Global Infrastructure Resilience

Introduction

Asset loss and service disruption associated with disaster and climate risk erodes a significant proportion of the new capital investment countries need to address their infrastructure deficits. Given an estimated Average Annual Loss (AAL) of over US$ 700 billion[4] in infrastructure and buildings, new infrastructure investments without strengthened resilience are analogous to pouring water into a bamboo basket.

Strengthening infrastructure resilience is a major contemporary global challenge. Many high-income countries, particularly those that industrialized prior to the second World War, need to replace obsolete infrastructure assets to strengthen resilience to new and existing hazards. Meanwhile, social and economic development in lower income countries is constrained by large infrastructure deficits that are aggravated by weak infrastructure governance.

International agreements on the need to reduce emissions and mitigate climate change mandate a rapid transition from carbon-locked-in infrastructure to low, zero, or negative emission infrastructure. However, a significant proportion of new capital investments is eroded by asset loss and service disruptions associated with disaster and climate risk. In other words, new infrastructure investment without strengthened resilience is analogous to pouring water into a bamboo basket.

Most of the infrastructure that will be required by 2050 is yet to be built. Recent estimates of the annual investment required to address infrastructure deficits, achieve the SDGs, and achieve net zero by 2050, amount to $9.2 trillion of which $2.76 trillion must be invested in low- and middle-income countries (LMICs). While investments in high- and many middle-income countries are increasing at a

[4] Global Infrastructure Risk Model and Index (GIRI). See Chapter 2.

slow but steady pace, infrastructure investment in low-income countries continues to be an order of magnitude lower than the projected investment needs.

The long design lifecycles of many infrastructure assets will be key to making investments resilient and configure development trajectories in the decades to come. At the same time, strengthening infrastructure resilience is critical to address existential risks associated with catastrophic climate change and biodiversity loss.

Globally, we are at a fork in the road. Investing to strengthen infrastructure resilience could set countries on a development trajectory characterized by quality and dependable essential services, reduced damage to infrastructure assets, lowered systemic risk, and sustainable social and economic development. On the flipside, ignoring resilience could mean stagnant social and economic development, stranded infrastructure assets, increasing contingent liabilities, unreliable and inferior services, and growing existential risk.

Strengthening infrastructure resilience is particularly critical for low-income communities as risk distribution within countries is conditioned by factors such as social status, gender, power, access and control of resources, poverty, and vulnerability. Consequently, the disproportionate impact of climate change on women necessitates having them contribute towards strengthening resilience (Nellemann et al., 2011).

This first edition of CDRI's Biennial Report *Global Infrastructure Resilience* lays out the political and economic imperative for investing in infrastructure resilience based on a large body of evidence and analysis. The Report's aim is to highlight the resilience dividend or the full range of benefits possible from investing in infrastructure resilience. These include avoided asset loss, reduced service disruption, improved quality, and reliability of public services, accelerated economic growth and social development, reduced carbon emissions, enhanced biodiversity, improved air and water quality, more efficient land use, among others.

This Report examines the risk to infrastructure from both geological and climate-related hazards. The thesis of the Report is that a more complete estimation and visualization of the risk as well as the resilience dividend can provide a solid economic imperative for investing in infrastructure resilience. Further, realizing the resilience dividend in a way that benefits governments, investors, and other stakeholders may provide the missing financial incentive to mobilize the required capital.

The economic and financial imperatives for investing in resilience will only be effective if a political imperative is also identified. Infrastructure resilience faces challenges from short-term economic and social demands, aggravated by shocks and crises such as the COVID-19 pandemic and the war in Ukraine that consume political capital and distract attention. Although, elections have never been won on issues of avoided loss and damage or reduced contingent liabilities, improving coverage, quality, and reliability of essential services in most countries are increasingly political demands. Therefore, improving the delivery of essential services may provide the much-needed political incentive to invest in resilience.

This report is divided into five chapters and several annexures.

Chapter 1 explores the dual nature of infrastructure resilience as investing in resilient infrastructure on the one hand, and infrastructure for resilience on the other. It also discusses the scale of infrastructure deficits in relation to the SDGs; the need to consider asset, service, and supply chain resilience; the role of infrastructure governance in configuring resilience; and reducing systemic risk.

Chapter 2 provides a new and unique body of quantitative evidence on infrastructure risk and resilience. The Global Infrastructure Risk Model and Resilience Index (GIRI), as commissioned by CDRI, provides a globally comparable set of financial risk metrics for infrastructure assets. GIRI is the first-ever fully probabilistic model to identify and estimate the risks associated with major hazards (earthquakes, tsunamis, tropical cyclone winds and storm surges, landslides, floods, and hydrological drought) across principal infrastructure sectors (power, oil and gas, telecommunications, ports and airports, roads and railways, water and wastewater, health, education, and commercial, industrial and residential buildings) in all countries and territories, accounting for existing climatic conditions and two other climate change scenarios. Additionally, risk metrics such as Average Annual Loss (AAL) enable governments to identify and understand contingent liabilities internalized in their infrastructure systems and to inform resilience-related investments.

Chapter 3 examines the role of investments in infrastructure resilience in strengthening systemic resilience with a particular focus on Nature-based Infrastructure Solutions (NbIS) in complementing, substituting for or safeguarding traditional "grey" infrastructure. The chapter proposes enabling activities such as strengthening knowledge and capacities, documenting practices, and the formulation of appropriate standards necessary to transform NbIS from what is currently an exotic, into a quotidian approach to address infrastructure, particularly in sectors such as water and hazard mitigation.

Chapter 4 addresses the financing of infrastructure resilience. Between now and 2050, the gap between existing annual infrastructure investment (understood as the total of public and private infrastructure investment and climate finance) and that required to address the infrastructure deficit, reduce systemic risk, and strengthen resilience is immense. This is particularly the case in low-income countries. While there is sufficient unassigned private capital to fill this gap, investing in resilience is still generally perceived as an additional cost imposed by regulators rather than being seen as an investment opportunity. Therefore, identifying and estimating the full resilience dividend in all infrastructure projects is necessary to make a strong economic case for investing in resilience. Mechanisms to realize and distribute the identified resilience dividend could provide a solid financial case for mobilising private capital.

Chapter 5 summarizes the principal recommendations of the report, particularly highlighting the need for enabling activities that can collectively serve to strengthen infrastructure governance at national levels by sending positive market signals to unlock private capital and public investment. It concludes with a discussion on the mobilization of political capital for better quality and more dependable essential services.

Lastly, **Annexure 1** presents a proposal to monitor progress in infrastructure resilience including through the Global Infrastructure Resilience Survey that captured information on infrastructure governance and management across several countries in this iteration.

The risk and resilience metrics produced by the report cover all countries and territories across all geographic and income regions. Clearly, each country and each income and geographical region face their own specific infrastructure challenges. While high-income countries have huge capacities for public investment and are attractive destinations for private capital, many LMICs face serious challenges for mobilizing the capital needed for strengthening resilience.

LMICs include a wide range of economies, including low-income developing countries, emerging economies, Small Island Developing States (SIDS), and landlocked developing nations, each of which face different challenges. *Global Infrastructure Resilience* is unique in that it examines this challenge from an international organisation based in India, instead of a high-income European, North American, or East Asian country.

This edition of Global Infrastructure Resilience lays out the economic, financial, and political imperative for investing in infrastructure resilience and presents pathways to do so. Future editions of the Report will need to highlight the instruments that diverse LMIC can apply to transform their resilience objectives into actionable policies, strategies and plans, with greater granularity.

For example, it would be important to further specify the codes, standards, and regulations that could be applied in the planning of infrastructure resilience in each sector and for different categories, including strategic economic infrastructure and local infrastructure systems. Similarly, further work is required to define which are the most appropriate institutional architecture and governance arrangements to enable an effective application of such resilience-based codes, standards, and regulations. Other critical areas that require detailed instruments are the integration of infrastructure with land-use planning, with post-disaster recovery and the development of additional incentives for risk transfer and insurance.

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Global Infrastructure Resilience is published in digital and print versions. All the Position and Contributing Papers that support the analysis presented here are listed in Annexure II and may be viewed and freely downloaded online. The GIRI Data Platform, developed by the United Nations Environment Programme (UNEP) for CDRI, enables users to access and download the full range of risk metrics and perform on-screen visualization and analysis of the results.