T20 Policy Brief

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Task Force 02

SUSTAINABLE CLIMATE ACTION AND INCLUSIVE JUST ENERGY TRANSITIONS

Resilient Infrastructure Systems: Closing the Resiliency Gap

Rodolfo Benevenuto, Infratech and Sustainability Coordinator, PSP Hub (Brazil)

Elizabeth Losos, Executive in Residence, Nicholas Institute for Energy, Environment & Sustainability, Duke University (USA)

Michael Max Bühler, Professor of Construction Economics, University of Applied Sciences Konstanz (Germany)

Jennifer Whyte, Director, John Grill Institute for Project Leadership, Faculty of Engineering, University of Sydney (Australia)

Armando Ortuño, Technical Director, Madrid World Capital of Construction, Engineering and Architecture (Spain)

Daniel Galle, Partnership Manager, The Global Infrastructure Hub, (Canada)

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Abstract

While conventional infrastructure resilience tools and metrics attempt to address climate risks on a project-by-project basis, there is a significant gap in understanding and measuring the systemic risks and challenges posed by climate change on infrastructure networks. Sophisticated approaches fail to capture the broader system-wide impacts, such as the disruptions to utilities in urban areas and the cascading effects of network failures, disproportionately affecting the less developed communities. This policy brief advocates for a comprehensive mapping of existing benchmarks and indicators to create a framework for measuring systemic resilience. The brief emphasizes the critical need to integrate physical climate risk considerations into early planning and financial decision-making to effectively address and mitigate systemic impacts. This approach is designed to encourage governments and investors to focus on projects that not only promise significant economic, social, and environmental benefits but also enhance systemic resilience at the community and ecosystem levels. This collaboration aims to aid governments in formulating national adaptation plans and resilient infrastructure decision-making models. The recommendations in this paper can also help guide the next methodological steps to transform theoretical concepts of systemic resilience into practical, actionable tools. The recommendations will be critical to orient the prioritization of infrastructure investments that are more resilient and inclusive, addressing especially those most vulnerable to climate change impacts.

Keywords: Systemic Resilience, Infrastructure, Metrics, G20

Diagnosis of Issues

The G20 has emerged as a critical platform for global cooperation and action to address the multifaceted challenges of climate change. Over recent years, various presidencies of the G20 have underscored the urgency of mobilizing resources for climate adaptation and enhancing resilience. As the world grapples with increasingly frequent and severe climate-related events, it becomes evident that merely acknowledging the need for adaptation is insufficient; concrete steps must be taken to measure and bolster systemic resilience.

The efforts of past G20 presidencies have been commendable in recognizing the importance of climate adaptation and resilience-building. Initiatives, declarations, and collaborative endeavors have sought to elevate the discourse and spur action on this critical front. From Argentina's presidency in 2018, which recognized the importance of comprehensive adaptation strategies, to India's presidency in 2023, which institutionalized a Disaster Risk Reduction Working Group, there has been a growing acknowledgment of the need to prioritize adaptation alongside mitigation efforts.

The Brazilian Presidency in 2024 is dedicated to climate change adaptation through various working groups, which could benefit significantly from this systemic resilience approach:

- **Disaster Risk Reduction Working Group** focuses on fostering resilience and risk prevention, particularly in infrastructure resilient to disasters and climate change. A new set of systemic resilience metrics would help measure and evaluate infrastructure's ability to withstand disasters and climate change, guiding investment priorities and tracking progress.

- **Infrastructure Working Group** discusses innovative instruments for securing financial investment resources, focusing on unlocking private financing for climate-resilient infrastructure. Metrics are needed to support the assessment of projects to create the proper incentive structure that can mobilize further private capital to the infrastructure assets contributing to systemic resilience.
- **Environment and Climate Sustainability Working Group** has a workstream specifically focused on understanding the current barriers that prevent further progress on the global adaptation to climate change. The systemic approach to assessing and measuring the effectiveness of adaptation policies and initiatives would facilitate coordination among stakeholders and the integration of adaptation measures into broader development strategies.
- **Sustainable Finance Working Group** aims to promote a transition to greener, more resilient, and inclusive societies and economies, with adaptation addressed across all its workstreams. Integrating resilience metrics into sustainable finance frameworks ensures investments contribute to long-term resilience and global goals on adaptation, attracting more capital and enhancing the credibility of climate-resilient assets.

As the global community navigates the complexities of climate change, a pressing need arises to shift from rhetoric to tangible action. One crucial aspect that demands attention is the measurement of systemic resilience. While resilience has been broadly acknowledged as essential, quantifying and assessing it at a systems-level remains challenging. With a clear understanding of systemic resilience, it becomes easier to prioritize investments effectively and ensure their efficacy in building adaptive capacity.

Box 1 provides an example of the importance of considering systemic resilience as a complement to traditional risk assessments of infrastructure projects.

Box 1 - Mississippi River and Gulf Outlet (Mr Go) shipping canal:

In 1965, an 11-meter deep and 200-meter-wide shipping canal was built to connect the New Orleans industrial canal with the open sea to the east, facilitating shipping access to the city. However, within three months of its completion, Hurricane Betsy struck, marking the first US disaster to exceed $1 billion in damages, exacerbated by the presence of the Mr Go Canal. Hurricane Betsy, a Category 3 storm with easterly winds from the Gulf of Mexico, bypassed the defenses along Lake Pontchartrain, which would typically resist such forces. Instead, it directed a 3.6-meter-high surge of water along the Mr Go canal towards the industrial canal, breaching the newly exposed low embankments and causing flooding in the eastern part of the city. Consequently, 13,000 homes were submerged in floodwaters up to 2.7 meters deep, leaving 60,000 people homeless and resulting in 58 fatalities.

The construction of the Mr Go canal serves as a stark example of failing to prioritize the systemic resilience of a city, in this case, New Orleans, against a known challenge such as hurricanes. While the canal itself was resilient, its addition diminished the overall resilience of the city system. Conversely, the decision to close the canal after Hurricane Katrina—which again exposed the detrimental systemic inadequacies of the canal—ultimately bolstered the systemic resilience of New Orleans.

Source: Shaffe et al. (2009)

A recent analysis conducted by Darwin and Blanc-Brude (2023) suggests that by 2050, infrastructure assets may experience as much as 26.7% of average net value decline under the most severe climate and policy scenarios. While metrics such as the 'value at risk' of assets have been significant drivers of private investors' decision-making, other economic, environmental, and social impacts must be priced to ensure that private capital may also flow to projects that genuinely contribute to systemic resilience.

According to Verschuur et al. (2023), disruptions to ports caused by climate extremes can lead to systemic repercussions on global shipping, trade, and supply chains. By integrating projected climate-related downtime across 1,320 ports with an international transportation flow model, the researchers identify systemic risks to worldwide maritime transport, trade, and supply chain networks. They estimate that annually, a total of US$81 billion worth of global trade and at least US$122 billion in economic activity are vulnerable to these risks.

In light of these considerations, it seems imperative for the G20 to prioritize developing and adopting standardized methodologies for measuring systemic resilience. Collaborative efforts should be taken to harmonize approaches, share best practices, and build capacity among member states. By establishing common frameworks and standards, the G20 can enhance comparability and accountability in resilience assessments, enabling more informed decision-making at both national and international levels.

In this evolving landscape of climate resilience, the G20 stands at a pivotal juncture. The path forward requires a commitment to enhancing systemic resilience through strategic frameworks and methodologies, and an unwavering dedication to actualizing these plans on the ground. The Brazilian and the upcoming presidencies and member nations must seize this opportunity to transform the discourse into decisive action,

ensuring that the global pursuit of resilience translates into tangible outcomes for communities worldwide. This demands an integrated approach, where systemic resilience becomes a cornerstone of policy-making, investment decisions, and collaborative initiatives. By fostering a culture of measuring the resilience that permeates every aspect of our socio-economic systems, the G20 can lead by example, steering the world towards a future where societies are prepared to withstand climate-related challenges and thrive equitably and sustainably. The time for action is now as we endeavor to build a resilient legacy for generations, underpinned by robust, actionable metrics and a shared commitment to a more resilient world.

Recommendations

This section outlines a series of actionable strategies related to systems adaptation metrics specifically tailored for G20 nations. Specifically, by developing a comprehensive global toolkit for resilience measurement and communication, advancing cost-benefit analysis protocols, and addressing barriers to investment in adaptation, this brief presents a blueprint for transforming the resilience of infrastructure systems worldwide. By harnessing the collective expertise and resources of the G20, we can pave the way for a future that not only withstands the test of climate variability but also thrives in harmony with our environment, ensuring prosperity, and security for all communities.

TABLE 1: Recommendations

Categories	Recommendations	Descriptions
Improving Understanding and Measurement of Resilient Systems	Launch the Resilience Measurement Toolkit Initiative	Develop a comprehensive toolkit that integrates resilience frameworks, models, tools, and studies. It should include specific instruments for systems scoping, resilience assessment, advanced metrics for multi-dimensional evaluation, and tools for cost-benefit analysis to support decision-makers and stakeholders in making informed, adaptive decisions for enhancing resilience.
	Implement Advanced Modeling for Resilience Analysis	Incorporate dynamic systems and causal modeling into the toolkit to enable prediction and optimization of resilience strategies across critical infrastructure sectors. This should also include capabilities for real-time data analytics, leveraging big data, remote sensing (IoT), and digital technology.
Harvesting the Benefits of Resilient Systems	Enhance Cost-Benefit Analysis Protocols	Update cost-benefit analysis protocols to incorporate dynamic models that quantify the full benefits and externalities from resilience investments, including economic, social, and environmental dimensions, tailored to various climate scenarios.
Reducing Investment Barriers	Enhance Data Collection and Sharing Systems	Establish interoperable data platforms to enhance the collection, systematization, and accessibility of data on climate threats and exposures, promoting cross-sectoral collaboration and data sharing.
	Standardize Resilience Metrics	Develop and publish advanced systemic resilience metrics that accurately reflect vulnerabilities, risks, and resilience, covering social and environmental dimensions, to guide strategic investments and interventions.

	Create Unified Taxonomies for Resilience Investments	Develop a comprehensive taxonomy for categorizing resilience and adaptation investments to ensure clarity and consistency in communication across sectors, facilitating more transparent decision-making processes.
	Set Strategic Resilience Priorities and Objectives	Define global and national adaptation priorities and objectives based on a thorough analysis of the systemic impacts and needs to strategically guide policy and investment decisions.
Improving Implementation	Initiate Global Pilot Projects for Toolkit Application	Launch pilot projects in various geographical and sectoral contexts to test, refine, and demonstrate the efficacy of the toolkit and methodologies, ensuring the tools are adaptable and practical across different scenarios.
	Conduct Stakeholder Engagement Workshops	Organize cross-sectoral workshops and seminars to align the toolkit and methodologies with stakeholders' needs, promoting the exchange of best practices and fostering a collaborative approach to resilience building.
	Develop and Launch Resilience Training Programs	Create and implement training programs based on the resilience toolkit to empower practitioners and policymakers to track and enhance climate resilience, ensuring a wide dissemination of knowledge and skills.
	Foster International Collaboration on Resilience Practices	Establish a formal framework for international collaboration to adapt resilience tools to different contexts, share insights, and harmonize resilience approaches globally, encouraging a unified response to climate resilience challenges.

Pursuing the above-mentioned recommendations for resilient infrastructure systems unveils a complex terrain filled with significant benefits and inherent contradictions. Tackling these complexities necessitates a deep understanding of infrastructure systems'

interdependencies and an unwavering commitment to equity, inclusivity, and sustainable development. It calls for innovative financing mechanisms and the deployment of cutting-edge technology to bridge the resiliency gap. Moreover, forging a global partnership extending beyond the G20 is imperative to harness collective wisdom and resources in facing the climate crisis head-on.

Scenario of Outcomes

Adopting the strategies proposed for resilient infrastructure systems within Task Force 2 (TF2) - Subtopic 4 opens up various possible outcomes, each with unique contradictions and trade-offs. When interconnected, these scenarios form a landscape marked by risks and opportunities. This exploration delves into the potential dynamics that could arise from implementing these strategies, shedding light on the intricate relationships among enhanced resilience, economic factors, and the pursuit of social equity.

TABLE 2. Scenario of outcomes

A - Enhanced Systemic Resilience and Economic Implications
Scenario A-1: *Economic Optimization vs. Long-Term Resilience* Adopting a comprehensive framework for systemic resilience encourages prioritizing projects that demonstrate high economic, social, and environmental returns. This shift towards resilience-oriented infrastructure investment promises significant benefits, including reduced vulnerability to climate-related disasters and enhanced adaptability of urban and rural communities. However, the emphasis on systemic resilience could lead to increased upfront costs due to the integration of advanced technologies and design innovations. This scenario underscores a fundamental trade-off between immediate economic constraints and pursuing long-term resilience and sustainability goals.
Scenario A-2: *Inclusive Development vs. Resource Allocation Challenges* The focus on inclusive, resilient infrastructure aims to address the needs of the most vulnerable populations, enhancing community cohesion and social equity. While this approach fosters a more equitable distribution of resilience benefits, it also poses challenges in resource

allocation. Decision-makers may face dilemmas in balancing investments between high-risk areas with significant vulnerable populations and economically strategic projects that promise broader, albeit less targeted, societal benefits.

B System-Wide Impacts and Environmental Trade-offs

***Scenario B-1**: Environmental Sustainability vs. Infrastructure Expansion*

The drive towards sustainable and resilient infrastructure encompasses integrating green solutions, such as renewable energy sources and nature-based design elements. This approach aligns with environmental conservation goals and promotes ecosystem services. However, expanding resilient infrastructure, especially in urban areas, might conflict with land use priorities and biodiversity conservation efforts, illustrating the trade-off between infrastructure development and environmental preservation.

***Scenario B-2**: Technological Integration vs. Digital Divide*

Incorporating innovative tools, from big data analytics to IoT applications, is crucial for advancing infrastructure resilience. These technologies enable real-time monitoring, predictive maintenance, and adaptive response mechanisms. Nevertheless, this technological leap could exacerbate the digital divide, leaving behind communities with limited access to digital infrastructure and capabilities. Balancing technological advancement with inclusive access represents a significant challenge in this scenario.

C Policy and Governance Complexities and Challenges

***Scenario C-1**: Intersectoral Coordination vs. Siloed Governance Structures*

Effective resilience building requires coordinated efforts across sectors, from energy and water to transportation and communication. The recommended framework necessitates breaking down siloed governance structures to enable comprehensive planning and response strategies. However, achieving this level of intersectoral coordination is fraught with

challenges related to jurisdictional boundaries, varying regulatory frameworks, and competition for funding, underscoring the contradiction between integrated resilience goals and existing governance paradigms.

***Scenario C-2**: Adaptive Policy Frameworks vs. Regulatory Inertia*

Developing adaptive policy frameworks that can evolve with emerging resilience needs and technological advancements is essential. Yet, policy and regulatory frameworks often suffer from inertia, struggling to keep pace with rapid changes in climate risks, societal needs, and technological possibilities. This scenario highlights the trade-off between the need for dynamic, adaptive policy mechanisms and the realities of regulatory rigidity.

Pursuing the recommendations stated in Table 1 for resilient infrastructure systems unravels a complex landscape filled with profound benefits and intrinsic contradictions. Updating the Quality Infrastructure Investment (QII) principles and complementing other G20 agreed set of recommendations to account for systemic resilience will be crucial to fostering more resilient, sustainable, and inclusive communities.

To further advance the discourse initiated by our policy brief, we're preparing a more detailed academic paper that will address the highlighted gaps through an expanded exploration of existing metrics, global case studies, interdisciplinary collaborations, and in-depth analysis of policies, regulations, and innovative financing. This paper will propose a robust framework for leveraging technology in resilience projects, ensuring inclusivity, and establishing adaptive management practices. Our goal is to present actionable insights for crafting resilient, sustainable, and inclusive infrastructure systems ready to meet future challenges.

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