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Discussion Paper

Adaptation KPIs *in* Infrastructure's Sustainability-Linked Finance

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About IFC

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Acronyms

A&R	Adaptation and Resilience
GGA	Global Goal on Adaptation
GHG	Greenhouse Gas
ICMA	International Capital Market Association
IFC	International Finance Corporation
IFRS	International Financial Reporting Standards
IIGCC	Institutional Investors Group on Climate Change
IPCC	Intergovernmental Panel on Climate Change
ISSB	International Sustainability Standards Board
KPI	Key performance indicators
SLF	Sustainability-Linked finance
SLFP	Sustainability-Linked Finance Principles
SME	Small and Medium-sized Enterprises
SPO	Second Party Opinion
SPT	Sustainable performance target
TCFD	Task Force on Climate-Related Financial Disclosures
UNFCCC	United Nations Framework Convention on Climate Change

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Executive Summary

Investing in sustainable infrastructure development can drive both economic growth and climate resilience. Resilient infrastructure serves as a foundation for socio-economic development, particularly in emerging markets where infrastructure gaps in the context of rapid urbanization hamper progress and climate vulnerabilities may be acute.

But infrastructure, especially in emerging markets, is under significant strain, due to the increasing frequency and severity of physical climate risks. There is mounting pressure to strengthen infrastructure resilience.

Recent analysis indicates that by 2050, infrastructure assets could experience net value declines averaging 4.4 percent, reaching up to 26.7 percent under current climate and policy scenarios due to direct climate change effects.[1] This financial vulnerability is already materializing: Pakistan incurred an estimated $30 billion in economic damages during 2022 floods that destroyed critical infrastructure including roads, bridges, and power systems, while Hurricane Dorian caused $3.4 billion in damage to physical assets across the Bahamas, devastating transportation networks and utilities.[2]

Building infrastructure resilience against these climate impacts requires dedicated adaptation finance and public funding alone cannot cover the cost of investment. However, despite the urgent need, private sector investment in enhancing the resilience of infrastructure assets, services, communities, and natural systems remains strikingly low, accounting for less than 3 percent of global adaptation finance flows, according to conservative estimates. Meanwhile, infrastructure assets remain increasingly vulnerable to many climate impacts — from intensifying extreme weather events to slow-onset changes that undermine operational stability and capacity to deliver uninterrupted services, destroy shareholders' value and impact economic activity beyond infrastructure asset's perimeter.

Private sector approaches to integrating climate risks are evolving, driven by regulatory developments, investors' expectations, possible reputational concerns, and competitive advantage considerations, among others. Some infrastructure asset developers, operators, and investors are starting to see not only risks but also business opportunities. This is laying the ground for innovative financing approaches. Sustainable finance instruments, such as green, social, and sustainability loans and bonds, as well as sustainability-linked finance, channel investments into infrastructure sector development while

[1] Coalition for Climate Resilient Investment (CCRI). "Assessing Climate Change Costs with Systemic Resilience Metrics: A Forward-looking Approach." February 22, 2024.
[2] World Bank. 2022. Pakistan Floods 2022: Post-Disaster Needs Assessment Supplemental Report; Assessment of the Effects and Impacts of Hurricane Dorian in the Bahamas. IDB. 2020.
[3] Global Center on Adaptation. 2023. State and Trends in Climate Adaptation Finance 2023.

supporting resilient infrastructure, ecosystems, and populations. Sustainability-linked finance creates direct financial incentives for climate-resilience outcomes that establish foundations for growth. While green financing instruments recognize adaptation as a valid use-of-proceeds category, the sustainability-linked finance market has largely overlooked this opportunity. Despite their material importance for governance, business operations, and stakeholders, adaptation-focused key performance indicators (KPIs) remain underused in sustainability-linked loans and bonds, as evidenced by established frameworks like ICMA's indicative KPI registry.

The low usage reflects several market barriers, including uncertain returns from adaptation investments and misaligned incentives between short-term financing structures and long-term benefits. Additional barriers include the shortage of standardized and quantifiable metrics for measuring adaptation effectiveness and impact, and challenges in adapting global frameworks to diverse local contexts and risk profiles.

By focusing on adaptation and resilience (A&R) actions and developing effective A&R KPIs, infrastructure companies may achieve multiple benefits, enabling them to:

- **Preserve asset value** through physical climate risk management.
- **Integrate adaptation solutions within operations**, enabling business continuity for assets and surrounding communities.
- **Enhance business fundamentals** through reduced vulnerability to physical climate hazards, capturing opportunities such as retain credit ratings and insurability (and in certain cases lower insurance costs), and enhanced asset values.
- **Secure 'rewards' from resilience investments** during the lifetime of an investment through adjusted pricing mechanisms (while adaptation benefits typically actualize years after initial capital deployment). This alignment of potential rewards may help bridge the timing gap between infrastructure owners and operators' long-term resilience needs and investors' shorter-term return expectations.

This discussion paper offers insights on developing and implementing climate adaptation KPIs for sustainability-linked finance transactions for infrastructure. It is aimed at market practitioners—infrastructure owners and operators as well as investors—that are navigating the intersection of climate resilience and sustainable finance. Drawing on the real-world experience of ENGIE Energía Perú, a leading energy company that recently announced a first-of-a-kind sustainability-linked loan with adaptation-related KPIs[4], the paper highlights an illustrative five-step approach to developing credible adaptation KPIs.

The approach involves five steps:

1. Assess materiality through climate risk analysis.
2. Conduct baseline assessment using climate information.
3. Formulate KPIs.
4. Set targets.
5. Implement and report.

In addition to detailing the ENGIE Energía Perú experience, the paper presents the results of research on other types of adaptation-focused KPIs, with the goal of offering a bridge to untapped opportunity in sustainability-linked finance. Infrastructure companies can make use of the A&R KPIs to address climate risks, enhance business continuity, achieve socio-economic development, and create financial value.

4 https://www.ifc.org/en/pressroom/2025/sustainability-linked-loan-to-engie-energia-peru

1

The Business Case for Adaptation KPIs in Infrastructure

For infrastructure companies, implementation of proactive climate adaptation and resilience (A&R) strategies at the company level may deliver tangible benefits beyond compliance, such as reduced operational and replacement costs during climate events, maintained insurability in restrictive markets, enhanced stakeholder confidence, improved access to investors, and competitive advantage through service reliability. This so-called "resilience dividend" also enables strengthened social license for companies to operate, since local communities increasingly value partners who maintain operations under challenging climate conditions.

What we mean by climate adaptation and resilience?

Climate adaptation refers to the process of adjusting to actual or expected climate change and its effects, seeking to moderate harm or exploit beneficial opportunities.

Resilience is the capacity of social, economic, and environmental systems to cope with hazardous events or trends, responding in ways that maintain essential function, identity, and structure.

Infrastructure

In context of this discussion paper, "infrastructure" covers the following physical assets or systems: power generation, transmission, and distribution (including renewable energy), water and sanitation facilities (treatment, distribution, and wastewater systems), transportation network (roads, bridges, ports, airports, shipping, and logistics infrastructure), digital infrastructure (telecommunications networks, broadband systems, data centers, fiber optics, and cell tower networks), waste management systems, mining and extractive industry infrastructure, and related support facilities such as substations, control centers, and maintenance depots.

The paper is aimed at market practitioners: infrastructure asset managers, investors, and project developers and operators that are navigating the intersection of A&R and sustainable finance.

Current Market Landscape

Despite growing regulatory pressure for climate disclosure and increasing demand for adaptation finance, adaptation key performance indicators (KPIs) remain significantly underused in sustainability-linked financing (SLF). This low utilization results from measurement challenges, uncertain

Adaptation KPI considerations

The adaptation KPI considerations presented in this paper apply to both existing infrastructure assets (brownfield) and new infrastructure development (greenfield projects), though implementation approaches differ.

For brownfield assets, KPIs can typically focus on retrofits, operational improvements, and vulnerability-reduction measures in existing infrastructure.

For greenfield projects, KPIs can emphasize climate-informed design, climate-resilient construction and operational practices, and forward-looking adaptation measures built into project planning from inception.

financial returns, and the lack of standardized methodologies compared to established carbon emission metrics, which are widely considered core environmental KPIs.[5]

For example, ICMA's indicative KPI registry offers only proxy metrics rather than dedicated resilience indicators. Recent analysis reveals the extent of this imbalance: Climate-change adaptation, critical-incident risk, and systemic-risk management together account for less than 1 percent of embedded KPIs in SLF instruments, while broader "business-model resilience" adds only another 3.5 percent.[6] This creates the potential for first-mover advantage—and competitive positioning—for infrastructure companies willing to pioneer adaptation-focused financing approaches that address the urgent need for climate-resilient infrastructure as a foundation for economic growth and development.[7]

Vulnerability of Infrastructure Assets

Infrastructure assets face increasing physical climate risks from extreme weather events such as hurricanes, floods, hail, wildfires, and heat waves that cause catastrophic damage to physical infrastructure. Recent analysis indicates that by 2050, infrastructure assets could experience net value declines averaging 4.4 percent, reaching up to 26.7 percent under current climate and policy scenarios due to direct climate-change effects.[8] These impacts cascade beyond physical damage to affect operations, workforce safety, jobs, and continuity of community service delivery, often causing economic ripple effects to entire regions. Infrastructure failure during climate events creates business disruptions, revenue losses, reputational damage, and potential liability—compelling the sector to develop robust adaptation strategies supported by clear performance metrics.

Growing Investor Attention

Investors increasingly recognize climate resilience as a critical factor in investment decisions, particularly for long-lived infrastructure assets such as roads and ports. This shift also aligns with the United Nations Framework Convention on Climate Change's (UNFCCC) Global Goal on Adaptation (GGA), which emphasizes the urgent need for enhanced adaptive capacity and resilience worldwide. Recent analysis estimates that the climate adaptation and resilience market

5 Raquel de la Orden and Ignacio de Calonje. "Sustainability-Linked Finance: Mobilizing Capital for Sustainability in Emerging Markets." IFC EM Compass #110. January 2022.
6 Jose L. Resendiz et al. "Sustainability-linked finance: a lever for firm-level resilience innovation." LSE Grantham Research Institute Working Paper 429. September 2025.
7 ICMA's illustrative KPI registry offers these options for adaptation and resilience KPIs for sovereigns: (1) the percentage of budget or actual expenditures allocated for adaptation measures, and (2) the insurance protection gap.
8 CCRI. 2024.

may grow to between $0.5 trillion and $1.3 trillion from 2025 to 2030.[9] Research by the Global Commission on Adaptation indicates that investing $1.8 trillion in key areas, including climate-resilient infrastructure, could potentially generate favorable cost-benefit ratios, especially if the system-level resilience is considered.[10] A World Bank report similarly highlights the potential economic value that climate-resilient infrastructure investments may deliver under certain conditions.[11]

The Task Force on Climate-Related Financial Disclosures (TCFD) and related regulatory requirements have catalyzed this shift in investor expectations by encouraging companies and financial institutions to disclose climate risks affecting their businesses.[12] And the Institutional Investors Group on Climate Change (IIGCC) has developed a methodology to assess physical climate risks, which facilitates the integration of physical climate risks into investment processes.[13] Such efforts have helped increase attention on how infrastructure companies are demonstrating commitment to addressing climate risks. Investors and infrastructure services users make decisions based on companies' ability to maintain assets operational despite changing external conditions, to ensure investment value and avoid potential losses or delays.

Adaptation KPIs in SLF serve as an important tool to channel this rising investor demand into concrete action by linking the financial performance of SLF instruments to measurable outcomes for reliable infrastructure. They can also incentivize companies to commit to adaptation plans and/or measures in line with their physical risk profiles. SLF instruments build on a corporate A&R strategy and can address the full range of adaptation activities — from adaptation planning and stakeholder engagement to infrastructure upgrades, early warning systems, process strengthening, capacity building, and operational changes. This flexibility is particularly valuable for state owned enterprises (e.g., utilities) undertaking adaptation measures that involve significant process changes, policy reforms, or organizational capacity building rather than direct capital investment projects. In this respect, a sustainability-linked finance structure can incentivize and support the implementation of adaptation strategy.

Regulatory Momentum

Increasingly, international markets are seeing disclosure requirements that mandate adaptation reporting alongside mitigation efforts. Regulators in emerging economies like Brazil and Singapore, in addition to countries and groups of countries such as the European Union (through the Corporate Sustainability Reporting Directive), require reporting on climate risks by the financial sector and businesses. They also must report on mitigation and adaptation measures within their operations either as part of their own corporate reporting requirements or due to regional and international regulations. For example, the International Sustainability Standards Board (ISSB), particularly International Financial Reporting Standards (IFRS) S2, requires disclosure of processes for identifying, assessing, and managing climate-related risks and opportunities, including physical climate risks.[14]

These regulatory frameworks incentivize infrastructure companies to address adaptation challenges systematically, transforming compliance from a box-checking exercise into an opportunity to strengthen climate risk management and access financing for adaptation.

9 Daniel Oehling et al. The Private Equity Opportunity in Climate Adaptation and Resilience. BCG report. May 6, 2025.
10 Global Commission on Adaptation. 2019. Adapt Now: A Global Call for Leadership on Climate Resilience.
11 World Bank. 2024. Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience.
12 Task Force on Climate-related Financial Disclosures. 2023 Status Report. October 2023.
13 Mahesh Roy. "PCRAM provides valuable insights for climate resilience investment." Feature article. Institutional Investors Group on Climate Change (IIGCC) Insights. August 15, 2024.
14 International Sustainability Standards Board. 2023. IFRS S2.

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A Five-Step Approach to KPI Development

For SLF, adaptation and resilience KPIs document commitments to climate risk management from companies and investors. These KPIs track progress in preparing for and responding to climate risks affecting infrastructure assets and their operational environments (territories, natural ecosystems, and communities). Effective adaptation KPIs should align with broader sustainability goals. However, many KPIs track implementation activities rather than actual resilience results, which only become evident over time.

This section outlines an approach to developing adaptation KPIs for infrastructure companies and stakeholders, drawing primarily from the recent experience of ENGIE Energía Perú developing the first of its kind adaptation related KPI for an SLF transaction as the main example of how to structure robust adaptation KPIs (see Section 4 for more details). The approach includes materiality assessment, baseline development, KPI formulation, target-setting, and implementation. Together, this forms a good basis on which to establish relevant and ambitious climate resilience outcomes for companies.

Critical aspects of the KPI development process include:

- Developing KPIs based on climate risk assessments, differentiating across assets such as generation, transmission lines, or support infrastructure such as substations, control centers, and maintenance facilities.
- Ensuring KPIs track measurable adaptation outcomes and implementation progress.
- Establishing credible baselines and monitoring frameworks.

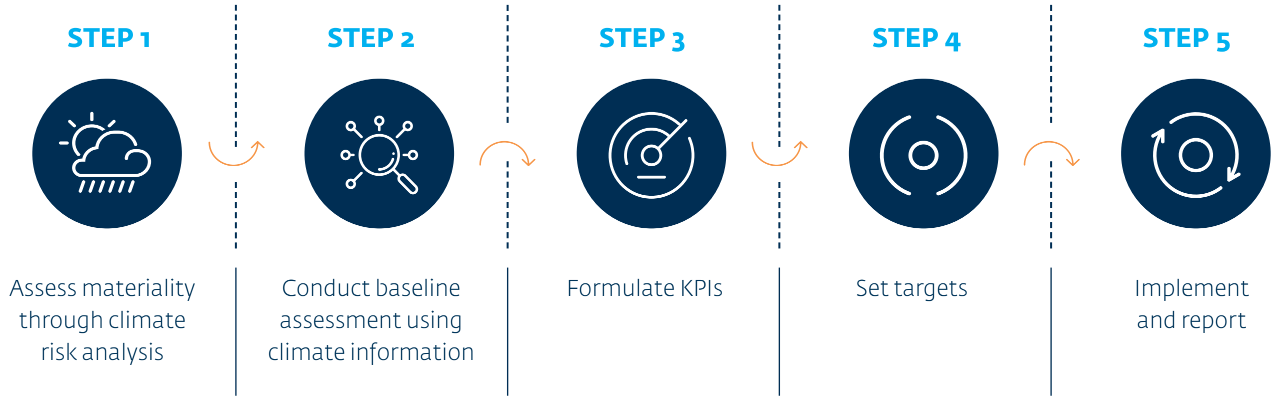
According to the published guidance, including the Sustainability-Linked Loan Principles and the Sustainability-Linked Bond Principles, KPIs should be relevant, core and material, consistent with the borrower's sustainability strategy, measurable or quantifiable, able to be benchmarked.[15] Additionally, they should be verified by independent third parties or Second Party Opinion (SPO) providers to enhance transparency and credibility, though this verification remains recommended rather than mandatory for loans.

Gulpur Hydropower Plant Pakistan © Asad Zaidi/IFC

[15] International Capital Market Association (ICMA). 2024. Sustainability-Linked Bond Principles: Voluntary Process Guidelines; Loan Syndications and Trading Association, Loan Market Association, & Asia Pacific Loan Market Association. 2023. Sustainability-Linked Loan Principles.

Structuring adaption KPIs

This section outlines five steps for structuring adaptation KPIs in sustainability-linked finance:



STEP 1: ASSESS MATERIALITY THROUGH CLIMATE RISK ANALYSIS

The context-specific nature of climate risks requires infrastructure companies to develop a tailored materiality approach that addresses unique sectoral, geographic, and temporal aspects of a project (see table 1 for examples of infrastructure sub-sector specific climate risks).

Different infrastructure assets and services face distinct climate sensitivities. For example, energy systems may be vulnerable to extreme temperatures, affecting generation efficiency and transmission capacity, while water infrastructure might face challenges from changing precipitation patterns and contamination risks during flooding events.

Conducting comprehensive climate risk analysis using established frameworks and forward-looking scenarios provides the foundation for identifying the most pressing material adaptation issues for infrastructure assets. Incorporating the latest climate projections, such as those from IPCC, across multiple GHG emissions scenarios into the analysis could help to understand a range of plausible future impacts. Companies may consider using specialized risk screening tools to translate global climate projections into location-specific materiality assessments along with guidance from their own experts on the suitability of these tools for their operations. For example, the World Bank's Climate Change Knowledge Portal and Climate and Disaster Risk Screening tools offer sector-specific resources for doing preliminary screening of climate and disaster risks to specific projects. Similarly, the ThinkHazard! tool provides information on eight natural hazards and their potential changes under climate change. Infrastructure stress test tools specifically evaluate infrastructure vulnerabilities to climate stressors.[16]

[16] These tools simulate extreme conditions on infrastructure to assess its resilience and prevent failures. They help companies identify vulnerabilities and address how systems can withstand peak demands. For more see: UNDRR: https://www.undrr.org/resilient-infrastructure/enhance-infrastructure-resilience)

TABLE 1

Sector-specific climate risk examples

Infrastructure sub-sector	Primary climate hazards	Key vulnerabilities
Energy generation	Extreme temperatures, droughts, flooding, storms	Reduced thermal efficiency, reduced water supply, reduced water availability for cooling needs due to water scarcity, equipment damage
Energy transmission	High winds, ice storms, extreme temperatures, wildfires	Line failures, transformer overheating, vegetation interference
Water	Droughts, flooding, contamination, sea-level rise	Source depletion, overwhelmed treatment capacity, saltwater intrusion
Transportation	Extreme precipitation, heat waves, freeze-thaw cycles, sea-level rise	Pavement degradation, rail buckling, bridge scour, port flooding
Telecommunications	Storms, flooding, extreme temperatures, wildfires	Equipment failure, power outages, physical damage
Waste management	Flooding, extreme precipitation, heat waves	Facility inundation, leachate overflow, equipment malfunction

These tools may help companies understand how climate hazards may evolve at specific asset locations and determine which risks warrant prioritization. For example, an energy utility might discover that transmission infrastructure in coastal regions faces high materiality risks from combined sea-level rise and increased storm intensity. At the same time, inland renewable assets may be more vulnerable to changing precipitation patterns and drought conditions affecting cooling systems or hydropower resources.[17] These assessments may also account for compound events such as simultaneous drought and extreme heat, and cascading failures where climate impacts on one asset trigger downstream effects across interconnected infrastructure networks.

This approach needs to complement stakeholder consultations with local communities, operational teams, and infrastructure users, as applicable, to capture practical knowledge on physical climate risks and validate vulnerability assessments. Exploring the intersection of scientific projections and stakeholder priorities creates a robust foundation for identifying material adaptation issues that warrant KPI development. This inclusive, science-driven approach supports the development of adaptation KPIs that are strong, people-focused, and business-centric.

[17] Stephane Hallegatte et al. 2019. Lifelines: The Resilient Infrastructure Opportunity. Sustainable Infrastructure. World Bank

STEP 2: ASSESS BASELINE USING CLIMATE INFORMATION

Baseline assessments should incorporate climate information or parameters that account for changing conditions rather than assuming static historic patterns. Establishing these climate-informed baselines is essential because adaptation KPIs will ultimately measure how companies respond to and prepare for these changing conditions, tracking corporate resilience actions rather than climate events themselves. This is also important since prior year patterns might not apply with the same reliability as in the past. For instance, stormwater management systems that were designed based on historical 100-year flood data may already be inadequate due to increased precipitation intensity in many regions. Similarly, cooling systems designed for historical temperature ranges may face efficiency losses under current and projected temperature increases.

Baselines should reflect current climate vulnerability and existing risk management practices and systems. Assessing asset-specific vulnerabilities may provide the basis for the development of the adaptation KPIs. Vulnerability assessment should also align with industry best practices to ensure robust technical foundations for KPI development.

STEP 3: FORMULATE KPIs

Formulating effective adaptation KPIs may include two complementary approaches: process-oriented metrics that track preparedness activities and outcome-focused metrics that measure actual resilience results. These KPIs should be relevant to the conclusions of climate risk assessments conducted.

Process KPIs evaluate preparatory activities, such as completing climate risk assessments, implementing adaptation plans, or training staff on climate resilience protocols. These metrics are particularly valuable in early adaptation stages when organizations are building necessary capabilities.

For example, a KPI for the percentage of critical assets evaluated for climate resilience tracks important preparatory work.

Outcome KPIs measure tangible resilience results, such as reduced service disruptions during extreme weather or decreased recovery times following climate events. These metrics demonstrate whether adaptation efforts are delivering meaningful improvements in operational resilience.

For instance, a metric for "reduction in weather-related service disruptions each year" directly measures improved performance.

In cases where companies may find measuring outcome indicators initially challenging, particularly without established monitoring systems, output indicators such as infrastructure upgrades completed, early warning systems deployed, or emergency response protocols updated may serve as interim measures that signal progress toward resilience outcomes. As companies mature their adaptation capabilities and data systems, they can move to more outcome focused tracking.

When designing effective KPIs, infrastructure companies may consider incorporating a combination of absolute and intensity metrics to enable meaningful comparisons across different events and locations:

- **Absolute metrics** provide concrete measures like "hours of service disruption during flooding."
- **Intensity metrics** normalize performance with indicators such as "percentage of service maintained during Category 3 hurricanes."

Leading, lagging, and other indicators

Infrastructure organizations may also consider using lagging indicators that track historical performance, such as recovery times after storms, with leading indicators that use climate projections to model future resilience outcomes, like the percentage of assets incorporating climate-informed design enhancements or coverage of early warning systems across critical assets. This approach may enable companies to assess current capabilities while also forecasting future resilience potential.

For companies that have already implemented adaptation measures and experienced multiple climate events, adaptive management indicators can track how effectively systems learn and improve following climate events. These might include metrics like implementation time for lessons learned or improvements in response protocols based on simulation exercises. Such indicators help capture the dynamic nature of climate resilience.

A well-formulated KPI connects directly to desired adaptation outcomes. Rather than simply tracking metrics such as "number of flood protection measures implemented," a more effective approach might measure "service availability during actual flooding event of varying severity." This outcomes-focused framework focuses on KPIs which may drive more meaningful adaptation results beyond mere activity completion.

Benchmarking approaches in the absence of standards

When established industry standards for adaptation performance do not exist, companies may use benchmarking strategies to establish credible targets. Traditional peer benchmarking faces significant limitations for adaptation KPIs due to the highly location-specific and asset-specific nature of climate risks. A road infrastructure project in Madagascar, for example, cannot meaningfully benchmark against projects in other countries due to different climate hazards, local conditions, and design requirements. This requires alternative benchmarking approaches that focus on climate science projections and international best practices rather than peer comparison. Among the alternatives:

- **Science-based approach:** Grounding targets in climate science projections for specific geographic locations using regional and/or downscaled climate models, may help companies understand the adaptation levels needed for their diverse asset portfolio across the varied climate zones in which they operate. This science-based approach uses targets that align with the resilience requirements of the best available climate projections rather than focusing on incremental improvements over current practice.
- **National policy alignment:** National policy frameworks offer another reference point. Companies can reference relevant regulatory guidance or sector-specific resilience standards established by national authorities. Similarly, when available, sectoral guidance from industry associations or resilience frameworks specific to infrastructure types may provide benchmarking references.

- **Integrated use of standards and frameworks:** Companies may also reference several emerging frameworks to strengthen the credibility of their targets. For example, the IFRS recommendations provide guidance on physical risk management practices that can inform adaptation target-setting.[18] International standards offer additional guidance, particularly ISO 14090 (Adaptation to climate change — principles, requirements, and guidelines) and ISO 14091 (Adaptation to climate change — vulnerability, impacts and risk assessment).[19] These standards establish methodological principles for climate adaptation planning that can guide KPI development and target-setting, which may provide good examples for performance benchmarks.

STEP 4: SET TARGETS

Setting appropriate targets for adaptation indicators requires careful consideration of current climate hazards, vulnerabilities, and projected changes for at least the duration of the financing term, but longer timescale is good practice. Targets should be ambitious, pushing organizations to strengthen resilience significantly, while recognizing the practical constraints of implementation timelines and resource availability (e.g., reducing climate-related service disruptions by 25 percent compared to baseline).

Given the long-term nature of climate change and adaptation considerations, establishing progressive improvement trajectories with regular milestones helps demonstrate credible ambition over time. These milestones provide accountability for tracking progress toward medium-term targets, and an early indication of implementation challenges requiring corrective action. This approach addresses the challenge that some adaptation KPIs, particularly outcome-focused metrics, may only become verifiable over 3–5-year periods as climate events occur.

Phased targets acknowledge the sequential nature of comprehensive adaptation, establishing distinct metrics for assessment, planning, implementation, and monitoring phases. Early phases might emphasize process indicators such as completion of vulnerability assessments, while later phases shift toward outcome metrics such as reduced service disruptions during climate events. This phased approach recognizes that adaptation capability develops progressively rather than instantaneously.

An effective SLF framework includes both process-based interim targets that drive necessary organizational changes and outcome-based final targets that demonstrate actual resilience improvements. Process-related targets establish mechanisms that enable adaptation, while outcome targets verify their effectiveness. They provide a comprehensive overview of the progress of adaptation implementation.

[18] Task Force on Climate-related Financial Disclosures. 2021. Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures.
[19] International Organization for Standardization. 2019. ISO 14090:2019 Adaptation to climate change — Principles, requirements and guidelines.

STEP 5: IMPLEMENT AND REPORT

In addition to measurement design, the effectiveness of adaptation KPIs depends on robust implementation. And successful implementation requires a comprehensive roadmap. The roadmap should address issues related to stakeholder engagement, data systems, and integration of climate risks into existing governance, risk management frameworks, and business strategies.

Additionally, companies should take into account external constraints that may limit achievable outcomes, including regulatory barriers, supply chain dependencies, and systemic vulnerabilities beyond organizational control. This structured approach may help organizations translate adaptation ambitions into practical action while maintaining accountability for results.

Internal governance

Effective governance structures provide the organizational foundation for achieving adaptation-related sustainable performance targets (SPTs). Reporting is an important pillar of the Sustainability-Linked Finance Principles (SLFPs) for performance monitoring. Cross-functional coordination mechanisms help integrate adaptation considerations across organizational silos. A governing body, for example, with representatives from operations, finance, sustainability, risk management, and community relations, can foster this integration while ensuring diverse perspectives inform adaptation action plans.

Board oversight can provide governance at the highest organizational level, with regular reporting on adaptation progress to board-level committees such as risk management or sustainability. However, effective governance also requires integration of adaptation planning into formal decision-making processes, budget allocation procedures, and performance evaluation to ensure adaptation leads to actionable organizational change. Incorporating adaptation KPIs into capital allocation, project design, community engagement strategies, and operational planning processes can enable more meaningful implementation. Such mainstreaming moves adaptation from a separate sustainability initiative to an integrated consideration in core business decisions. For example, infrastructure project approval processes might require a climate risk assessment and adaptation measures as standard components rather than optional add-ons.

Stakeholder engagement

Building stakeholder buy-in strengthens both the design and implementation of adaptation KPIs. Internal engagement begins with training employees on climate risks and adaptation strategies relevant to their roles. This education builds organizational capacity while empowering staff to contribute to resilience improvements in their daily work. Training should include general climate literacy and function-specific adaptation knowledge tailored to different operational areas.

Community outreach may help companies gather valid inputs to adaptation planning, as residents of host communities are often at the forefront of climate vulnerabilities and impacts. They have valuable local knowledge about historical climate impacts, vulnerable populations, and acceptable adaptation approaches. Engaging diverse community voices, including women, youth, elderly, people with disabilities, refugees, and other marginalized groups that may have different adaptive capacities and needs may help ensure adaptation measures address public concerns while building social license for implementation.

Data and reporting systems

Robust systems for tracking and reporting progress form the technical backbone of effective KPI implementation. Data management systems should prioritize the creation of centralized repositories capable of efficiently collecting, analyzing, and reporting adaptation metrics. These systems should integrate with existing enterprise data platforms while incorporating new data streams specific to climate resilience. Data visualization can serve as a helpful communication tool to translate complex adaptation and climate information easily to diverse stakeholders with varying technical backgrounds.

Establishing monitoring processes ensures consistent methodologies for measuring KPIs across different sites and periods. This will enable meaningful comparison and aggregation.

Setting up a robust tracking system includes several actions:

- Defining key terms
- Specifying measurement techniques
- Establishing reporting frequency
- Identifying personnel responsible for data collection

Aerial image of the Rio Pinheiros, Brazil © Factstory for IFC

Standardization reduces variability that might otherwise undermine data reliability while simplifying verification by external reviewers.

Recent regulatory developments suggest that sustainability-related claims in SLF must be "fair, clear and not misleading" and fully substantiated with credible evidence.[20] Companies should therefore ensure that communication about adaptation KPI is factually accurate, avoid overstating resilience benefits, and provide complete context about both achievements and limitations. Rigorous verification, independent validation, and transparent reporting build credibility for adaptation claims while protecting companies against regulatory and reputational risks associated with greenwashing.

Integration with broader climate strategy and plans

Adaptation KPIs should complement and reinforce other climate initiatives, rather than operate in isolation. Climate risk assessment can serve as a starting point for defining adaptation priorities, followed by identifying the steps needed to address specific vulnerabilities based on assessment results. This approach may also enable the design of KPIs that reduce the risk of maladaptation.[21]

Co-benefits or integrated solutions offer companies the dual benefits of reducing emissions and increasing climate resilience. For example, distributed renewable energy systems can reduce carbon emissions and enhance resilience through diversifying energy generation sources and moving away from centralized infrastructure that may be more vulnerable to climate disruptions. Green infrastructure like urban forests provides both carbon sequestration and temperature moderation benefits. Identifying and leveraging these synergies improves cost-effectiveness and stakeholder support for climate initiatives.

Just transition considerations ensure adaptation measures support equitable outcomes for workers and communities rather than exacerbating existing inequalities. Vulnerable populations often face disproportionate climate impacts while possessing fewer resources for adaptation. Infrastructure adaptation plans may explicitly address these equity dimensions through inclusive planning processes, prioritization of services for vulnerable communities, and workforce development that creates adaptation-related employment opportunities.

20 Financial Conduct Authority. Sustainability-linked loans market—two years on. Letter to Sustainable Finance Heads. August 24, 2025.

21 The IPCC defines maladaptation as: Actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas (GHG) emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence. See: IPCC, 2022: Annex II: Glossary [Möller, V., R. van Diemen, J.B.R. Matthews, C. Méndez, S. Semenov, J.S. Fuglestvedt, A. Reisinger (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

3

Illustrative Examples of Adaptation KPIs for Infrastructure

This section features KPI examples[22] designed to address material climate risks commonly faced by infrastructure assets, such as weather disruptions and floodings, and drive meaningful resilience outcomes. However, companies need to recognize practical trade-offs when selecting KPIs. For example, process-oriented indicators (such as training programs or governance changes) are typically easier to implement and monitor but may have limited direct impact on resilience if not followed by concrete action. On the other hand, outcome-oriented KPIs (such as reduced disruptions from extreme weather) can be more meaningful for demonstrating actual resilience improvements but are often harder to measure due to data gaps, attribution challenges, or long verification timeframes. Understanding these considerations helps companies select KPIs that balance feasibility with impact within their specific operational context.

Disclaimer: The examples provided in the following tables are illustrative suggestions developed for this paper. These indicators should be tailored to address specific vulnerabilities, operational contexts, and stakeholder priorities of individual infrastructure assets.

TABLE 2.1

Technical infrastructure resilience

Indicator	Percentage of vulnerable infrastructure assets retrofitted or designed to withstand projected climate hazards
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Set targets exceeding regulatory requirements and common industry practices, align with science-based climate projections
Baseline requirements	Asset inventory, vulnerability assessment, engineering assessments, implementation tracking
Potential co-benefits	Jobs creation in construction, engineering, and maintenance sectors; avoided financial losses from damage or disruptions maintaining economic productivity; higher property value; lower insurance premiums; decreased maintenance costs; reduced climate impacts on vulnerable communities; improved food security through reliable infrastructure services; poverty reduction through climate resilient development

[22] While these examples are framed for portfolio level assessment across multiple infrastructure assets, they can be adapted and scaled for individual infrastructure projects by adjusting scope, scale, and measurement approaches to specific asset characteristics and risk profiles.

Indicator	Percentage of new infrastructure projects incorporating forward-looking climate projections
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Require designs that exceed current building codes or business-as-usual engineering standards and address projected conditions through 2050 or beyond
Baseline requirements	Design documentation, climate projection data, third-party verification, capital investment tracking
Potential co-benefits	Avoided future retrofitting costs, extended life of assets and performance, avoided financial losses from damage and disruption, innovation of building materials, reduced displacement risks for vulnerable populations, increased inclusive development through forward-looking design, enhanced basic services during climate events

Indicator	Percentage of vulnerable assets protected against projected flood levels
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Protection against 1-in-x-year flood levels projected under high-emission scenarios, where the return period (x-year) should reflect increasingly ambitious targets that exceed current regulatory minimums, if exist, or best industry practices, and align with climate
Baseline requirements	Flood risk modeling data, asset elevation information, flood protection measure documentation
Potential co-benefits	Ecosystem services from nature-based solutions (if used), lower insurance costs, reduced post-disaster recovery costs, job creation, prevention of business interruption losses, protection of vulnerable communities in flood prone areas, improved health outcomes through reduced flood related diseases, enhanced livelihood security in coastal and riverine communities

Indicator	Percentage of vulnerable infrastructure assets and physical operations with heat-resistant materials and designs adapted to projected temperature increases
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Set targets addressing projected temperature increases and thresholds that exceed historical extremes and are aligned with high-emissions scenario (e.g., SSP5-8.5 projections) rather than current climate conditions. Targets should be location-specific and address the most material climate stressors for each asset type (e.g., heat resistance for equipment in hot climates)
Baseline requirements	Heat-related disruption history, temperature thresholds for infrastructure damage, materials specification data, projected climate conditions for asset locations
Potential co-benefits	Avoided economic losses from transport disruption, reduced maintenance costs and cycles, enhanced mobility and labor market access during heatwaves, health benefits from reduced urban heat island effect, enhanced reliability of supply chains and logistics, protection of outdoor workers, extended infrastructure life through reduced heat stress, technology innovation in materials, enhanced market access for rural communities

TABLE 2.2

Operational resilience

Indicator	Percentage of operations maintained during defined climate events
Applicable sub-sectors	Energy, water, telecommunications, mining, waste management, transportation
Demonstrable ambition	Maintain specified operational levels during climate events based on event intensity categories (e.g., >90% operations during moderate events or >75% during severe events). Set targets using climate projections for asset locations rather than historical averages.
Baseline requirements	Historical service disruption data, weather/climate event data, service monitoring systems
Potential co-benefits	Continued economic activity during extreme events, protection of public health services, avoided financial losses from services disruption, enhanced social equity through reliable basic services, enhanced food security through uninterrupted service delivery
Indicator	**Average time to restore full service after defined climate events**
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Progressive targets reducing recovery times year-over-year normalized by event severity
Baseline requirements	Incident response logs, service disruption duration records, recovery operation documentation
Potential co-benefits	Faster post-disaster economic recovery, reduced business losses from extended outages, enhanced community resilience social protection, lower temporary housing and relief costs, supply chain maintenance, reduction in post-disaster poverty traps
Indicator	**Percentage of critical assets covered by early warning systems with response protocols**
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Comprehensive coverage of all critical assets, integration with community-wide warning systems
Baseline requirements	Hazard-monitoring data streams, response protocol documentation, alert system testing records
Potential co-benefits	Avoided evacuation costs, improved emergency resource allocation efficiency, enhanced worker safety during extreme events, reduced insurance costs, psychological benefits from increased warning time, reduction in climate-related mortality and morbidity, increased agricultural yields through anticipatory action

Indicator	Percentage reduction in weather-related power outages (frequency and duration) after a defined climate event of specified intensity levels
Applicable sub-sectors	Energy, mining, and all infrastructure sectors (as applicable)
Demonstrable ambition	Progressive reduction targets based on historical performance adjusted for changing climate conditions
Baseline requirements	Outage management system data, weather event classification, smart grid monitoring data
Potential co-benefits	Avoided business losses, enhanced energy security for critical facilities, improved health outcomes through continued service delivery, protection of vulnerable populations, reduced backup-generation costs and emissions, continued digital connectivity, improved educational outcomes through reliable power delivery, enhanced healthcare service delivery during climate events

Indicator	Percentage of critical systems with redundancy designed for projected climate extremes
Applicable sub-sectors	Energy, water, telecommunications, mining, critical facilities
Demonstrable ambition	Full redundancy coverage for all critical systems
Baseline requirements	System criticality classification, redundancy configuration documentation, backup system testing results
Potential co-benefits	Business continuity during disruption events, reduced recovery and response costs, protection of lives in critical care settings, data security and maintenance, maintenance of vital services during emergencies, protection of critical public health infrastructure

Indicator	Reduction in emergency repairs following extreme weather events through proactive, climate-informed maintenance
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Progressive reduction in reactive maintenance; movement toward fully predictive, climate-adjusted maintenance
Baseline requirements	Maintenance records by type, climate variable correlation analysis, asset condition monitoring
Potential co-benefits	Extended asset lifespans, efficient allocation of maintenance resources, job creation in the technology sector, enhanced worker safety through planned activities, reduced losses from climate-related damages, reduced environmental impacts from emergency repairs, reallocation of funds to other developmental priorities

TABLE 2.3

Community and environmental resilience

Indicator	Percentage of staff trained in climate resilience practices: disaster preparedness protocols, evacuation procedures for extreme weather events, heat stress management in high-temperature environments, and emergency response during climate-related service disruptions, as appropriate[23]
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Universal staff coverage; regular refresher training including scenario-based exercises; demonstration of training application through periodic drills, simulations, or actual event responses; progression from basic awareness to operational proficiency
Baseline requirements	Training completion records, skills assessment results, scenario exercise outcomes, pre-training competency levels, documentation of current climate response procedures, baseline response times and effectiveness metrics
Potential co-benefits	Worker skill development and employment prospects, knowledge transfer to communities, better emergency response capacities, enhanced system-wide resilience through education and training, improved preparedness for climate impacts and disasters, improvement livelihood diversification, knowledge spillovers

Indicator	Percentage of vulnerable community members reached or benefiting from company-supported climate resilience initiatives[24]
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Targets addressing the most vulnerable community members,[25] comprehensive coverage of operational areas
Baseline requirements	Community vulnerability assessments, program participation data, resilience outcome measurements
Potential co-benefits	Enhanced social license to operate, strengthened community-company relationships, enhanced local knowledge and capacity to manage climate risks, improved educational outcomes, social cohesion through collaborative resilience planning

[23] This process indicator should be paired with outcome-based metrics such as "average response time during climate events by trained personnel" or "percentage reduction in climate-related incidents through staff intervention" to ensure training translates into operational improvements.

[24] Climate resilience initiatives could also include company supported actions on climate change education and capacity building.

[25] Vulnerable community members are defined as populations having limited adaptive capacity due to factors such as low income, disabilities, higher exposure to climate hazards, and limited access to adaptation solutions.

Indicator	Percentage reduction in asset exposure to climate-related hazards (such as flood depth or heat stress levels) through implemented nature-based solutions (NbS)
Applicable sub-sectors	Water, urban infrastructure, transport, mining, waste management
Demonstrable ambition	Progressive exposure reduction targets based on climate projects, minimum performance thresholds for effective NbS (e.g., green infrastructure must demonstrate capacity to manage 1-in-25-year flood events)
Baseline requirements	Current hazard, vulnerability, exposure assessment, modeling to assess nature-based solution risk levels, climate projection data, engineering assessment of NbS design capacity
Potential co-benefits	Provision of ecosystem services, biodiversity conservation co- benefits, carbon sequestration and climate mitigation, health benefits through green space access, recreational value, and tourism opportunities, reduced urban heat island effects and energy costs

Indicator	Number or capacity of backup/alternative water sources developed/installed to address drought and contamination risks
Applicable sub-sectors	Water utilities, energy, mining, digital
Demonstrable ambition	Development of sources to ensure supply under worst-case climate scenarios
Baseline requirements	Water source reliability assessments, climate projection data for water resources, supply contingency planning
Potential co-benefits	Water security during extended drought periods, protection of agricultural productivity and food security, prevention of water related conflicts, public health protection through clean water provision, reduced emergency water distribution costs, extended asset life through reliable water sources

Indicator	Water-use intensity adjusted for climate variables such as temperature and precipitation
Applicable sub-sectors	Water utilities, energy, waste management, digital
Demonstrable ambition	Targets accounting for projected climate stress on water resources through efficiency improvements that exceed industry benchmarks and align with water scarcity projections under shared socioeconomic pathways (SSP) scenarios, maintenance of operational performance during drought conditions, inclusion of integrated water management solutions into projects and operations
Baseline requirements	Water consumption data, climate variables data, production metrics, climate projections
Potential co-benefits	Sustainable water resource management, lower operational costs, enhanced water availability for ecosystems and communities, reduced water treatment energy demands, innovation in water efficiency technologies, reduced conflict over shared water resources

TABLE 2.4

Governance and financial resilience

Indicator	Percentage of critical/key suppliers with verified climate adaptation plans[26]
Applicable sub-sectors	All infrastructure sectors
Demonstrable ambition	Coverage of all Tier 1 suppliers,[27] inclusion of Tier 2 suppliers,[28] verification of implementation
Baseline requirements	Supplier assessment records, supply chain mapping, supplier adaptation plan documentation
Potential co-benefits	Enhanced supply chain reliability, knowledge transfer across industry sectors, reduced business interruption risks, SME capacity building in supplier networks, system-wide resilience through coordinated planning, resilient supply chains

[26] Critical suppliers could be defined as those representing >5-10% of annual procurement spend, providing essential services with limited alternative sources. This could be adjusted based on companies' respective supply chains.

[27] Tier 1 could be direct contractual partners.

[28] Tier 2 could be sub-contractors to Tier 1 partners.

4

Structuring an Adaptation KPI for SLF: ENGIE Energía Perú Example

This section highlights the experience of ENGIE Energía Perú, offering a real-world example of how to structure and implement adaptation KPIs for SLF transactions for infrastructure developers and operators. The example informed the development of the structured, materiality-driven five-step process detailed in Section II of this paper—it also illustrates how the process may be used. The company's approach focused on identifying physical climate risks that could impact both energy generation assets and surrounding communities.

ENGIE Energía Perú: Company background and approach

ENGIE Energía Perú operates a diverse portfolio of energy infrastructure assets across Peru's varied geographic and climatic zones.[29] In 2025, IFC and ENGIE Energía Perú signed a financing package of up to USD 600m, structured as a sustainability-linked loan that incorporates an adaptation-related KPI critical to both operational resilience of their projects and social license of the company's activities. ENGIE Energía Perú's systematic approach to achieving these objectives is built on five key elements:

- Identifying material climate risks to assets.
- Establishing a robust baseline to understand existing climate risks and resilience capacity.
- Designing KPIs, which balance process indicators with measurable resilience outcomes, recognizing that input and activity metrics serve important functions in early-stage adaptation implementation while outcome-based measures demonstrate actual effectiveness Setting targets that are ambitious, time-bound, and demonstrate improvement in climate performance.
- Developing an implementation roadmap with clear governance, designated responsibilities.
- Developing monitoring and reporting mechanisms.

Step 1: Assess materiality through climate risk analysis

In this first step, ENGIE Energía Perú completed a preliminary climate risk screening to understand material physical climate risks across operational sites using ENGIE Group's Environmental and Adaptation Platform—a geospatial tool that overlays climate hazard projections on asset locations, which served as a reference point. The exercise was supplemented by expert observations during project-level site visits, which helped contextualize the hazard data and validate tool-based projections.

The assessment resulted in preliminary binary climate risk identification for all operational sites. This screening identified varying risk profiles across portfolio sites including heatwaves, extreme wind exposure, and flood and landslide risks. While some risks remained "in evaluation," this systematic cataloging established a baseline understanding of each site's vulnerability level.

[29] For more information, see the company's website: https://engie-energia.pe/perfil.

Step 2: Assess baseline using climate information

The systematic cataloging of site-specific climate risks provided the foundation for location-specific adaptation planning and future KPI development. This baseline understanding enabled ENGIE Energía Perú to acknowledge the need to differentiate between asset types and their specific climate vulnerabilities, creating a foundation for targeted adaptation measures and corresponding performance metrics.

Step 3: Formulate KPIs

ENGIE Energía Perú structured their KPIs across different performance levels:

LEVEL 1

Setting process-related SPTs such as completing vulnerability or climate risk assessments.

LEVEL 2

Implementation of specific adaptation measures.

LEVEL 3 AND 4

Review, reassessment, and calibration of measures to achieve resilient outcomes for assets.

The company's framework illustrates a dual approach. They structured a main process Indicator, such as "100 percent of sites with fully implemented climate adaptation plans," to track preparatory activities and capacity-building initiatives across different levels in the company. Outcome metrics were integrated into Level 3 and 4 SPT benchmarks such as "cost savings tracked and documented" to measure tangible resilience improvements. While the primary KPI focused on process implementation (climate adaptation plan completion), Level 3 and 4 SPTs incorporated financial outcome metrics that serve as proxies for successful adaptation results. This approach worked well for the company.

Step 4: Set targets

ENGIE Energía Perú's target-setting approach makes use of practical benchmarking strategies in the absence of established industry standards. Given the nascent state of adaptation KPI disclosure across the energy sector, the company adopted a company-focused, multi-reference approach. In practice, they established an internal baseline by assessing climate risks across their entire portfolio, which served as the primary reference point. This internal assessment was combined with scientific climate projections for their specific asset locations, Peru's national adaptation policy frameworks, and international technical standards (such as ISO 14090) to develop adaptation measures and performance targets. This approach compensates for the lack of peer benchmarking data by creating a robust target-setting foundation using multiple credible reference points, ensuring targets are both scientifically grounded and practically achievable within their operational context.

Given their portfolio's varying risk profiles, the company decided to choose different timelines for completing the SPTs, recognizing that some adaptation measures require longer implementation periods. ENGIE Energía Perú structured targets across multiple timeframes with different milestones for each level of target:

- **For Level 1:** To complete detailed risk assessments for priority sites, the company selected a year-long deadline for all new and existing sites (100 percent).
- **For Level 2:** To implement specific adaptation measures based on risk profiles, the company selected a two-year timeline following Level 1 completion.

- **Levels 3 and 4:** To achieve measurable resilient outcomes and calibration, the company selected a 2–5-year timeframe, taking into account the context and risk profile of each site.

ENGIE Energía Perú adopted a phased implementation of SPTs that acknowledges the sequential nature of comprehensive adaptation. This phased approach recognizes that adaptation capability develops progressively rather than instantaneously, moving from assessment through implementation to outcome verification.

Step 5: Implement and report

This step involves establishing a comprehensive plan to address implementation issues such as managing stakeholder engagement, developing robust data systems, and integration of climate risks into existing governance, risk management frameworks, and business strategies. ENGIE Energía Perú understands the importance of robust reporting and measures that address issues such as stakeholder engagement, updating of data systems, and integration of climate risks into existing governance, risk management frameworks, and business strategies. But because the company's adaptation KPI framework remains at the initial stages of implementation, reporting systems are still being designed rather than operationally proven.

However, the company has outlined intentions to set up a monitoring and learning database that would allow the company to track the performance of adaptation measures and make improvements in the adaptation planning process. This system enables continuous refinement of adaptation approaches based on real-world performance data. As part of the framework, ENGIE Energía Perú will conduct annual third-party verification of their adaptation KPIs. This verification is intended to assess both process completion (adaptation plan implementation) and outcome achievement (performance during climate events), though specific protocols and verification standards are still under development.

Key lessons

Based on ENGIE Energía Perú's experience, key lessons for target-setting include:

Timeline flexibility

Targets should focus on measurable implementation activities (completing adaptation plans, implementing adaptation measures) with clear deadlines that don't depend on climate event timing.

Phased implementation

Targets should be structured as a progression, from assessment completion (Level 1) to full plan implementation (Levels 2-4) with appropriate timelines for each phase.

Verified implementation

Verification should assess whether adaptation plans have been implemented as committed, using technical assessments, site inspections, and documentation review appropriate to each implementation milestone.

ENGIE Energía Perú's experience demonstrates several principles applicable to other infrastructure companies:

- **Tailored materiality:** Climate risks are project- and context-specific, requiring differentiated climate risk assessment across assets, such as generation, transmission lines, or support infrastructure.
- **Use of fit-for-purpose tools:** Platforms like ENGIE's internal portal and specialized climate modeling tools can help translate global climate models into asset-level insights.
- **Asset-level vulnerability assessment:** Site visits and stakeholder consultation validate climate projections with asset-level operational information, identifying climate risks that require location-, context- and time-specific adaptation measures.
- **Progressive refinement:** Companies can start with basic screening but should evolve toward forward-looking, scenario-based risk assessments using the latest IPCC projections for robust KPI design.

Arabia One Solar Plant, Jordan ©Nadia Bseis/IFC

5

Conclusion

Integrating climate adaptation KPIs into SLF represents a valuable opportunity for infrastructure companies seeking to systematically strengthen resilience while accessing innovative financial instruments. As physical climate risks intensify, investors, regulators, and communities increasingly focus on adaptation capabilities alongside emissions reduction efforts. This growing attention incentivizes infrastructure organizations to develop robust adaptation KPI frameworks.

The approach presented in this discussion paper provides a suggested pathway for developing meaningful adaptation KPIs that address material climate risks, align with companies' strategic objectives, and deliver tangible resilience benefits. By conducting thorough materiality assessments, establishing climate-adjusted baselines, formulating outcome-focused indicators, and setting ambitious yet achievable targets, infrastructure companies can create KPI frameworks that drive genuine adaptation progress while satisfying the requirements of sustainability-linked financing principles.

The illustrative examples demonstrate how metrics can be tailored to different aspects of infrastructure resilience—from technical asset performance to operational continuity, community protection, and financial resilience. This multidimensional approach recognizes that effective adaptation encompasses physical infrastructure modifications, operational protocols, stakeholder relationships, and governance systems. By selecting indicators appropriate to their vulnerability profile and strategic priorities, infrastructure companies can develop KPI frameworks that address their most material climate risks while leveraging their distinctive capabilities. Setting ambitious yet achievable targets requires careful consideration of climate projections, stakeholder priorities, and organizational capacities. Companies can reference peer performance, national policies, scientific predictions, and emerging frameworks without established adaptation benchmarks to establish credible ambition levels. Progressive improvement trajectories with phased targets create accountability while acknowledging the evolutionary nature of adaptation capability development. Above all, targets should demonstrate connections to meaningful resilience outcomes that protect business value and stakeholder interests.

A comprehensive implementation roadmap, with clear roles and responsibilities, stakeholder inputs, and robust data systems for monitoring and reporting, transforms adaptation KPIs into a practical and effective framework for achieving concrete adaptation outcomes. These factors create an organizational foundation for achieving adaptation targets while embedding climate resilience considerations into key business operations and decision-making processes.

As the market for adaptation-focused sustainable finance matures, early adopters could gain competitive advantage through proven climate resilience capabilities, though success depends on effective implementation rather than

KPI design alone. Well-documented KPI performance can provide insurers with quantifiable evidence to examine preferential premiums for resilient infrastructure assets, creating potential financial incentives for adaptation investments.[30]

Although outcomes remain contingent upon external factors—such as regulatory frameworks, market conditions, and broader systemic risks beyond organizational control—the value proposition of combining business risk management with community benefit makes adaptation KPIs a potentially powerful tool for achieving adaptation and resilience goals when supported by robust implementation frameworks.

This paper is designed to stimulate additional discussion among market practitioners, including on the additional work needed to build further interest in and use of adaptation KPIs. Advancing the sustainability-linked finance market will require additional guidance on adaptation and resilience target setting, including practical frameworks for verification, measurement approaches suited to diverse infrastructure contexts, and tools to support credible target development.

[30] Climate Finance Lab. Climate Insurance-Linked Resilient Infrastructure Financing. Web page.

Landing, Türkiye ©IFC

Additional References

Amiot, Marion et al. How Climate Scenarios Help Identify Potential Credit Impacts. S&P Global Ratings special report. September 17, 2024.

Asian Development Bank and the Global Center on Adaptation. A System-Wide Approach for Infrastructure Resilience. Technical note. January 2021.

Bapna, Manish; Christina Chan; and Carter Brandon. "4 Things to Know About the Global Adaptation Challenge." Feature article. World Resources Institute Insights. September 10, 2019.

Bernhofen, Mark, et al. The Impact of Physical Climate Risks and Adaptation on Sovereign Credit Risks. November 25, 2024. Available at SSRN: https://ssrn.com/abstract=4950708 or http://dx.doi.org/10.2139/ssrn.4950708.

Bhreasail, Âine Ní and Ed Persson. n.d. Measuring Resilience: A Guide to Tracking Progress. ARUP.

BlackRock. "Investors Underappreciate Climate-Related Risks in Their Portfolios—BlackRock Report." Press release. April 4, 2019.

Climate Bonds Initiative. 2019. Climate Resilience Principles.

Climate Bonds Initiative. Climate Bonds Resilience Taxonomy.

EU Technical Expert Group on Sustainable Finance. Taxonomy: Final Report of the Technical Expert Group on Sustainable Finance. March 2020.

Global Commission on Adaptation. "Adapt Now: A Global Call for Leadership on Climate Resilience." Press release. September 10, 2019.

GRESB. 2023. GRESB Infrastructure Asset Standard and Reference Guide.

Hallegatte, Stephane; Jun Rentschler; and Julie Rozenberg. 2019. Lifelines: The Resilient Infrastructure Opportunity. World Bank.

International Coalition for Sustainable Infrastructure. Resilience Toolbox.

International Hydropower Association. 2021. Hydropower Sector Climate Resilience Guide.

Moody's. 2024. Moody's Climate-related Risks and Opportunities Assessment.

Naran, Baysa et al. Global Landscape of Climate Finance 2024. Climate Policy Initiative report. October 31, 2024.

Network for Greening the Financial System. 2021. Progress Report on Bridging Data Gaps.

Rozenberg, Julie and Marianne Fay, eds. 2019. Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet. World Bank.

Task Force on Climate-related Financial Disclosures. 2021. Implementing the Recommendations of the TCFD.

United Nations Environment Programme. 2023. Adaptation Gap Report 2023: Underfinanced. Underprepared.

United Nations Environment Programme. 2024. Adaptation Gap Report 2024: Come hell and high water.

Urban Land Institute. 2023. ULI Developing Resilience Toolkit.

Woetzel, Lola et al. Climate Risk and Response: Physical Hazards and Socioeconomic Impacts. Report. McKinsey Global Institute. January 16, 2020.

International Finance Corporation
WORLD BANK GROUP