

Second CDRI Biennial Report

Global Infrastructure Resilience

Concept Note

October 2024



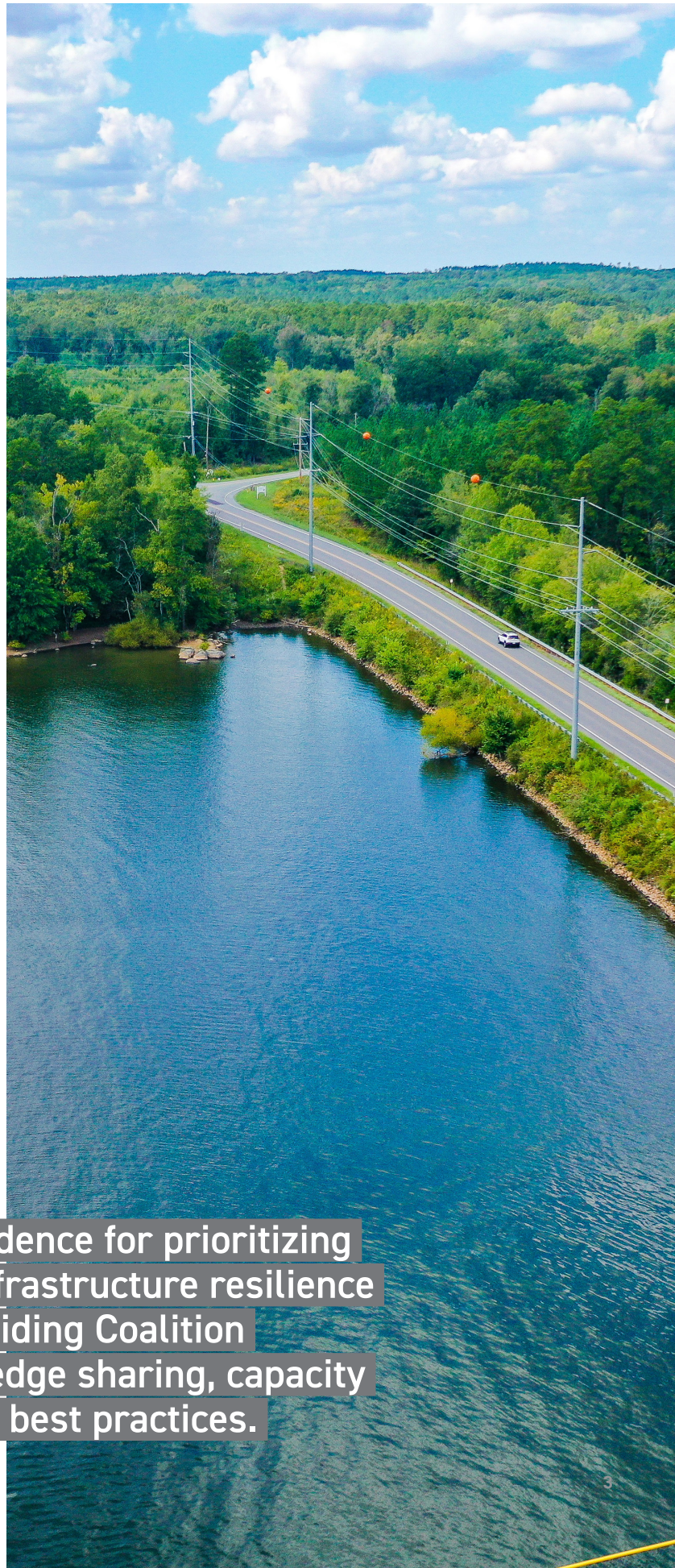
1. Introduction

The Coalition for Disaster Resilient Infrastructure (CDRI) launched its inaugural Biennial Report *Global Infrastructure Resilience: Capturing the Resilience Dividend* in October 2023. The Biennial Report is CDRI's principal vehicle for engaging and focusing the attention of a global audience of political leaders, policymakers, practitioners, and researchers on the critical and multifaceted challenges posed by disasters and climate change on infrastructure assets, systems, and services.

Each edition of the Report builds the evidence for prioritizing investments to bolster infrastructure resilience globally, particularly by aiding Coalition members through knowledge sharing, capacity building, and exchange of best practices. CDRI will publish the Second Biennial Report by 2025. The Second Biennial Report will leverage the key findings and lessons from the inaugural edition to strengthen the analysis and address some of the questions posed by the Report towards capturing the resilience dividend. This note outlines the foundational components of the forthcoming Second Biennial Report, along with the overall approach, milestones, and timeframe for its completion.



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2. Context

Infrastructure is the cornerstone of social and economic progress, core to several Sustainable Development Goals (SDGs), including SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) and fundamental to ensuring resilient developmental trajectories for countries.

Nearly 90 percent of global infrastructure was built in the last half-century; the critical need for resilient systems amidst rapid urbanization and infrastructure development cannot be stressed enough. Infrastructure faces escalating risks from disasters and climate change, with significant annual losses amounting to US\$ 732-845 billion globally, disproportionately impacting low- and middle-income countries (LMICs). These nations, burdened by infrastructure deficits, unequal investment distribution, and poor infrastructure quality due to weak governance compared to high-income countries, experience higher relative risks from disasters and climate change, thus, hindering their developmental trajectories. Investing in and strengthening resilience of infrastructure today will ensure the sustainability of services and reliable socio-economic growth of future generations in these nations.

By prioritizing infrastructure resilience, countries can not only reduce the loss and damage across sectors and populations, but also accrue a range of benefits or “dividends” such as environmental sustainability, robust and reliable services, economic growth amidst others.

To respond effectively to this resilience challenge, Prime Minister Shri Narendra Modi, launched CDRI at the UN Climate Action Summit in 2019. In collaboration with 42 countries and seven partner organizations, CDRI champions resilient infrastructure globally through international cooperation and partnership for resilience, technical capacity building, and knowledge sharing. As a partnership of national governments, UN agencies, multilateral banks, the private sector and knowledge institutions, CDRI is dedicated to promoting the resilience of infrastructure systems to climate and disaster risks in support of sustainable development.

3. The First CDRI Biennial Report

The First Edition of the Biennial Report addresses the unique challenges LMICs face. It outlines pathways for global resilience improvement, leveraging data from the first-ever fully probabilistic global risk assessment of infrastructure assets, known as the Global Infrastructure Risk Model & Resilience Index (GIRI). GIRI assesses the risk and resilience across nine major critical infrastructure assets covering seven hazards at a global level to arrive at financial metrics that instigate countries to formulate policies, plans, and strategies that incorporate resilience. Further, through rigorous data, evidence, and outputs, the Report underscores the idea of the “resilience dividend” that can support countries in transforming the perception of resilience from a cost to an opportunity, fostering financial incentives for resilience investments that benefit governments, investors, and communities alike.

Apart from GIRI, the First Biennial Report also outlined four critical dimensions for enhancing infrastructure resilience and capturing the resilience dividend, starting with improving infrastructure governance that involves enhanced planning, design standards, codes, regulations, compliance with operations and maintenance, and exchange of best practices to ensure the reliability and quality of infrastructure. The third dimension is investing in resilience by attracting untapped private institutional capital (US\$ 106 trillion worldwide) and innovative financial mechanisms. The Report also highlights the need for knowledge sharing and capacity building on infrastructure resilience. Lastly, it explored the innovative use of nature-based infrastructure solutions (NBIS) to integrate natural systems in infrastructure design and operation strategies.



4. The Second CDRI Biennial Report

The Second CDRI Biennial Report builds on the comprehensive risk assessment methodology with global applicability developed for the First Biennial Report. The Second Biennial Report aims to answer some of the questions raised during the preparation and dissemination of the First Report, expanding its remit and strengthening the connections between risk analysis and the financial, institutional, and technological dimensions of resilient infrastructure.

CDRI intends to align the various lines of work of the Second Report with CDRI’s strategic workplan to ensure that the on-ground results and learnings from CDRI initiatives are reflected in the Biennial Report and, vice versa.

The Report will be organized along two main pillars. The first pillar is based on a series of modeling and analytical pieces that deepen, downscale, and project the results of the First Biennial Report into the future. The second pillar advances the work of the First Biennial Report from the “what” to the “how.”

4.1 Pillar 1: Deepening, Downscaling, Projecting

The Second Biennial Report builds upon and expands the work of the First Biennial Report along three essential lines of work:



Deepening the understanding of resilient infrastructure by (i) incorporating additional risks and updating the model with new databasesⁱ; (ii) undertaking specific assessments of economic and poverty impacts due to infrastructure services failures caused by disasters, including a perspective on small and community infrastructure; and (iii) completing global surveys to better understand the underlying factors of insufficient resilience and the impacts on businesses and the economy.



Downscaling the global analysis undertaken for the First Biennial Report to the country and sub-national level to provide higher-quality risk assessments using better data and understanding of local conditions through national partners. At the same time, these analyses will review options, costs, and benefits of resilience and adaptation measures to reduce the impacts of disasters on infrastructure assets, systems, and services.



Projecting the modeling exercise to incorporate future expected trends, including investment trajectories to achieve the targets of infrastructure-related SDGs (with particular attention to the vulnerabilities of last mile infrastructure services), the projected growth of urban centres, and related areas of analysis.

The following sections describe the specific research and analysis questions that will be explored in the Second Biennial Report. The questions that can be answered with existing data

and reasonable levels of accuracy will be included in the Second Biennial Report.

4.1.1 Deepening

The Second Biennial Report will deepen the analysis undertaken in the First Biennial Report by leveraging the model built, the databases compiled, and the indicators processed. Areas of focus include:

- Expanding the risk analysis by including additional hazards such as heatwaves and wildfires, adding new infrastructure sub-sectors such as irrigation infrastructure, and preparing sub-sectoral deep dives such as for the renewable energy sector^{ii,iii}.
- Exploring ways to calculate the indirect economic costs caused by infrastructure service interruptions at the national or sub-national level for some specific cases. Several studies have shown at the local level that the economic impacts (e.g., disruption to business and economic activities, additional transport and logistics costs, etc.) are significantly higher, in many cases than the direct costs linked to infrastructure reconstruction and restoration of services. Applying the GIRI model to this type of analysis, combined with local data on the linkages between infrastructure services and economic activities, will provide insights into the true magnitude of the potential resilience dividend, the ways in which disasters have differential impacts between groups (poor vs less poor populations^{iv}, small and medium enterprises vs large corporations). As part of this work, the Second Biennial Report will explore ways to estimate the benefits of enhancing resilience through new infrastructure^v.
- Using the model to better understand the specific burden resulting from infrastructure damages caused by disasters at the sub-national level (specifically in provinces with higher levels of poverty) or in small countries (with smaller economies) to unpack the analysis beyond global or regional averages.
- Improving and rolling out the pilot survey

undertaken as part of the First Biennial Report to understand (and rate where possible) the underlying factors behind the critical weaknesses of the infrastructure systems to disasters in individual countries. This survey will be conducted with engineering associations and similar stakeholders from about 50 to 75 countries worldwide. The survey will help understand diverse factors associated with the institutional, financial, capacity and regulatory environment needed for resilient infrastructure systems and services. A second survey is being considered, targeted at businesses that depend on infrastructure services to understand the vulnerability of the business environment to interruptions in infrastructure services caused by disasters.

4.1.2 Downscaling

The risk assessment approach used at the global level in the First Biennial Report can be applied at smaller scales (national or sub-national) by disaggregating the results at the country or provincial/state levels using the global dataset. The Second Biennial Report will go further and “downscale” the analysis using national data. The Report will work with a selected number of countries (about two large, medium, and small island states) to apply the global methodology with better local data, enhanced understanding of the local context, and better validation with expert opinions.

The national and sub-national analysis allows a better understanding of specific resilience-building and adaptation-enhancing options. A review of costs, benefits and prioritization of resilience measures in specific sub-sectors will complement the risk analysis, including the weakest links in specific infrastructure networks that require upgrades to strengthen the resilience of the overall system. This analysis will quantify the resilience dividend that can be captured using different strategies and provide practical examples of how to choose resilience-strengthening pathways and robust approaches ready to handle different risk profiles due to climate change. These

results will inform the discussions in Pillar 2 of the Second Biennial Report, as discussed in Section 5 of this document.

This work is expected to build capacities of CDRI Member Countries and other relevant stakeholders on geophysical and climate risk assessment and provide access to different tools, the latest methodologies, techniques, and data products to help resilience and adaptation planning at the national and sub-national level. CDRI is considering the creation of a Data Hub that will serve as a repository and platform for this analysis and data (see Box 1).

4.1.3 Projecting

The First Biennial Report conducted its analysis using current data. The Second Biennial Report will explore the question of the additional annual average and probable maximum losses under potential future scenarios. The first scenario will review the expansion of infrastructure assets to reach the targets of related SDGs. The second scenario will run the model with the projected growth of urban areas (population and footprint). Different global warming trajectories and climate change scenarios will be added to the analyses of the First Biennial Report. Other future scenarios may be considered depending on data available at the global level.

The conclusions of these analyses will be drawn with the necessary caution given the uncertainties surrounding these projections, including deep uncertainties associated with climate change impacts. Nevertheless, the orders of magnitude calculations will aim to show the substantial growth in annual average and probable maximum losses if the existing levels of resilience for the existing infrastructure are not changed. Conversely, the analysis will show the level of resilience dividend countries can capture if they strengthen the resilience of infrastructure growth. Several studies have shown that the cost of retrofitting infrastructure to make it more resilient is substantially higher than incorporating resilience measures in the original design and construction.

Box 1– Proposed CDRI Data Hub

The proposed CDRI Data Hub aims to build capacities of CDRI Member Countries and other relevant stakeholders on geophysical and climate risk assessment and provide access to different tools, latest methodologies, techniques, and data products to help resilience and adaptation planning at the national and sub-national level. The Data Hub is not seen as a CDRI product but as a platform that will allow different stakeholders to share their models and field modeling experiences. At the country level, the Data Hub will support the relevant ministries related to different infrastructure sectors, finance and planning ministries, ministries for local governments including cities, scientific and research institutions, academic Institutions, national survey agencies, remote sensing and meteorological agencies, private sector, and domain experts. The design of the proposed CDRI Data Hub will start with a thorough review of related platforms, their experiences, and lessons learned.

Data Hub Components and Activities - The Data Hub will support:

- A compilation of the latest methodologies, approaches, and techniques used for disaster risk and climate shock assessments, and quantification of risk control and resilience measures (grey, nature-based, and behavioural).
- Hands-on support to stakeholders in conducting risk assessments and resilience planning. All non-confidential information and data sets compiled and used will be shared with other stakeholders to aid in their risk analysis and resilience planning work.
- Brokering across data providers and users to enhance the analysis and planning of resilient infrastructure.
- Development of relevant use cases from diverse geographical contexts to present detailed, step-by-step descriptions of the work done with Member Countries. The Data Hub will also aggregate case studies from various CDRI Member Countries (developed and developing) and other relevant stakeholders.
- Tailor-made training programmes for different categories of CDRI Member Countries and SIDS to build their capacities to use data science for disaster risk management and resilience planning.
- Discussion and exchange spaces for stakeholders worldwide, webinars, communities of practice on specific topics, a library repository of reference materials, and other knowledge management activities.

4.2 Pillar 2: How to Capture the Resilience Dividend

The First Biennial Report provided a robust analysis of the magnitude of the resilience dividend at the global and national levels. It also took the first steps in analyzing ways to build and maintain more resilient and climate-adapted infrastructure, including NBIS and financial mechanisms. The Second Biennial Report will build on this foundation, to move from the question of “What is the magnitude of the potential resilience dividend?” to “How can this resilience dividend be captured?”

Under this Pillar, the Second Biennial Report will review (i) financial instruments for resilience and adaptation, (ii) institutional, governance and capacity frameworks, and (iii) frontier tools, including disruptive technologies and NBIS, among others.

The Report will present frameworks for each work area, building on the best approaches developed by other organizations, documenting good practices, and creating roadmaps for action.

The “how to” discussions in Pillar 2 will be structured around and closely linked to the framework used in the First Biennial Report, which is based on countries’ capacities to absorb disturbances to the infrastructure assets caused by a disaster, respond to the disaster, and recover to the original performance (or even to build back better).

These capacities depend on various capacities, mechanisms, institutions, regulations and overall governance of the infrastructure systems and services. Pillar 2 will explore how to strengthen each of these capacities through enhanced financial mechanisms, institutional, governance and capacity characteristics, as well as innovative solutions. Pillars 1 and 2

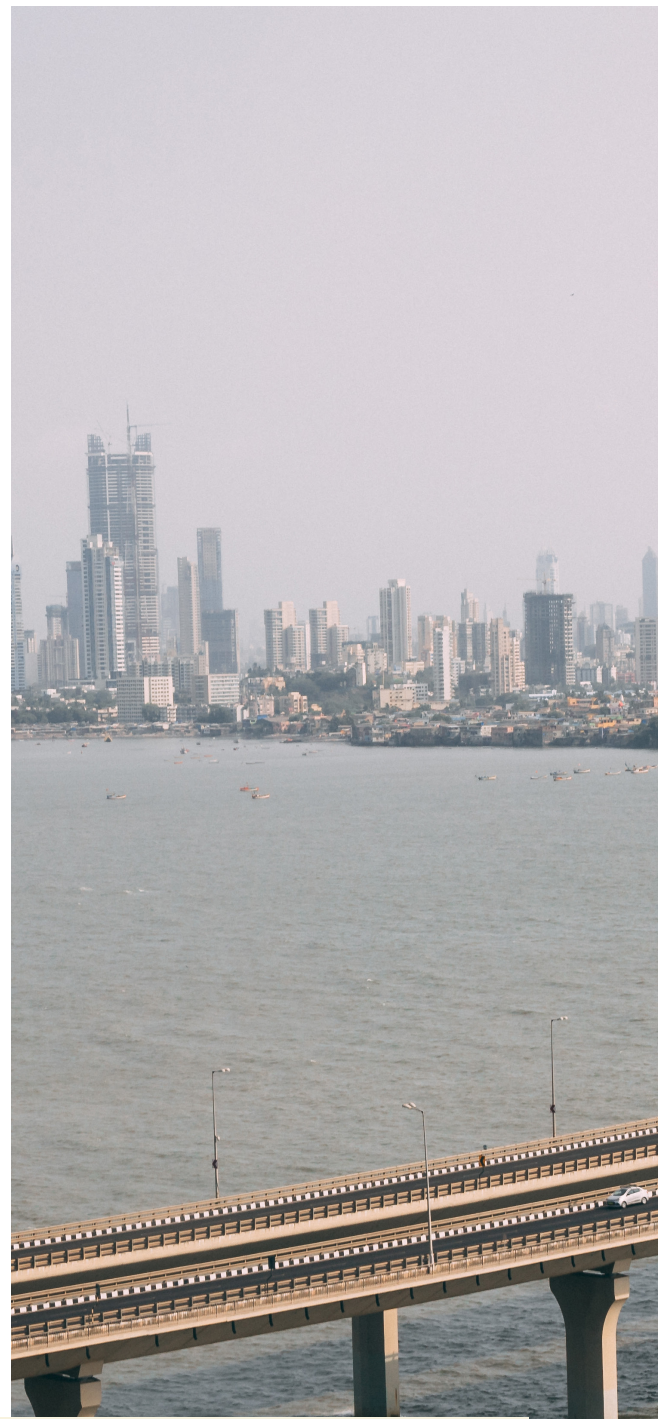
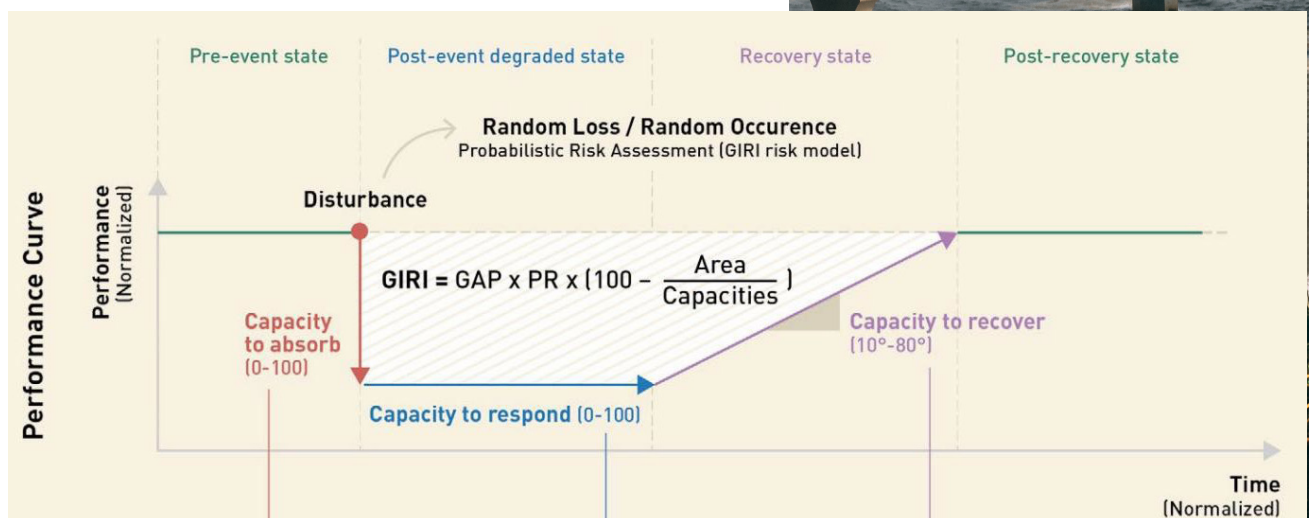


Figure 1: Conceptual Framework of GIRI



of the Report are closely connected in practice, as the modeling results and insights developed in Pillar 1 are indispensable to define roadmaps for action to capture the resilience dividend as analyzed in Pillar 2.

- **Finance:** Pillar 2 of the Second Biennial Report will present practical approaches to financing infrastructure assets and systems with greater capacity to absorb disturbances caused by disasters. These include funding more resilient and better climate-adapted infrastructure and proactive disaster-focused enhanced maintenance of the assets. The Report will also review experiences and best practices with financial mechanisms allowing faster and more efficient post-disaster response and recovery. These include insurance, credit lines, catastrophic bonds and other tools. The financing of maintenance, upgrades to ageing infrastructure, and NBIS, among others, will be explored. The institutional arrangements, capacities and roadmaps to develop and continuously improve these financial mechanisms will also be discussed, including the role of significant stakeholders such as the financial regulators and the insurance sector. Business models to mobilize private capital for resilient infrastructure will be explored. Finally, the analysis will explore ways to quantify and monetize the resilience dividend across public and private stakeholders.
- **Institutions and governance:** The capacities to absorb, respond, and recover depend on the institutions, governance arrangements and capacities of government agencies, infrastructure users, and the infrastructure construction, maintenance, and operations ecosystem (with its many public and private stakeholders and often, uncoordinated and overlapping responsibilities). The differential capacities of the national and local governments will be part of the analysis, as well as the diverse governance mechanisms and systems for resilient infrastructure^{vi}. Pillar 2 of the Report will review the best approaches and frameworks of analysis, present global good practices, and propose roadmaps to strengthen institutions and governance for resilient infrastructure. The institutions and stakeholders to be analyzed are not limited to the infrastructure

agencies. Still, they will encompass many other related government agencies, the private sector (designers, contractors, construction supervisors, and operators), and users.

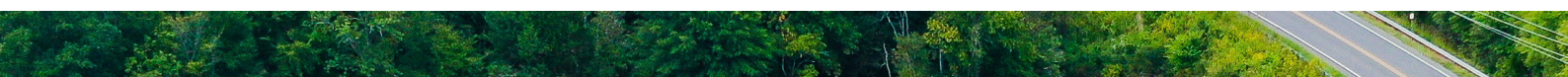
- **Tools and technologies:** The Second Biennial Report will conduct a deep dive into new tools and technologies currently under development, testing and initial stages of scaling up. The analysis will go beyond listing these tools and technologies and focus on the “how to” identify, prioritize, select, finance, implement, and upgrade these tools and technologies. Pillar 2 will focus on disruptive and information technologies for resilience (from artificial intelligence to remote sensing, advanced sensors and materials, machine learning, and cybersecurity) and NBIS. The review will take a cautious approach to applying these technologies in countries with diverse capacities and avoid the perception that new tools and technologies alone can help governments and users capture the resilience dividend. Furthermore, the Report will provide a balanced analysis to illustrate the need to combine NBIS with grey infrastructure and the difficult trade-offs involved in design and implementation^{vii}.

Each of these work areas will develop:

- Approaches for governments to continuously scan the horizon, understand, and leverage new technologies
- Tools to work with the private sector to develop, test and scale up the use of disruptive technologies to enhance the resilience of infrastructure assets and networks
- Global examples and good practices of technologies to capture the resilience dividend

The three work areas will work closely across on issues such as:

- Instruments to finance new technologies
- Institutional arrangements to support the development, testing, and scaling up of disruptive technologies for resilient infrastructure
- Institutional mechanisms to engage communities around infrastructure assets for the effective design and maintenance of NBIS^{viii}



Furthermore, the Second Biennial Report is expected to serve as an input to and provide elements to enhance several global and national climate adaptation processes, including National Adaptation Plans (new and updated) and the Global Goal on Adaptation among others.

5. Quality Assurance

An International Advisory Board (IAB) of senior global leaders on sustainable development, infrastructure and resilience will be constituted to provide strategic guidance and advice to CDRI. A Technical Advisory Group (TAG) with technical experts, academics, and government officials will provide in-depth advice as the Report is being developed. It is expected that at least three meetings of the TAG will take place at critical junctures of report preparation. Finally, each technical area of the Report (modeling, finance, institutions, NBIS and technology) will be overseen by a smaller Advisory Group of highly specialized experts to provide substantive support, from framework to methodology and draft outputs.

6. Audience

The Report's comprehensive scope implies several audiences to be reached, from engineering professionals to decision-makers, financial sector stakeholders, ministries of finance and planning, infrastructure construction companies, asset managers and private partners in public-private partnerships, and the general public. Focused knowledge, capacity building and communication products targeting specific audience groups will be developed to augment the Report's dissemination and uptake of its key messages.

7. Milestones, Timeframe and Consultations

The Second Biennial Report is targeted to be launched in October-November 2025. Key milestones and timeframes are as follows:

- **Initial Consultations (August – September 2024):** Consultations with technical experts

and representatives from Member Countries will feed into the scoping, research and drafting of the Report. Early engagement with these countries will ensure an inclusive process and their buy-in and ownership of the Report.

- **Advisory Groups Meetings (September 2024 – July 2025):** A high-level IAB along with TAGs are being constituted. The first round of IAB and TAG meetings is planned for September-October 2024 to review concept notes and annotated outlines of chapters. The TAGs will review the first-order drafts of individual chapters and the overall Report. The IAB will provide advice on the final version of the Report.
- **Report Production (June 2025 - October 2025):** After incorporating comments from the TAGs and IAB, the Report will be designed and printed for its launch in October/November 2025, before COP30 in Brazil.
- **Outreach and dissemination:** The outreach and dissemination efforts for the First Biennial Report began in July 2024 with a series of webinars through CDRI's digital DRI Connect platform. Earlier in the year, critical outputs from the Report were shared through sessions and deliberations at ICDRI 2024. As momentum builds for the second edition, the outreach for the First and Second Biennial Reports will ensue starting Quarter 4 of 2024. This process will entail activities promoting the key narratives and findings from both editions at various international and national conferences, forums, social media platforms, blogs, and other media, including through the use of new technologies. The findings of the First Biennial Report will be repurposed into specific sub-products targeted at different audiences, including report summaries in languages other than English. A detailed communication plan will be developed to structure the outreach and dissemination efforts. Knowledge-sharing and capacity-building products will be generated based on the methodologies, insights, and findings of the Second Biennial Report.

Endnotes





- i The downscaling work will continuously look at opportunities to validate the model results against actual damage data at the regional or country level, and emphasize the need for countries to strengthen their data collection and post-disaster forensic analysis for later use in improving the probabilistic risk assessment model.
- ii This work will present the model limitations and caveats, particularly with regards to data availability, so that partner countries recognize and understand the benefits of continuously improving baseline data.
- iii The downscaling analysis will explore whether calculations on deaths as a result of infrastructure failures caused by disasters could be included. While methodologies are less developed in this area, the team will explore this question as suggested in the consultations.
- iv The report will explore ways to disaggregate differential impacts on women and children. The lack of data will be a challenge to undertake this task but the Report will analyze how to potentially develop a methodology and data collection to tackle this important question.
- v For example, the lack of flood infrastructure significantly impacts surrounding communities and livelihoods. In addition to understanding the need for resilience of assets, the Report will explore ways to understand and model the resilience enhancement provided by certain infrastructure assets.
- vi Procurement was highlighted as a critical area of analysis for the institutions and governance workstream of the Report in the consultations.
- vii This analysis will consider local conditions and will highlight the need to bring together solid engineering, ecological, and cost-benefit analyses.
- viii Including complex issues such as land acquisition and resettlement for NBIS.



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