new investments – initial evidence may be lacking or qualitative in nature before becoming more available and quantitative later as new industry guidance such as taxonomies and technical thresholds gain greater adoption and standardisation.

Not every credible resilience investment will produce a complete set of indicators. Depending on the nature of the investment and its stage of development, the most appropriate evidence may be a combination of forward-looking climate analysis, technical design information, operational data, and expert judgement.

Where a highly technical indicator is included, it is because, in some cases, technical design features may provide the strongest available evidence that a proposed measure is likely to remain effective under future climate conditions.

The indicators below are illustrative. Readers looking for comparable metrics, reporting templates or indicator sets can find potential reference sources listed under each case study as useful starting points. These are examples of existing A&R metrics frameworks, not an exhaustive or prescriptive source list, and the availability and relevance of any given source will depend on the sector, geography and stage of the transaction.

Worked example: Data centre water resilience

Consider a financing transaction for a data centre in Johor that includes reclaimed water integration and cooling system optimisation. While the transaction may not be labelled as resilience finance, the proposed measures may nonetheless contribute to climate resilience if they address a material water related climate risk.

Applying the framework in Section 3, the assessment would consider whether the facility faces increasing water stress over its expected operating life and whether the proposed measures reduce dependence on constrained freshwater resources while supporting operational continuity under future conditions.

The indicators presented in Section 4 provide examples of the evidence that may support this assessment, including local water stress conditions, projected reductions in freshwater withdrawals, and the proportion of cooling demand met through reclaimed water or alternative sources. Together, these indicators help translate the assessment framework into a practical evidence base for investment decision making.

4.2 Heat stress affecting commercial real estate in India

This indicator set is an illustrative example that may be employed for large, investment-grade commercial real estate portfolios in India that are already pursuing high-performance envelopes and efficient cooling, such as LEED- and IGBC-certified office portfolios developed by DLF,[49] Tata Realty, RMZ and Godrej Properties. It is intended to help banks judge whether a proposed heat-related intervention appears credibly linked to a material climate risk and whether the underlying response is likely to support asset functionality, tenant comfort, and operational continuity under worsening heat conditions.

For commercial real estate, the key judgement is rarely whether heat matters in principle, but whether the financed intervention is likely to reduce overheating risk in a way that is proportionate, technically validated, and verifiable over time. The indicators below can, therefore, be read in two layers. Early-stage evidence supports first-pass judgement on whether the transaction is relevant to a material heat risk and whether the proposed response appears directionally aligned. Deeper-stage evidence supports fuller assessment of technical robustness, implementation quality, and confirmation that the target resilience outcomes are achieved over time.

ICMA and related harmonised impact reporting handbooks provide general examples of adaptation indicators and reporting templates, while Adaptation Fund and UNFCCC guidance summarise core adaptation indicators and national monitoring approaches. For heat and buildings in particular, Deloitte offers practical examples of how portfolio-level heat risk and building performance are being measured.

- ICMA, Suggested Impact Reporting Metrics for Climate Change Adaptation Projects[50]
- Adaptation Fund, Methodologies for Reporting Adaptation Fund Core Indicators[51]
- GCA, Adaptation Metrics: Current Landscape and Evolving Practices[52]
- Deloitte, Corporate heat adaptation and mitigation strategies[53]

Infosys Hyderabad radiant-cooled office building

Infosys' Software Development Building 1 in Pocharam, Hyderabad, is split into two identical halves, one using conventional variable air-volume air-conditioning and the other using a radiant cooling system embedded in slabs and ceilings, with the same layout, occupancy, and envelope on both sides.[54]

The radiant-cooled half of the building recorded per-capita cooling energy use of about 57 kWh per month versus 78 kWh per month for the most efficient conventional system on the same campus, demonstrating roughly 27% lower cooling-energy intensity with equal or better thermal comfort.

Envelope measures such as insulation and external shading were also deployed to keep the building's envelope heat load below 1.0 W/ft^2, showing how combined envelope and system upgrades can materially reduce cooling demand in India's heat-stressed commercial buildings.[55, 56, 57]

4.2.1 Illustrative indicator set for heat stress-resilient CRE

A. Hazard and exposure indicators

Heatwave frequency and intensity in project location [early-stage evidence]

Metric: Number of days per year above the relevant heat threshold (e.g. wet bulb temperature >35°C), together with projected change in extreme heat frequency over the relevant asset life, where available.

Source: Physical risk screening outputs; Indian Meteorological Department (IMD) records .

Practical use: Helps establish whether the asset sits in a materially heat-stressed area and therefore whether a heat-resilience rationale is justifiable at all. Projects in locations facing recurrent or rising extreme heat should score higher on relevance.

Heat vulnerability level of ward/district [early-stage evidence]

Metric: Heat Vulnerability Index (HVI) score/decile for the ward/district where the asset is located.

Source: National/city level HVI studies ; state disaster management plans.

Practical use: Helps distinguish assets in broadly hot markets from assets located in areas where heat is more likely to translate into operational or social vulnerability.

Supporting indicators

- **Urban Heat Island intensity at site:** This can be supported by site-level geospatial screening or local heat-mapping analysis.
- **Night-time heat persistence:** Useful where thermal recovery overnight is a material concern for building operations and can be screened using local heat projections.

B. Vulnerability and adaptive capacity indicators (baseline)

Baseline cooling energy intensity [early to deeper-stage evidence]

Metric: kWh/m^2 year for cooling systems, ideally normalised for weather, where possible.

Evidence: Metered building energy data; external standards such as ECSBC 2024 benchmarks.

Practical use: Provides a practical first read on how exposed the asset may already be to rising cooling demand and whether the proposed intervention is plausibly targeted at a material operational issue.

Baseline building thermal performance [deeper-stage evidence]

Metric: Average indoor operative temperature during a representative hot period without supplemental cooling, compared with outdoor temperature.

Evidence: Thermal modelling and/or monitored data; ECSBC 2024 thermal comfort criteria.

Practical use: Helps assess whether the building's fabric and design are materially contributing to overheating risk and whether the proposed intervention is likely to address that vulnerability.

Supporting indicators

- **Baseline envelope and shading condition:** Establishes how exposed the current building envelope is.
- **Tenant vulnerability / criticality:** Optional, for identifying vulnerability (such as hospitals and schools) helps with prioritisation of measures.
- **Occupant heat-related health and productivity:** Optional, useful to add quantitative indicators of heat effects on tenants and workforce.

C. Implementation / activity indicators

Cool roof coverage
[early to deeper-stage evidence]

Metric: % of total roof area retrofitted with high albedo/reflective coating meeting relevant design standard (e.g. aligned with ECSBC 2024).

Source: Design drawings; project completion documents.

Practical use: Useful because it is visible, attributable to financing, and relatively easy to understand in a live transaction. It is also one of the clearest examples of a measure that can be linked to reduced heat gain.

Envelope insulation, shading or glazing optimisation [deeper-stage evidence]

Metric: % of envelope upgraded, improvement in U-value or solar heat gain performance, or documented changes to external shading and glazing design.

Source: Design drawings; modelling outputs; project completion documents.

Practical use: Helps test whether the intervention addresses the underlying source of overheating risk rather than merely compensating for it through more intensive mechanical cooling.

Supporting indicators

- **Passive cooling and ventilation measures:** Useful where natural or mixed-mode ventilation forms part of the resilience strategy.
- **Nature-based cooling elements:** Useful where greening, shading or site design play a meaningful role.
- **Evidence base for design process:** Presence of documented thermal modelling or future climate scenario analysis.
- **Stakeholder engagement on heat risk and retrofit design:** Optional, but helpful where occupier behaviour affects resilience outcomes.
- **Whole-building energy and emissions implications:** Useful DNSH check where cooling gains could drive maladaptive increases in energy use. Helps ensure heat resilience measures do not drive maladaptive increases in overall energy use or emissions relative to local baseline codes.

D. Outcome / impact indicators

Reduction in indoor operative temperature under heat stress [deeper-stage evidence]

Metric: Change in peak indoor operative temperature before and afterintervention, during comparable hot spell conditions or through equivalent modelling under future heat scenarios.

Source: Monitoring data; thermal modelling.

Practical use: One of the clearest indicators that the intervention is reducing actual overheating exposure rather than simply changing building inputs.

Reduction in cooling energy intensity [early to deeper-stage evidence]

Metric: % reduction in annual cooling energy use (kWh/m^2 year), ideally normalised for weather over a baseline period.

Source: Metered energy data; utility bills; post-retrofit energy analysis.

Practical use: Particularly useful because it links operational performance, resilience logic and potential co-benefits, whilst still requiring care to avoid treating efficiency as a substitute for resilience.

Supporting indicators

- **Reduction in peak load contribution during heatwaves:** Demonstrates a reduced demand for mechanical cooling in comparable conditions.
- **Improvement in thermal comfort hours:** Comparing to baseline temperatures and safety standards shows improvement in the building's useability.
- **Avoided operational disruption or productivity loss during heat events:** Measures operational improvements due to the intervention.
- **Heat-related health and wellbeing impacts:** Where data exists, it can demonstrate improvements to tenant wellbeing.
- **Net change in building resource:** Useful as a DNSH check, where cooling gains might drive unsustainable energy or water demand.

Palava City: design-led heat intervention as a basis for resilience assessment

Lodha's development of Palava City in Maharashtra demonstrates an alternative form of evidence, where resilience outcomes are derived from design interventions. The use of passive cooling strategies, including reflective materials, green cover, and urban layout considerations, has resulted in a reported reduction in ambient temperature of 2-3°C compared to neighbouring areas.[58]

Despite the link between intervention and outcome being clear, the nature of the indicator differs materially from operational metrics. The result is dependent on local context, including climatic conditions, site characteristics, and design execution. It is less easily benchmarked or standardised across assets or markets.

This example illustrates that credible evidence does not always take the form of precise, universally comparable data. Instead, it may rely on design outcomes and contextual performance, which are valid but inherently less transferable.

Together, this and other cases in this section show that indicators of resilience lie on a spectrum, from highly quantified operational measures to context-specific outcome proxies, requiring different forms of interpretation and judgement.

4.3 Water stress affecting data centres in Malaysia and Singapore

This indicator set is designed for data centre operators, developers and investors in Singapore and the wider Johor-Singapore corridor managing water stress as a material operational and regulatory constraint. It is relevant both to operators already subject to Singapore's water-efficiency expectations and to operators in Johor navigating tightening approval requirements, water-conservation expectations, and emerging reclaimed-water solutions. For banks, it supports assessment of water resilience investments across both existing facilities and new developments in one of Southeast Asia's most water-constrained digital infrastructure markets.

For data centres, the key judgement is whether the proposed investment reduces dependence on constrained freshwater supply and improves operational continuity under tightening water conditions without simply shifting the problem elsewhere through materially higher energy use, unsustainable sourcing or unmanageable technical dependencies.

For data centres, there is a growing body of work on water usage metrics and water stress-adjusted indicators. The Climate Neutral Data Centre Pact's water-usage metric proposal and ISO/IEC 30134-9 define water usage effectiveness WUE as a standard KPI. Recent reports on the cumulative impact of data centres on regional water stress and water-balanced computing provide additional examples of indicators that link facility performance to local water availability.

- Climate Neutral Data Centre Pact, White Paper on Responsible Use of Water[59]
- ISO/IEC 30134-9:2022, Data centres key performance indicators[60]
- UK BEIS/DEFRA, AI and Data Centre Water Footprint appendix[61]
- Ceres, Drained by Data: The Cumulative Impact of Data Centres on Regional Water Stress[62]

Bridge Data Centres (BDC) Ulu Tiram - reclaimed water transition in a rapidly scaling market

Johor, Malaysia has emerged as Southeast Asia's fastest growing data centre market, partly driven by Singapore's moratorium on new approvals between 2019 and 2022, but its rapid expansion has created acute water stress of its own. Approved data centre facilities in Johor currently require 808 million litres per day against infrastructure capable of supplying only 142 million litres per day, prompting the state to introduce a dedicated water tariff for data centre operators of MYR5.33 per cubic metre, tighten approval requirements around water conservation plans, and support the development of reclaimed water infrastructure.[63]

BDC's Ulu Tiram campus, Malaysia's first data centre to use treated effluent for cooling, illustrates the direction of travel. Operators that cannot demonstrate verified water conservation plans are increasingly facing approval delays or restrictions, making water resilience a commercial necessity rather than a voluntary commitment.[64]

Together with the Digital Realty SIN10 case, this example shows that the indicators below apply across a regional market in which water stress is intensifying and regulatory pressure is accelerating adaptation, not just within Singapore's mature regulatory environment but across the broader Johor-Singapore corridor.

4.3.1 Illustrative indicator set for water stress-resilient data centres

A. Hazard and exposure indicators

Water stress level at facility location [early-stage evidence]

Metric: Country and, where available, site or basin level baseline water stress score and percentile rank.

Source: Climate risk screening outputs; WRI Aqueduct or comparable datasets.

Practical use: Helps establish whether water scarcity is sufficiently material to justify a resilience rationale and whether deeper review is warranted.

Exposure to dry periods and climate driven variability [early-stage evidence]

Metric: Frequency of below-average rainfall periods, drought alerts or projected increase in water-availability variability over time.

Source: Climate risk screening tools; national climate assessments and IPCC aligned regional projections.

Practical use: Useful for distinguishing structural water stress from short-term or incidental water constraints and for aligning the resilience case with future conditions rather than historical averages alone.

Supporting indicators

- **Dependence on centralised potable supply at the location level:** Where there are constraints, it is a useful measure of key water stress vulnerabilities. Facilities heavily dependent on potable mains need stronger justification if they are not switching to reclaimed or alternative sources.
- **Regulatory or licensing pressure linked to water use in the relevant market:** A regulatory constraint carries additional risks which can add to the overall business case of an investment.

B. Vulnerability and adaptive capacity indicators (baseline)

Baseline water usage effectiveness (WUE) [early to deeper-stage evidence]

Metric: Baseline WUE in m^3 of water per MWh of IT load (m^3/MWh), compared with local policy targets or sector benchmarks.

Source: Internal metering data; operating reports.

Practical use: One of the most useful bridge indicators between screening and deeper diligence because it gives a first view on how water-intensive the current cooling set-up already is.

Baseline source mix for cooling water [early to deeper-stage evidence]

Metric: % of cooling water from potable mains, reclaimed water, seawater, and recycled blowdown.

Source: Facility water balance; utility contracts.

Practical use: Useful because facilities heavily dependent on potable supply in water-stressed locations will generally need a stronger resilience case if they are not moving toward alternative sources.

Supporting indicators

- **Cooling system technology and redundancy:** A useful metric for baseline business continuity risks concerning water.
- **Share of water demand currently supplied from potable versus non-potable sources:** Baseline metric showing the breakdown of water sources.

C. Implementation / activity indicators

WUE improvement programme implemented [early to deeper-stage evidence]

Metric: Existence of a documented programme to improve WUE within a defined period, with capex allocated and works contracted or underway.

Source: Internal investment plans; project documentation.

Practical use: A strong transitional indicator because it shows that the resilience response is not merely conceptual but is being operationalised through a defined work programme.

Non-potable or reclaimed water integration [deeper-stage evidence]

Metric: % of total cooling water demand expected to be met from treated effluent, seawater or other non-potable sources after implementation.

Source: Connection agreements and PUB NEWater supply contracts.

Practical use: Particularly important where the resilience logic rests on reducing exposure to constrained freshwater systems rather than only improving efficiency within the existing sourcing model.

Supporting indicators

- **Blowdown water recycling:** % of blowdown treated and reused onsite as a metric, where applicable for the project.
- **Low-water cooling technologies deployed:** Share of racks or IT load served by liquid cooling or comparable technologies, similarly where applicable for projects.

D. Outcome / impact indicators

Reduction in freshwater withdrawal intensity [deeper-stage evidence]

Metric: % reduction in potable water withdrawal per MWh of IT load (m^3/MWh) versus baseline, ideally normalised for IT load growth.

Source: Metering data; operational records; post-implementation water balances.

Practical use: One of the clearest indicators that the intervention is improving resilience by reducing dependence on constrained freshwater supply rather than simply displacing water use elsewhere.

Increase in share of non potable or reclaimed water [deeper-stage evidence]

Metric: Increase in the percentage of total cooling water sourced from reclaimed or non-potable supply relative to baseline.

Source: Metering data and supply contracts.

Practical use: Useful because it connects directly to the resilience rationale in both Singapore and Johor, where regulatory and infrastructure developments are pushing the market toward alternative sourcing.

Supporting indicators

- **Monthly water saved through recycling:** Benchmarking against the industry or past performance, useful for showcasing how many cycles of water recycling exist before discharge.
- **Operational continuity during water-supply constraints:** Where service may be disrupted or compute load limited, this metric demonstrates where the intervention drove useful improvements.
- **Net contribution to local or national water resilience:** As a DNSH check to demonstrate that the project reduces, rather than increases, pressure on limited potable water resources while meeting digital infrastructure needs. In the case of Singapore, meeting their water resilience strategy is an adequate measure.

Cooling retrofit in Singapore: lessons for water resilience assessment

Digital Realty's SIN10 retrofit in Singapore illustrates how adaptation-related performance can be captured through operational metrics. The installation of electrolysis technology within the cooling system reduced water discharge by approximately 90% while improving water use efficiency beyond industry benchmarks set by Singapore's Public Utilities Board.

The outcome is measurable, repeatable and trackable. This means it lends itself to routine asset management and tracking. The impact is significant; saving approximately 1.24 million litres per month, improving site-level WUE by 15%, and outperforming Singapore's industry benchmark of 2.6 m^3/MWh by around 30%. That said, the indicator is a partial one, given the use case. It captures water use under stress, not wider system dependencies or trade-offs such as energy intensity.[65]

4.4 Storms affecting power infrastructure in China

This indicator set is designed for grid, transmission, distribution, and related power-sector assets in coastal China facing sustained exposure to typhoon and severe storm risk. It is intended to help banks and businesses judge whether a proposed hardening, redundancy or preparedness measure is credibly linked to a material physical climate risk and whether the response is likely to improve continuity and recovery under more severe storm conditions.

For power infrastructure, the central question is whether the financed measure materially improves the system's ability to withstand, absorb or recover from storm events that are relevant to the geography and the asset's function in the network.

Several guidance documents set out practical approaches to adaptation indicators for power and energy infrastructure. The ICMA, University of Manchester report and broader resources such as the Climate Resilience Infrastructure Officer Handbook collectively provide examples and frameworks to design indicators that track resilience processes, outputs and outcomes over time.

- ICMA, Suggested Impact Reporting Metrics for Climate Change Adaptation Projects[66]
- GCA, Adaptation metrics: Current landscape and evolving practices[67]
- University of Manchester, Adapting the power system to a changing climate[68]
- GCA, Climate-Resilient Infrastructure Officer Handbook

China Southern Power Grid: systematic grid hardening in Hainan and Guangdong

China Southern Power Grid serves over 280 million customers across five southern provinces and has pursued a sustained programme of storm resilience investment across its coastal service areas in response to repeated typhoon exposure. The programme includes reinforcing cable lines and indoor station channels in Class I strong-wind cities, accelerating reconstruction of indoor guaranteed power transformer stations, and laying dedicated route maps for cabling disaster-proof grid infrastructure across Guangdong and Hainan.

In 2026, the company committed RMB 180 billion in fixed-asset investment, a record high for the fifth consecutive year, directed primarily toward development of a new-type power system and enhancement of power supply reliability across its storm-exposed regional grid.[69] The scale and consistency of this commitment illustrates how grid resilience has moved from a reactive maintenance posture to a systematic capital programme, creating a sustained and measurable pipeline of hardening activity against which the indicators below can be applied.

4.4.1 Illustrative indicator set for storm-resilient power infrastructure

A. Hazard and exposure indicators

Tropical cyclone or severe wind exposure at asset location [early-stage evidence]

Metric: Asset exposure to tropical cyclone, severe wind or extreme gust risk over the relevant operating life, using geographically relevant hazard screening.

Source: Climate risk screening tools; Typhoon Committee assessments for the Northwest Pacific.

Practical use: Helps confirm that the asset lies within a genuinely storm-exposed geography rather than relying on broad country-level assumptions.

Exposure to storm surge or flood-related damage, where relevant [early-stage evidence]

Metric: Exposure of substations, coastal assets or other fixed infrastructure to storm-surge or flood impacts associated with typhoon events.

Source: Climate risk screening tools; national flood and coastal risk maps.

Practical use: Important for distinguishing pure wind exposure from multi-hazard exposure, especially for coastal assets where flood pathways may be central to damage.

Supporting indicators

- **Historical frequency of severe storm landfall in the operating province:** For multi-hazard exposure, including landslide risks can further improve baseline risk awareness.
- **Network concentration in high-exposure coastal zones:** Adds an additional vulnerability element that measures network criticality.

B. Vulnerability and adaptive capacity indicators (baseline)

Asset criticality within the network [early to deeper-stage evidence]

Metric: Whether the asset serves critical loads, high-density customer areas or key transmission pathways with limited redundancy.

Source: Internal network maps; asset criticality assessments; system planning documents.

Practical use: Helps distinguish an exposed asset from one whose failure would have wider operational consequences

Baseline susceptibility to outage or physical damage [deeper-stage evidence]

Metric: Existing vulnerability of the asset to wind, flooding or failure under severe storm conditions, including any relevant design-age or standard gap.

Source: Engineering assessments; maintenance history; past outage records; vulnerability assessments.

Practical use: Useful for testing whether the intervention is focused on a genuine weak point in the system rather than a generic resilience narrative.

Supporting indicators

- **Existing redundancy or alternative feeder capacity:** Useful to capture existing plans for asset downtime, where limited capacity exists it highlights increased resilience needs.
- **Dependence on overhead versus underground infrastructure:** Where relevant, overhead infrastructure is more vulnerable to climate hazards.

C. Implementation / activity indicators

Physical hardening measures installed [early to deeper-stage evidence]

Metric: Installation or upgrade of storm-resilient towers, flood-protected substations, undergrounded lines, elevated equipment or similar hardening measures.

Source: Project completion reports; works records; engineering certifications.

Practical use: Directly links financing to the physical measure intended to reduce storm-related damage.

System redundancy enhancements [deeper-stage evidence]

Metric: Installation of alternative feeders, automated reclosers, sectionalising devices or comparable redundancy measures.

Source: Network upgrade plans; system design records; implementation schedules.

Practical use: Important because in power systems resilience often depends not only on the strength of the asset but on the ability of the wider network to continue operating around damaged sections.

Supporting indicators

- **Microgrid or islanding capability for critical loads.**
- **Pre-positioning and operational preparedness measures.**
- **Vegetation management and corridor clearance:** All these supporting indicators can be applied where relevant, demonstrating evidence of specific interventions implemented to improve business continuity.

D. Outcome / impact indicators

Reduction in outage frequency or duration following severe storms [deeper-stage evidence

Metric: % change in outage frequency, outage duration or restoration time during comparable storm events or modelled severe-event conditions.

Source: Utility outage records; restoration logs; internal performance data.

Practical use: One of the clearest ways to show that the financed measure improves operational resilience rather than merely changing engineering specification on paper.

Continuity of service to critical loads [deeper-stage evidence]

Metric: Ability to maintain or rapidly restore service to critical customers or essential infrastructure under severe storm conditions.

Source: System performance reports; contingency planning tests; emergency response records.

Practical use: Particularly relevant where the resilience case rests on the wider system importance of the asset rather than on a stand-alone physical upgrade.

Supporting indicators

- **Reduction in storm-related physical damage to critical components:** Where large weather events occur, an indicator demonstrating annual damages compared to previous years shows potential measure improvements, though establishing a consistent baseline may be difficult.
- **Reduced customer-hours lost:** Useful customer-centric metric for reduced downstream impacts.
- **Improvement in restoration readiness or emergency response performance:** Improvements in business continuity plans demonstrate readiness for future weather events.

Storm resilience indicators for power infrastructure: implication for assessment practice

At the hazard and baseline level, the indicators flagged above tend to draw on publicly available data (typhoon landfall records, national flood maps, utility reliability statistics), all of which are typically reported in many jurisdictions and can be assembled without specialist modelling.

At the implementation level, the indicators correspond directly to documented programme activities (numbers of substations hardened, kilometres of line strengthened, emergency crews deployed) that can be verified against project completion reports and engineering certifications.

What distinguishes the stronger examples, including China Southern Power Grid's sustained capital programme (see Section 2), is the presence of outcome data that links investment to measurable change in system performance. That link is not always available at origination, and the indicator architecture reflects this: implementation indicators are assessable at disbursement, while outcome indicators are tracked over time as the resilience programme matures.

At the same time, the indicators remain partial proxies. They capture specific dimensions of storm resilience (outage frequency, restoration time, asset hardening) but do not in themselves quantify the full system-level value of avoided disruption, or capture interdependencies between power, water, communications and healthcare that make grid resilience a public good and commercial imperative.

4.5 Flooding and storms affecting transport infrastructure in Taiwan

This indicator set is designed for transport assets and corridor interventions in Taiwan exposed to flood, typhoon, and related landslide risk. It is intended to help banks and businesses judge whether a proposed drainage, elevation, bridge-strengthening, slope-stabilisation or continuity-related measure is credibly linked to address a material physical climate risk, and whether the response is likely to improve network functionality under more severe future conditions.

For transport, a credible resilience case often depends less on a single asset-level metric than on whether the financed intervention reduces the likelihood or duration of service disruption across a critical corridor or node. Several practical guides set out climate-adaptation indicator frameworks that can be applied across transport systems. ClimateXChange's work highlights a small set of indicators for tracking climate readiness of national road and rail networks, while the U.S. Department of Transportation's Momentum Toolkit and Climate Resilient Infrastructure Officer Handbook provide step-by-step guidance and cross-cutting examples covering exposure, vulnerability and performance indicators to assess and track resilience of transport systems.

- ClimateXChange, Context and Overview for Transport Infrastructure Indicators[70]
- U.S. DOT, Momentum: Building Resilient Infrastructure Toolkit[71]
- WRCOG, Climate-Resilient Transportation Infrastructure Guidebook[72]
- GCA, Climate-Resilient Infrastructure Officer Handbook[73]

Taiwan government flood control programme: public investment creating private financing opportunities

The previously outlined case study (see Section 2), which showcased Taiwan's sustained public investment in transport, illustrates that flood resilience has reached a scale that creates a substantial and ongoing pipeline of private financing opportunities. Subsequently, we can consider the indicators that could be applied throughout the whole transaction for the sector.

There is a need for broad criticality and vulnerability indicators to facilitate physical upgrades such as drainage improvements, elevated roadways, and bridge strengthening as well as new facilities including detention basins, pumping stations, embankments, and stormwater drainage systems.

The indicators below are designed to support assessment of whether specific transport resilience investments, whether publicly procured or privately financed, are credibly designed to reduce vulnerability to the identified flood and typhoon hazards.

The public investment programme is not itself the financing counterparty of interest here, rather it is the pipeline that follows. Banks are in the position to engage contractors, EPC firms, materials suppliers, and equipment financiers who deliver the programme on the ground.

4.5.1 Illustrative indicator set for flood and storm-resilient transport

A. Hazard and exposure indicators

Fluvial or pluvial flood exposure at asset location [early-stage evidence]

Metric: Exposure of the relevant road, bridge or corridor section to flood risk under current and future climate conditions.

Source: Climate risk screening tools; Typhoon Committee assessments and Taiwan's national climate report.

Practical use: Useful for establishing whether the corridor is genuinely flood-exposed and whether a flood-resilience rationale is justifiable.

Exposure to extreme rainfall or typhoon-related disruption [early-stage evidence]

Metric: Frequency or projected change in extreme rainfall, typhoon passage or storm-related disruption affecting the relevant corridor.

Source: Climate risk screening tools; national hazard assessments.

Practical use: Helps situate a proposed intervention within the broader hazard context rather than treating it as a generic infrastructure upgrade.

Supporting indicators

- **Exposure to landslide-prone slopes in mountainous corridors:** Where applicable, can highlight multi-hazard exposure to manage.
- **Coastal exposure where storm surge affects transport assets:** Where applicable, can also highlight multi-hazard exposure to manage.

B. Vulnerability and adaptive capacity indicators (baseline)

Corridor or asset criticality [early to deeper-stage evidence]

Metric: Importance of the road, bridge or transport node for access to ports, logistics hubs, hospitals, emergency services or major communities.

Source: Network maps; traffic studies; public planning documents; asset criticality assessments.

Practical use: Important because the resilience case is often stronger where the asset is a chokepoint or essential connector rather than one of many interchangeable links.

Baseline disruption susceptibility [deeper-stage evidence]

Metric: Existing tendency toward washout, inundation, scour, slope failure or closure under heavy rainfall or typhoon conditions.

Source: Incident logs; engineering assessments; maintenance records; post-event repair records.

Practical use: Helps show that the intervention is responding to a real and evidenced vulnerability in the corridor.

Supporting indicators

- **Existing drainage adequacy:** If drainage is a limiting factor during flooding events, this demonstrates an additional vulnerability layer.
- **Baseline structural or design limitations relative to current hazard intensity:** Where there are known historic design limitations, this can highlight particular vulnerabilities.

C. Implementation / activity indicators

Physical flood-resilience upgrades installed [early to deeper-stage evidence]

Metric: Delivery of drainage improvements, elevated road sections, embankments, freeboard enhancements, scour protection or comparable flood-resilience measures.

Source: Engineering plans; contractor reports; completion documentation; capex records.

Practical use: Useful because it links financing directly to tangible physical changes that can reduce flood-related disruption.

Slope or bridge resilience measures installed [deeper-stage evidence]

Metric: Delivery of slope stabilisation, retaining structures, bridge strengthening, or comparable measures addressing typhoon and landslide risk.

Source: Design documents; construction records; engineering certifications.

Practical use: Important where disruption risk arises from the wider corridor condition rather than from inundation alone.

Supporting indicators

- **Early warning and monitoring systems integrated with operations:** Where applicable, demonstrates improvements to business continuity.
- **Network redundancy enhancements:** Useful metric where the project reduces dependence on a single chokepoint as an improvement to counter potential hazards.

D. Outcome / impact indicators

Reduction in disruption duration or closure time [deeper-stage evidence]

Metric: % change in the duration of road or bridge closures, loss of access periods or service interruption during comparable events or modelled design events.

Source: Incident logs; transport operations data; after-action reviews; scenario modelling.

Practical use: One of the clearest indicators that the financed measure improves real-world continuity rather than only technical compliance.

Improved continuity of access to critical destinations [deeper-stage evidence]

Metric: Ability to maintain or restore access to key logistics, emergency or community destinations during severe weather events.

Source: Network performance reports; contingency planning records; transport authority data.

Practical use: Particularly useful for financing conversations, because it links the intervention to broader economic and social continuity rather than to an isolated engineering outcome.

Supporting indicators

- **Reduction in repeat damage or repair frequency:** Where large weather events occur, an indicator demonstrating annual damages compared to previous years shows potential measure improvements, though establishing a consistent baseline may be difficult.
- **Reduced downtime for freight or passenger movement:** Useful customer-centric metric for reduced downstream impacts.
- **Lower expected recovery cost over time:** Improvements in disaster recovery plans demonstrate readiness for future weather events.

Flood resilience indicators for transport infrastructure: applying common metrics to resilience assessment

The sort of indicators used in the transport infrastructure section above – and in disclosures from this sector more broadly - show how adaptation-related performance can begin to be captured through operational metrics. Commonly reported measures such as flood barrier installation, elevation of critical equipment, and drainage improvements, represent tangible actions tied to known hazard exposures such as 1-in-100-year flood thresholds.

Stronger examples show the presence of outcome data: reductions in service disruption or downtime following interventions. These figures are measurable and operationally grounded, enabling at least partial comparison against internal baselines, and in selected cases, against external benchmarks.

At the same time, the indicators remain partial. They reflect specific dimensions of resilience, physical protection under flood stress, but do not capture wider system dependencies or trade-offs. For example, how definitions of "flood risk" vary by jurisdiction, or whether disclosed proportions of at-risk assets are genuinely comparable across geographies.

Section 5: Certification of resilience financing and the CBRT

This report has outlined practical approaches that market participants can use to assess A&R investments within the constraints of current market practice, data availability, and evolving methodologies. For banks, borrowers and issuers seeking a higher level of assurance that an investment makes a credible and substantial contribution to climate A&R, certification provides an additional pathway.

The certification process follows many of the same principles outlined in Section 3 but applies them through a more rigorous and detailed assessment framework. As a result, certification is generally best suited to organisations and assets with access to more comprehensive climate risk, technical, and performance information, and can provide a higher level of confidence in the credibility of resilience outcomes.

The importance of certification

The Climate Bonds Certification Scheme is a voluntary, internationally recognised labelling framework that enables organisations to demonstrate alignment with robust climate mitigation and adaptation pathways. Certification confirms that a debt instrument, asset, or entity meets the requirements of the Climate Bonds Standard and relevant science-based Sector Criteria. Independent external reviews conducted by qualified Climate Bonds Approved Verifiers form a core part of the process, providing additional rigour, transparency, and credibility.

For issuers and borrowers, certification offers an independent and standardised mechanism for demonstrating the climate integrity of financing activities. It can support access to sustainability focused investors, strengthen stakeholder confidence, and help manage reputational and regulatory risks as climate related disclosure expectations continue to evolve. For investors and lenders, certification can reduce due diligence burdens by providing assurance that a recognised third-party framework has been applied. More broadly, certification supports the integrity of sustainable finance markets by promoting greater consistency, comparability, and transparency across labelled instruments.

Historically, Climate Bonds Certification has focused on climate mitigation and alignment with science-based decarbonisation pathways. Version 4.3 of the Climate Bonds Standard expands this approach to include climate A&R through the introduction of the CBRT and associated Resilience Criteria.[74]

The Resilience Criteria provide a structured framework for assessing whether a project, asset, or activity makes a credible and substantial contribution to climate A&R. Developed alongside the CBRT, the criteria evaluate how effectively an investment is designed to anticipate, withstand, adapt to, and recover from physical climate risks over time.

The introduction of resilience certification reflects growing demand from investors, issuers, regulators, and policymakers for robust approaches to identifying investments that make a substantial contribution to climate resilience. The framework is designed to be applicable across a broad range of issuers, including sovereigns, municipalities, corporates, and financial institutions.

As investor scrutiny increases and resilience finance markets continue to mature, independent third-party certification can play an important role in building confidence, reducing concerns around resilience washing, and supporting the growth of resilience finance markets.

Case study: the landmark TMG Resilience Bond

In October 2025, the Tokyo Metropolitan Government (TMG) priced a EUR 300 million five-year Climate Bonds Certified resilience-labelled bond, marking the world's first Certification under the Climate Bonds Resilience Criteria and Taxonomy.[75] The bond drew EUR 2.2 billion in bids, achieving a 7x oversubscription, underscoring strong investor demand for high-quality, resilience-focused instruments. The Climate Bonds Approved Verifier conducting the verification was R&I Investment.

The proceeds from the TOKYO Resilience Bond will finance projects that enhance the capital's capacity to withstand climate-related risks, including flooding, storm surges, and typhoon impacts. These include:

- Upgrading rivers to enhance flood resilience;
- Developing coastal protection facilities for the Port of Tokyo and surrounding islands;
- Reinforcing river and port infrastructure;
- Undergrounding power lines to reduce disaster risk.

The evidence collected by the verifier in the context of this engagement has included the review of the following documents:

- Climate change scenarios for infrastructure development
- Long-term historical data on the frequency of rainfall in the region
- Collection and analysis of meteorological data and the impact of adaptation measures
- The Tokyo Climate Change Adaptation Plan
- The River Facilities in Consideration of Climate Change plan
- The Tokyo Bay Coastal Conservation Master Plan
- The Izu Ogasawara Islands Coastal Conservation Master Plan
- The Tokyo River Improvement Plan
- The Zero Emission Tokyo Strategy[1]

[1]More details of these projects are described in the Rating and Investment Information, Inc. (R&I) verification report: https://www.climatebonds.net/files/documents/Certified-bonds/320251006_TOKYO-Resilience-Bond-SPO_en.pdf

The process-based approach to certification

Resilience investments that are not covered by the Climate Bonds Sector criteria may be assessed for eligibility for Use of Proceeds Certification or Asset Certification using the Criteria for Certification against the CBRT (the interim Resilience Criteria). Where no existing sector criteria cover the investment, eligibility is assessed against the interim Resilience Criteria. To qualify, the proposed investment must closely match a CBRT investment across four dimensions:

a) it must fall within the same theme, sector and subsector;

b) address the same climate hazard consequence;

c) be of the same investment type; and

d) deliver an equivalent output-level substantial contribution to resilience

Where a proposed investment cannot be matched to an existing CBRT investment, it may be submitted to Climate Bonds for consideration to be added to the taxonomy.

Issuers/applicants shall be required to document how the above steps have been followed so that proposed investments can be identified as CBRT investments. If it is not possible to identify a proposed investment as a CBRT investment, then the investment may be submitted to Climate Bonds for review and consideration to be added to the CBRT.[2]

An investment must meet the following three core requirements in order to be considered aligned with the Resilience Criteria:

- Substantial contribution to climate resilience (except for whitelisted investments)
- Management of maladaptation risks (except for whitelisted investments)
- DNSH to mitigation objectives

Details of this were given in Section 3. The table below summarises the certification requirements and eligible costs for each investment type:

Investment type	Eligible costs	Certification requirements
Whitelisted adapting measures (see Annex 1)	Costs of the A&R Investment	Automatically satisfies the Substantial Adaptation and Maladaptation Requirements
Other adapting measures	Costs of the A&R Investment	Full assessment against three core requirements
Adapted activities	Costs of the A&R Investment	Full assessment against three core requirements
Enabling measures	Costs of the A&R Investment	Full assessment against three core requirements plus enabling assessment
Enabling activities	Costs of whole activity	Full assessment against three core requirements plus enabling assessment

[2]For Enabling Activities (see Annex 2), the entire cost of the activity is eligible for resilience financing. This sets them apart from other investment types, i.e., as Adapting/Enabling Measures and Adapted Activities, where only the costs directly associated with specific resilience measures are eligible.

Conclusion

Escalating physical climate risks in Asia Pacific present a critical juncture for businesses and banks. These risks pose a tangible financial reality impacting asset values, operations, and creditworthiness, necessitating a proactive approach from businesses to identify opportunities to bolster their resilience, and from commercial banks to ensure credible and impactful financing.

For businesses, integrating climate resilience into their models is no longer optional. This involves understanding localised climate hazards and their sector-specific implications. For instance, Indian commercial real estate can invest in passive cooling and high-efficiency HVAC to combat heat stress, which affects operating costs and valuations. Singaporean and Malaysian data centres facing water stress can optimise cooling systems and diversify water sources for operational continuity. In coastal China, power infrastructure vulnerable to typhoons can invest in physical hardening and system design. Taiwanese transport corridors, prone to typhoons and floods, can upgrade infrastructure and implement early warning systems.

These examples demonstrate how businesses can transform climate risks into strategic resilience investments for growth and secure long-term viability in a changing climate.

For banks, credible and impactful financing in adaptation and resilience can be achieved by:

- **Embracing A&R finance as a strategic imperative:** Recognising A&R finance as complementary to mitigation, addressing locked-in risks. The significant financing gap in Asia presents a substantial opportunity for banks to lead in this developing space.
- **Developing robust assessment frameworks:** Adopting a structured approach to assess for credible resilience investments, starting with identifying material climate risks to the markets and sectors of interest, utilising a pre-defined set of credible investments (whitelist) contextualised to your organisation, conducting more detailed process-based assessments where required, evaluating if it can deliver credible resilience benefits in the future with necessary safeguards around avoiding maladaptation and significant harm.
- **Leveraging data and certification:** Adapting context-specific indicators to assess climate hazards and to monitor the effectiveness of A&R measures – utilising requisite climate risk analytic and geospatial data and tools. Encouraging third-party certifications like the Climate Bonds Resilience Criteria to enhance credibility, reduce due diligence, and strengthen investor confidence.

Supporting businesses through meaningful resilience financing presents an opportunity to strengthen client relationships, drive sustainable economic development and contribute to a more resilient future for the region.

Annexes

Annex 1: Whitelisted investments

A. Water Resilience and Water Efficiency Infrastructure

Illustrative Whitelisted Activities and why they qualify

- Urban drainage upgrades
- Installing water metering
- Water recycling and water control systems
- Storm water separation systems
- Development of ground water recharge projects
- Creation of wetland buffers along rivers and streams to reduce flood velocity and erosion
- Leak detection systems
- Stormwater management systems
- Restoration of watersheds and aquifers
- Restoration and management of coastal wetlands
- These investments improve water security, reduce water losses, or strengthen flood management capacity are therefore viewed as having a clear and measurable adaptation benefit.

Case Example

The National Capital Integrated Coastal Development (NCICD) is one of Asia's largest climate adaptation and flood defence infrastructure programmes, designed to protect Jakarta from rising sea levels, coastal flooding, and severe land subsidence. The project includes strengthening existing sea walls, constructing offshore coastal barriers, upgrading urban drainage systems, improving wastewater and water supply infrastructure, and rehabilitating coastal zones.

The construction was in phases and continues to get budget allocations in 2026 due to its criticality. Financing and technical support have involved the Government of Indonesia along with international partners including the Dutch government, South Korean agencies, the World Bank, and the Asian Development Bank. The project is widely cited as a major APAC example of climate resilience investment because Jakarta faces acute flooding risks driven by both climate change and groundwater-related subsidence.

Binh Duong Water Environment Joint Stock Company (BIWASE) undertook a major water treatment expansion project in Binh Duong Province, Vietnam, to strengthen long-term urban and industrial water security amid rapid industrialization and rising water demand. The project expanded the Tan Hiep Water Treatment Plant by an additional 100,000 m^3/day and included upgrades to water intake systems, transmission pipelines, and distribution infrastructure.

The total project cost was approximately USD 46 million, financed through a combination of corporate funding and international development finance, including loans from the Asian Development Bank (USD 8 million) and Japan International Cooperation Agency (USD 8 million). The project is considered a strong APAC example of climate-resilient water infrastructure because it improves water reliability, strengthens resilience against water stress and urban growth pressures, and supports the continuity of industrial and community water supply systems across one of Vietnam's fastest-growing manufacturing regions.

B. Climate-Resilient Agriculture and Food Systems

Illustrative Whitelisted Activities and why they qualify

- Climate-resilient seed Precision agriculture technologies / irrigation systems
- Water-efficient farming systems
- Automated water control systems
- Implementation of early warning systems
- Remote sensing crop performance data
- Back up power storage systems
- Refrigerated transportation for reduced food loss during transit
- These investments improve crop resilience, soil health, water / resource efficiency and long-term food system stability and hence quality as resilient.

Case Example

A strong example of resilience finance in this sector the USD 35.5 million funding provided by National Bank for Agriculture and Rural Development (NABARD) to the Odisha groundwater recharge and solar micro-irrigation project in India.

The project focuses on improving climate resilience in drought- and water-stressed tribal districts of Odisha through groundwater recharge systems, renovation of community water tanks, and deployment of solar-powered micro-irrigation systems.

The programme aims to strengthen water security, improve drought resilience, and support climate-resilient agriculture for vulnerable rural communities facing increasing climate stress. The project is expected to benefit around 5.2 million people across 15 vulnerable districts in Odisha.

The investments directly address climate adaptation risks including water scarcity, rainfall variability, agricultural vulnerability, and declining groundwater levels.

C. Resilient Cities & Settlements – Buildings (Commercial / Residential including schools and hospitals / warehouses)

Illustrative Whitelisted Activities and why they qualify

- Installation of adjusted drainage capacity
- Installation of raised structures for key electrical equipment
- Building design for shedding snow/ice
- Installation of cool lighting
- Installation of reduced heat emitting electrical fittings
- Installation of passive or natural ventilation
- Sheltered walkways
- Installation of reflective windows / doors
- Provision for temperature-controlled storage facilities heat sensitive cargo.
- These measures improve the ability of a specific building or facility to withstand, adapt to, and recover from extreme physical climate hazards.

Case Example

Brigade Citrine is a recently launched large-scale residential development by Brigade Enterprises located near Budigere Cross in the Whitefield growth corridor of Bengaluru. Spread across approximately 4.3 acres with around 420 residential units and a total development area of about 0.7 million sq. ft., the project has an estimated Gross Development Value (GDV) of approximately USD 50 million.

Positioned as India's first net-zero residential community, the project incorporates several climate-resilient and sustainability-focused features including energy-efficient building design, reduced embodied carbon (targeting up to 40% reduction), renewable energy for 100% of common-area lighting, extensive water conservation measures expected to save around 8,900 water tankers annually, eco-friendly construction materials, improved natural ventilation and daylight access, and long-term carbon offsetting initiatives.

These features help address key climate risks relevant to Bengaluru such as water stress, rising temperatures, and increasing energy demand, while also reducing the project's operational carbon footprint over its lifecycle.

D. Climate Information, Monitoring, and Early Warning Systems

Illustrative Whitelisted Activities and why they qualify

- Flood forecasting systems
- Weather monitoring infrastructure
- Climate analytics platforms
- Emergency response systems
- Disaster preparedness systems
- These activities strengthen adaptive capacity by improving climate risk awareness, preparedness, planning, and emergency response capabilities, and are therefore resilience enabling investments as they support resilience outcomes across wider systems and communities.

Case Example

Indonesia's Ministry of Public Works and Housing has been implementing a Flood Forecasting, Early Warning and Flood Management System programme financed by the Asian Development Bank. The financing supports:

- hydrological forecasting systems,
- flood early-warning infrastructure,
- climate and weather monitoring capabilities,
- and digital flood-management platforms.

A further USD 500 million has been raised from ADB for Indonesia's Disaster Resilience Improvement Program (DRIP), for contingent disaster financing to strengthen disaster-risk management, climate resilience systems, and emergency-response preparedness.

Most of such contracts provide opportunities for commercial banks to finance contractors to whom the contracts are awarded.

Annex 2: How the CBRT looks at micro and macro interventions

In the broader market, A&R investments are generally segregated into enabling and adapted activities. The CBRT breaks this down further, distinguishing between four types of resilience investment, each of which reflects a different role in delivering climate resilience outcomes. This is relevant for users who are trying to identify eligible activities in the CBRT specifically.

The four categories are as follows:

Adapted activities: core economic activities that have been designed or modified to withstand identified climate hazards, such as buildings retrofitted to perform under heat stress or infrastructure designed to function under increased flood risk.

Enabling activities: activities whose primary purposes are to support or facilitate resilience outcomes in other systems or sectors, such as climate data services, early warning systems or resilience advisory services.

Adapting measures: discrete interventions applied to an existing activity to reduce its climate vulnerability, such as installing cool roofs, upgrading drainage systems or deploying water-recycling technology.

Enabling measures: discrete interventions that support the resilience of activities beyond the immediate investment, such as community-level flood protection infrastructure that reduces risk across multiple assets.

The interim Resilience Criteria apply to CBRT investments across all the sectors and investment types identified in the CBRT.

These process-based criteria effectively bypass the draft technical screening criteria in the CBRT which are pending technical review until their validation by Technical Working Groups.

The validated criteria and proxies will progressively replace the interim criteria in this document, facilitating more streamlined and efficient certification processes over time.

Certain Climate Bonds Criteria, notably the Water Resilience Criteria, have already been approved by a Technical Working Group (TWG) and incorporate the resilience investments identified in the CBRT. Where sector criteria are available, such investments must be assessed for eligibility based on the Sector Criteria requirements.

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